Strategies for Fostering Academic Entrepreneurship

Four empirical studies on constraints and organizational practices impacting entrepreneurial attitudes and supporting knowledge and technology transfer

vorgelegt von
M.Sc.
Anna Sinell
geb. in Berlin

von der Fakultät I – Geistes- und Bildungswissenschaften
der Technischen Universität Berlin
zur Erlangung des akademischen Grades

Doktorin der Philosophie
– Dr. phil. –

genehmigte Dissertation

Promotionsausschuss:

Vorsitzender: Prof. Dr. Friedrich Steinle
1. Gutachterin: Prof.in Dr. Angela Ittel
2. Gutachterin: Prof.in Dr. Martina Schraudner

Tag der wissenschaftlichen Aussprache: 12. Januar 2018

Berlin 2018

Für meine Eltern
und meine Großeltern

Abstract–English

An effective knowledge and technology transfer (KTT) process is essential for the competitiveness and sustainability of national innovation systems. On both a national and European level, ever more is being done by various stakeholders for the benefit of transfer–and in particular academic entrepreneurship as a specific dimension thereof–as a research institution's third mission alongside research and teaching. However, many research institutions still lack systematic transfer strategies that are tailored to their individual needs. This deficiency in strategic planning translates to unsatisfactory performance among German research institutes in the field of KTT and academic entrepreneurship in particular (The German Council of Science and Humanities, 2016).

In seeking to address the above-mentioned deficiency, this thesis draws on four empirical studies (Part B of the thesis) to analyze constraints impacting scientists' active engagement in academic entrepreneurship, as well as organizational practices that help reduce such constraints. To this end, all four empirical studies follow qualitative social research approaches that allow in-depth analysis of subtle mechanisms in transfer and academic entrepreneurship. Drawing on this analysis, the aim of the thesis is to derive recommendations which can help research institutions develop individually tailored transfer strategies with a particular focus on facilitating academic entrepreneurship. Using the findings of the four empirical studies, six key elements underlying a successful transfer strategy have been derived and integrated into a framework. These key elements are: *(1) goal and resources, (2) communication, (3) teambuilding, (4) actions (initiatives and services), (5) networks (organizational infrastructure and external partnerships)* and *(6) incentive systems.*

With the aid of central questions that have been developed on the basis of the empirical findings, research institutes can obtain guidelines on creating individual, needs-oriented transfer strategies in terms of each of these six elements, thus fostering entrepreneurial attitudes and a transfer-friendly organizational culture. The six key aspects and respective questions are visually presented in the form of an easily understandable illustrative tool, designed to facilitate the implementation of the practical measures recommended in this thesis: the "Transfer Strategy Framework". At the same time, the tool itself constitutes the thesis' own transfer product.

The findings are then discussed against the background of current shifts and new dynamics and relationships among stakeholders within innovation ecosystems. Ultimately, the thesis indicates aspects of potential future research with regard to the mechanisms of transfer and academic entrepreneurship, highlighting the relevance of multiple perspectives and the interaction of various actors within an innovation system.

Abstract—German

Ein effektiver Wissens- und Technologietransfer (WTT) ist essentiell für die Wettbewerbs- und Zukunftsfähigkeit nationaler Innovationssysteme. Zwar wachsen die Bemühungen unterschiedlicher Stakeholder auf nationaler und europäischer Ebene, den Transfer von Forschung in die Gesellschaft – insbesondere in Form von akademischen Ausgründungen – zu stärken, doch verfügen Forschungsinstitutionen häufig noch nicht über systematische Transferstrategien, die passgenau auf ihre Bedarfe zugeschnitten sind. Dieses strategische Defizit resultiert in unbefriedigenden Transferleistungen deutscher Forschungseinrichtungen (The German Council of Science and Humanities, 2016).

Dieses Strategiedefizit adressierend, untersucht die vorliegende Dissertationsschrift anhand von vier empirischen Studien zunächst Hemmnisse, die dem Engagement von Wissenschaftlerinnen und Wissenschaftlern in unternehmerischen Transferaktivitäten entgegenwirken, und organisationale Praktiken, wie diese Hemmnisse zu reduzieren sind. Um sich dem Untersuchungsgegenstand zu nähern und Wirkmechanismen im Transfer eingehend zu untersuchen, werden in den vier empirischen Studien Methoden der qualitativen Sozialforschung angewandt. Basierend auf dieser Analyse ist es Ziel der vorliegenden Dissertationsschrift, Empfehlungen zu formulieren, die Forschungsorganisationen helfen, individuell passgenaue Transferstrategien zu entwickeln und so insbesondere das unternehmerische Handeln der Wissenschaftlerinnen und Wissenschaftler zu stärken. Aus den Forschungsergebnissen werden sechs Schlüsselelemente abgeleitet, die einer erfolgreichen Transferstrategie zugrunde liegen sollten. Die Schlüsselelemente lauten: *(1) Zieldefinition und Ressourcen, (2) Kommunikation, (3) Teambuilding, (4) Aktivitäten (Unterstützungsleistungen und Initiativen), (5) Netzwerkbildung (Infrastruktur und externe Partnerschaften), (6) Anreizsysteme*.

Mithilfe der entwickelten Leitfragen erhalten Forschungsinstitute Anhaltspunkte, wie sie ihre Transferstrategie in jedem dieser Schlüsselelemente individuell und bedarfsorientiert ausrichten und das unternehmerische Denken und Handeln an ihren Organisationen stärken können. Die sechs Schüsselelemente und die jeweiligen Leitfragen werden als übersichtliches Tool visuell dargestellt (das „Transfer Strategy Framework"). Dieses Tool stellt somit seinerseits das Transferprodukt der vorliegenden Dissertationsschrift dar und soll die Anwendung der abgeleiteten Handlungsempfehlungen erleichtern.

Die Ergebnisse werden vor dem Hintergrund aktueller Verschiebungen und neuer Akteurskonstellationen in Innovationsökosystemen diskutiert. Es werden neue Forschungsaspekte zu Wirkmechanismen in Transfer und akademischem Entrepreneurship aufgezeigt, die die Relevanz von Perspektivenvielfalt und Interaktionen unterschiedlicher Akteure im Innovationssystem beleuchten.

Publication list

Sinell, Anna; Heidingsfelder, Marie; Schraudner, Martina (2015): Entrepreneurship and Academic Employment - More Alike than You'd Think. In: *Journal of Technology Management & Innovation* 10 (3), p. 1-10. DOI: 10.4067/S0718-27242015000300001. Available at: https://dx.doi.org/10.4067/S0718-27242015000300001

Best, Kathinka; **Sinell, Anna**; Heidingsfelder, Marie Lena; Schraudner, Martina (2016): The gender dimension in knowledge and technology transfer - the German case. In: *European Journal of Innovation Management* 19 (1), p. 2-25. DOI: 10.1108/EJIM-07-2015-0052. Available at: https://doi.org/10.1108/EJIM-07-2015-0052

Sinell, Anna; Iffländer, Vivien; Muschner, Antonia (2017). Uncovering transfer - a cross-national comparative analysis. In: *European Journal of Innovation Management 27* (80). DOI: 10.1108/EJIM-01-2017-0006. Available at: https://doi.org/10.1108/EJIM-01-2017-0006

Sinell, Anna; Brodack, Franziska; Denef, Sebastian (2017). Academic Entrepreneurship and Design: The Role of Design in Spin-off Processes. The Design Journal 20(1). S457-S468. DOI: 10.1080/14606925.2017.1352984. Available at: https://doi.org/10.1080/14606925.2017.1352984

Contents

List of Tables

List of Figures

List of Abbreviations

BMBF	Federal Ministry of Education and Research
BMWi	Federal Ministry for Economic Affairs and Energy
EC	European Commission
HEI	Higher Education Institutions
IP	Intellectual property
IPR	Intellectual property rights
KTT	Knowledge and technology transfer
OECD	Organization for Economic Cooperation and Development
PhD	Doctor of Philosophy
REF	Research Excellence Framework
RWTH Aachen	Rheinisch-Westfälische Technische Hochschule Aachen
SME	Small and medium-sized businesses
STEM	Science, Technology, Engineering and Math
TTO	Technology transfer office
US	United States (of America)

Part A

1 Introduction

1.1 Relevance and problem

"*European technology transfer today shows similarities with an emerging industry: many valuable product ideas; a highly fragmented landscape; a lack of critical mass; wide disparities in terms of performances and developing practices.*" European Commission, 2016a

The transfer of knowledge and technology generated by research institutions[1] to the public constitutes a crucial mechanism in innovation-driven economies. As the lines between academia, industry and policy grow increasingly blurry and the demand for societal relevance of publicly funded research continues to increase, mechanisms of effective cross-sector interaction gain increasing relevance (Etzkowitz & Leydesdorff, 2000; Etzkowitz, Webster, & Healey, 1998; Ranga & Etzkowitz, 2013b). In recent years, knowledge and technology transfer (KTT) has, therefore, gained overwhelming attention from political stakeholders, funding bodies, industry and academia itself. In this regard, decision makers from these sectors have spotlighted the pivotal role of academic entrepreneurship and spin-off creation–as particular transfer mechanisms[2] (Grimaldi, Kenney, Siegel, & Wright, 2011; Link, Siegel, & Wright, 2015; Siegel & Wright, 2015b).

[1] If not stated differently, the general term "research institution" describes publicly-funded and private research institutions including universities, non-university research organizations, polytechnics and advanced technical colleges.
[2] Definitions of the constructs knowledge and technology transfer, academic entrepreneurship, and academic spin-offs and their relation to one another will be provided in chapter 2.

Research institutions pursue such transfer activities for multiple reasons. As they find themselves under increasing pressure to demonstrate their relevance to society (Bornmann, 2013; Perkmann et al., 2015), research institutions need to foster the transfer of their research results to the public–often referred to as the 'third mission' of research institutions. Siegel and Wright (2015a) postulate three main reasons behind the "*aggressive pursuit of academic entrepreneurship*" (Siegel & Wright, 2015a, p. 583). First, research organizations find themselves under competitive pressure against rival organizations to expose their transfer performance as numbers of generated spin-offs and registered patents are publicly available. Second, as national support for public research institutions has been declining, research organizations are compelled to generate money from private donors (such as alumni or commercialization funds)–this holds particularly true for research institutions in Europe (Link et al., 2015). Third, support programs of academic entrepreneurship from federal agencies have become a lucrative source of additional funding (Siegel & Wright, 2015a). In this vein, alongside the quality of research and teaching, an institution's transfer performances has gained immense value for its reputation and excellence. Moreover, funding bodies across Europe and the US require academics to provide evidence of how their research benefits society–and not just in the manner of how it contributes to the scientific community. Seeking to push academia toward stronger transfer efforts and, thus, promote the multi-directional transfer process, the European Commission has stated in its HORIZON 2020 funding program that one of three major funding criterions will be the proposed projects' capacity for societal impact and the expected effectiveness of the transfer of the research results (European Commission, 2016b). On a national level, the High-tech Strategy of the German Ministry of Education and Research (BMBF) aims to accelerate knowledge and technology transfer by encouraging researchers to engage in entrepreneurship, and thereby promoting the national capacity for innovation (Federal Ministry of Education and Research, 2010, p. 10)[3]. In this vein, German government funding of academic entrepreneurship reached 65 million euros in 2013–an increase by 28 percent in one year (Grave et al., 2013). Additionally, the BMBF launched the funding measure "*Innovative Hochschule*" to support third mission activities particularly at small and mid-size universities and universities of applied sciences and, thus, boost knowledge transfer and innovation (Federal Ministry of Education and Research [BMBF], 2017).

Irrespective of the external pressure to demonstrate their societal legitimacy, academic entrepreneurship as a particular dimension of transfer holds various benefits and potential for research institutions when successfully pursued. It can stimulate economic activity in the regional environment and generate additional revenue for the research organizations (Perkmann et al., 2013, p. 432; Siegel & Wright, 2015b) and can offer additional career perspective for scientists (Foo, Knockaert, Chan, & Erikson, 2016; Sinell, Heidingsfelder, & Schraudner, 2015). While licensing has traditionally been the most common form of technology transfer, in recent years policy actors and academic bodies have increasingly been emphasizing the creation of academic spin-offs (Grimaldi et al., 2011; Link et al., 2015; Siegel & Wright, 2015a).

As described above, research institutions face both *external* pressure (by policy makers and rival organizations) and *internal* motivation (great potential for various benefits) to pursue effective transfer of their research. Despite their persistent efforts to promote

[3] As all empirical papers were conducted in the context of research projects that analyze KTT in Germany (with an exception of paper III that additionally conducted an international comparison), this thesis has a particular emphasis on the German innovation system and its legal environment.

transfer and academic entrepreneurship, research institutions vary widely in their respective performances. Generally speaking, although under particular conditions (Link et al., 2015), Audretsch and Göktepe-Hulten (2015) found that academic entrepreneurship in Europe still lacks behind the transfer performance of US universities (see also Mustar & Wright, 2010). Although comparably strong in patenting, academics' engagement in venturing research-based businesses is particularly low in Germany. Such businesses constitute less than one percent of all newly created businesses in Germany (Braun-Thürmann, Knie, & Simon, 2010, p. 9), whereas in the US, these numbers lie at least at two to three percent (Lester, 2005, p. 10)[4]. In Europe and in Germany in particular, the gap between high levels of excellence in research and low levels in commercialization tends to be large, which is often referred to as the "European academic paradox" (Audretsch & Göktepe-Hulten, 2015, p. 189; Baldini, 2009; Mosey, Guerrero, & Greenman, 2016; Organization for Economic Cooperation and Development [OECD], 2003). The European Commission compares technology transfer today in Europe with "*an emerging industry: many valuable product ideas, a highly fragmented landscape, a lack of critical mass, and wide disparities in terms of performances and developing practices*" (European Commission, 2016a). This low level of transfer performance can partially be explained by the fact that most university technology transfer in Europe has been informal and undertaken by large firms who own the patents that were registered through university-industry research projects (Audretsch & Göktepe-Hulten, 2015).

[4] Reliable data on research-based academic spin-offs is hard to come by in Germany as objective databases are missing. Universities often do not systematically monitor their spin-off performance and apply different definitions for this mechanism of knowledge and technology transfer (see chapter 2.1.2), which limits the explanatory power of cross-university comparisons. For the case of North America, Landry, Amara, and Rherrad (2006) and Fini, Lacetera, and Shane (2010) found that 16.8% of Canadian scientists have attempted to create a spin-off (Landry, 2006) and 11% of scientists in the US (Fini et al., 2010).

However, The German Council of Science and Humanities (2016) sees two main reasons for this untapped transfer potential: (1) a strategic deficit in the research institutions' transfer activities and (2) a lack of acknowledgement and appreciation for transfer activities in the German academic community ("*Strategie- und Anerkennungsdefizit*"; The German Council of Science and Humanities, 2016, p. 8). Often reluctant to embrace their third mission and to increase efforts to transfer research findings to the public, publicly funded academic institutions in Germany tend to concentrate on the traditional university missions–conducting research and providing education (The German Council of Science and Humanities, 2016, p. 6). Consequently, these institutions rarely set specific goals concerning their transfer activities, not to mention their failure to develop systematic plans for their achievement and monitoring (The German Council of Science and Humanities, 2016, p. 8). Correspondingly, Grave, Hetze, and Kanig (2014) found that, in 2013, the majority of German Higher Education Institutions (HEI) were without a defined transfer strategy[5]. Although knowledge and technology transfer has been promoted by multiple political actors and defined as a central function of HEIs and most of the HEIs had already established transfer offices at their organizations, only 42% of HEIs in Germany had defined their specific transfer strategies by 2013 (Grave et al., 2014, p. 12). The number and quality of publications remain the most common indicators for both the research and transfer performance within the German academic community (The German Council of Science and Humanities, 2016).

---

[5] Additionally, 60% of these jobs at transfer offices are limited-time positions and financed by third-party funds, which leads to a high fluctuation and thereby constraints sustainable start-up support (Grave et al. 2014).

1.2 Research motivation

Given the fact that managing transfer activities is–compared to the long history of public research institutions–a relatively new phenomenon, research organizations are still in the process of defining and establishing optimal practices relating to IP issues, incentive schemes, strategic objectives and measurements (Link et al., 2015). Contextual factors and institutional specifics, such as their regional environment, their research focus and their faculty, play a crucial role in a research institution's transfer performance, but they only explain part of it (Rasmussen & Wright, 2015). Along these lines, scholars wish for further research to understand how organizational structures influence academic entrepreneurship and the researchers' individual propensity to engage in such activities (Grimaldi et al., 2011; Mosey et al., 2016; Siegel & Wright, 2015a). Addressing the above outlined "strategic deficit" that is prevalent in the German transfer landscape, this thesis aims to identify recommendations that help research institutions to define their individual transfer strategies and thus reduce potential constraints impacting transfer and academic entrepreneurship at their organizations. Thereby, the thesis contributes to findings by Siegel and Wright (2015a) who argue that research organizations become more strategic in their approach to academic entrepreneurship and that more and diverse actors become involved in such processes. Their findings on the relationships between environmental and institutional factors within universities indicate the importance of developing organization-specific strategies to manage and facilitate transfer and academic entrepreneurship. Transfer does not follow the principle of 'one size fits all'; the complexity of the topic makes general strategies that can ubiquitously be applied by every research institution impossible. As research institutions are heterogeneous in terms of their research disciplines, size, available resources, scientific orientation, structures and needs, it is impossible to apply the same transfer strategy that might be successful for one research-intensive university to any other institution (Mustar et al., 2006; Siegel & Wright, 2015a; Wright, Clarysse, Lockett, & Knockaert, 2008).

Addressing this general call for more research[6], the present thesis analyzes *(A) potential constraints impacting academic entrepreneurship* at research institutions and *(B) organizational practices* that help reduce the identified constraints and barriers. Based on the analysis, this thesis aims to derive recommendations for research institutions of how to develop their individual transfer strategies and thus, facilitate academic entrepreneurship at their organizations. To this end, four empirical studies were conducted. While the focus of the first two studies is to identify factors that help explain scientists' low engagement in entrepreneurial activities, the latter two studies analyze organizational practices that help reduce the identified constraints and thus, help foster transfer and academic entrepreneurship at organizations. Drawing on the findings of the four empirical studies, this thesis derives recommendations for key elements of transfer strategies that when being integrated into their transfer strategies can help research institutions encourage academics to actively participate in entrepreneurial activities, thereby strengthening their overall knowledge and technology transfer. These derived elements can serve as guidelines for the development of institution-specific transfer strategies as they provide the flexibility to be applied to the specific strength, needs and context factors. In order to facilitate the application of the findings, I will integrate these elements into a visual template and formulate guiding questions that help to illustrate different application scenarios.

[6] A more detailed description of existing gaps in academic entrepreneurship research will be given in chapter 4.4. Research questions will be outlined in chapter 5.

1.3 Structure of the thesis

The present dissertation thesis comprises two parts:

Part A represents the theoretical part and summarizes the overall findings of the thesis, its outcome and contribution to the literature. **Part B** builds the core of the thesis as it constitutes the empirical analysis and includes the four conducted studies.

Part A is structured as follows:

Chapter 1 serves as a brief introduction to the phenomenon of transfer and academic entrepreneurship, its relevance and the prevalent problems which the thesis aims to shed light on.

Chapter 2 provides the theoretical foundation of the analysis including explanations of the differing concepts of knowledge and technology transfer, academic entrepreneurship and academic spin-off creation as well as their relation to one another (chapter 2.1). By presenting the analytical frame, it will be outlined on what different levels academic entrepreneurship can be analyzed and which one of these levels constitutes the level of analysis in the present thesis. Chapter 3 then describes the selected research methods for each of the four empirical studies.

Drawing from the analytical frame, related research to the topic will be presented on three different levels: the system level (chapter 4.1), the organizational level (chapter 4.2), and the individual level (chapter 4.3). Building on the outlined existing findings, the selection criteria for the individual-organizational level nexus as a level of analysis and the research gaps the thesis aims to address will be outlined more thoroughly in chapter 4.4.

Chapter 4 thereby summarizes the empirical background of the four empirical studies of the thesis (**part B** of the thesis).

Drawing upon the presented analytical frame and empirical findings, in chapter 5 I will outline precisely the overall research question and the individual sub-questions of the four empirical papers.

Chapter 6 provides a brief summary of the four empirical studies (chapter 6.1) and the discussion of their findings (chapter 6.2). The first part of the discussion focuses on identified constraints impacting transfer and academic entrepreneurship at research organizations (chapter 6.2.1). The second part discusses the findings on organizational practices that help reduce identified constraints (chapter 6.2.2).

The conclusions section (chapter 7) draws on the discussed findings and introduces the derived recommendations for key elements of transfer strategies. These elements are transformed into a visual tool comprising guiding questions for research organizations to help them define their individual transfer strategies (chapter 7.1). The limitations of the thesis are outlined in chapter 7.2. Finally, the aspects and organizational practices of transfer and academic entrepreneurship are outlined which may grow in relevance and should therefore be analyzed in future (chapter 7.3).

Part B of the thesis includes the four published, empirical studies in full length (chapter 8 - 11). The empirical data within the studies stem from different publicly funded research projects[7] and were mostly qualitatively analyzed.

[7] All research projects were conducted by Fraunhofer IAO, Center for Responsible Research and Innovation and were funded by the Federal Ministry of Education and Research. For a closer description of the research projects and methods of analysis, see chapter 3.

2 Theoretical Background

Chapter 2 provides an introduction to the phenomenon of knowledge and technology transfer (KTT) with academic entrepreneurship constituting a specific dimension of it and academic spin-offs constituting a particular outcome of academic entrepreneurship. Various definitions of the constructs will be provided in order to develop a thorough understanding of KTT, academic entrepreneurship and academic spin-off creation. Moreover, this chapter outlines the analytical framework that serves as the theoretical foundation of the thesis as it allows for a structured analysis of the constructs KTT and academic entrepreneurship in innovation systems (chapter 2.2). This theoretical foundation furthermore also serves as the analytical frame to systematically review existing empirical findings on KTT and academic entrepreneurship on different levels (chapter 4). Summarizing the presented, it will be outlined which level of analysis this thesis addresses and why this thesis always refers to transfer and academic entrepreneurship together–although the focus lies on the entrepreneurial dimension of KTT.

2.1 Defining the constructs

As outlined in the introduction, knowledge and technology transfer and its associated dimensions are pivotal for national innovation systems and constitute highly complex phenomena. For these reasons, transfer and academic entrepreneurship are often analyzed with regard to specific research foci and in different research fields. Definitions of the constructs that are relevant for the present thesis are discussed in the following (chapter 2.1.1). An introduction of academic spin-offs as particular products of transfer and academic entrepreneurship is given in chapter 2.1.2.

2.1.1 The constructs: knowledge and technology transfer and academic entrepreneurship

Research institutions have evolved from their original role of traditionally serving as a source for human resources and knowledge toward becoming a key innovation stakeholder. They generate research and technologies that can be a main source of competitive advantage and economic growth (Carayannis & Campbell, 2011; Ranga & Etzkowitz, 2013b). However, linking their research and making it accessible to other stakeholders in innovation systems–the industry, policy and society–constitutes the essential trigger mechanism for such sustainable advantage and prosperity (Carayannis & Campbell, 2009, 2011).

In this thesis, this knowledge and technology transfer (KTT) process is defined as *complex exchanges of ideas, scientific findings, and methods of production among research institutions, industry, and the public, with the purposes of accommodating public preferences and of making innovations more accessible, useful, and appealing* (see also paper II, chapter 9.2). This definition integrates findings of Szulanski (2000) who postulates that transfer constitutes a process rather than an act and findings of Bercovitz and Feldman (2006) who stress the importance of incorporating economic, social, and political influences into research in order to produce socially relevant and economically useful knowledge. KTT can thereby furthermore be described as a structured and typically multidirectional process of exchanging scientific findings and (preliminary) results between diverse actors within the innovation system (Meißner & Sultanian, 2007).

Occurring between the science and the industry sector, knowledge and technology transfer can help commercializing research by transforming theoretical results and findings into marketable products and can thereby foster economic growth and wealth creation (Shane, 2004). Knowledge and technology transfer, however, encompasses a broader scope and is not limited to science–industry interaction. Moreover, it includes linkages between science and the other sectors–to policy and the society–as well as interaction within the science system such as interactions among basic, applied and experimental sciences (Carayannis & Campbell, 2011). Mechanisms of the latter include publications, researcher mobility, joint research projects, transdisciplinary research and international research projects (Grimaldi et al., 2011).

Due to the changing role of research institutions toward key innovation stakeholders in national economies, science–industry collaboration has intensified immensely in the last two decades. Some scholars have argued that there is a significant difference among informal and formal transfer mechanisms in science–industry interaction (Bercovitz & Feldman, 2006; Link, Siegel, & Bozeman, 2007; Perkmann et al., 2013). Formal transfer mechanisms between the two sectors include IP-creation (patenting, copyrights, trademarks), licensing agreements between research institutions and private companies, participation in spin-off creation, joint research agreements with industry, contract research agreements, consultancy activities, joint university-industry supervision of PhD as well as establishing property-based institutions such as incubators and accelerators and research, science, and technology parks (Crespi, D'Este, Fontana, & Geuna, 2011; D'Este & Patel, 2007b; Link et al., 2015).

Informal transfer on the other hand includes ad-hoc advice, networking with practitioners as well as attendance at meetings and conferences (Crespi et al., 2011; Link et al., 2007; Perkmann et al., 2013). However, this differentiation between formal and informal transfer is not consistent in the literature. D'Este and Perkmann (2011) for example consider consultancy activities, contract research agreements and collaboration-research also as informal transfer. Other scholars do not differentiate between these mechanisms at all (Foo et al., 2016; Grimaldi et al., 2011).

The differentiation between formal and informal transfer stems from the fact that scholars have found that academics often do not disclose inventions to the university administrators or transfer managers in the TTOs (Huyghe, Knockaert, & Obschonka, 2016). Instead, academic findings and invention are often "*going out of the back door*" (Link et al., 2007, p. 654) leaving universities with insufficient revenues from their intellectual property potential. Often firms contact academics directly, particularly successful professors and star scientists, and work with them through informal working arrangements (Link et al., 2007; Perkmann et al., 2013), which weakens the research institutions' transfer performances.

Scholars often refer to these efforts undertaken by research institutions to promote commercialization of their research as academic entrepreneurship (Siegel & Wright, 2015a). Accordingly, Grimaldi et al. (2011) define forms of academic entrepreneurship as mechanisms "*by which academic research can be transferred to the market place*" (p. 1047). Such forms include patenting and licensing–which constitute the traditional forms of transfer–the generation of academic spin-offs, collaborative research, contract research and consulting, as well as ad-hoc advice and networking with practitioners (Bonaccorsi & Piccaluga, 1994; D'Este & Patel, 2007a; Klofsten & Jones-Evans, 2000; Meyer-Krahmer & Schmoch, 1998; Perkmann & Walsh, 2008; Wright et al., 2008). As presented above, the latter two mechanisms are often referred to as informal technology transfer (Link et al., 2007; Perkmann et al., 2013). Following these understandings, I define academic entrepreneurship herein as *activities directed toward the commercialization of scientific findings*.

As this thesis differentiates between transfer and academic entrepreneurship, it also differentiates between a research institution's transfer and entrepreneurial activities. I use the term "entrepreneurial activities" for all activities that occur between the scientific and the business communities and can help transform theoretical findings into marketable products, hence support the commercialization of research. As has been pointed out, such commercialization activities include contract research, academic consulting, patenting, licensing and, ultimately, participation in academic spin-off creation. The other presented transfer mechanisms such as publications, joint research projects, joint supervision of PhD-students, collaboration projects, informal mechanisms are referred to as "broader" transfer activities. Since academic entrepreneurship constitutes a dimension of transfer, all entrepreneurial activities are at the same time transfer activities.

The presented informal transfer activities are not particularly within the current scope of the present thesis. The thesis rather provides recommendations for research institutions of how to avoid such informal transfer and prepare organizational practices that encourage researchers to actively engage in transfer and academic entrepreneurship and to disclose their inventions to the organizations.

2.1.2 The outcome: academic spin-offs

As has been pointed out, academic spin-off creation constitutes a particular mechanism of transfer and academic entrepreneurship precisely. Although increasing, so far engagement in academic spin-off formation has been less subject of scholarly research as compared to other more traditional commercialization channels such as patenting and licensing (Link et al., 2015).

This thesis sets a particular focus on the analysis of constraints impacting scientists' participation in academic spin-off creation at research institutions and organizational approaches toward strengthening this outcome of academic entrepreneurship. The thesis thereby follows the growing emphasis on academic spin-off creation by scientific and political bodies who stress the importance of transferring research findings into new ventures.

This rising emphasis on the creation of academic spin-offs in order to promote knowledge and technology transfer can be explained by the numerous benefits that these research-based companies can provide: They have been found to be particularly effective at fostering innovation, creating jobs, generating a direct economic impact, and promoting technological development (Auer & Walter, 2009; Bijedić, Maass, Schröder, & Werner, 2014; Lautenschläger, Haase, & Kratzer, 2014; Rasmussen & Wright, 2015). Dickel (2009) furthermore found them to develop more rapidly than other types of newly created businesses. A recent study by Hvide and Jones (2016) showed that Norwegian academic spin-offs are more likely to survive than start-ups from non-university contexts. Thereby, spin-offs have the potential to generate "*local economic and technological spillovers through the stimulation of additional R&D investment and job creation*" (Siegel & Wright, 2015b). Up to now, however, very few studies have examined those spillover effects on local economies. One such study, conducted by the Technical University of Berlin, found that academic spin-offs originating in universities in Berlin created over 10,000 jobs in its metropolitan area (Kirchner & Matuschka, 2011).

Besides creating jobs in the local environment, participation in academic spin-off creation provides an additional career perspective for the scientists being involved in it. As has been shown by many studies, the German science system does not offer enough job opportunities for all academics who once enter the system (Commission of Experts for Research and Innovation, 2014b; Funken, Rogge, & Hörlin, 2015; Kahlert, 2012; Schütz, Sinell, Trübswetter, Kaiser, & Schraudner, 2016). This results in the fact that most scientists have to leave academia at a certain point, often lacking alternative job opportunities. Founding a research-based business therefore offers an additional career path and can open a new career perspective for academics–however, up to now, this opportunity seems highly unrealistic to them (see paper I and section 6.2).

Scholars use various terms for the creation of research based new ventures: the most common term of this commercialization mechanism is academic spin-off creation, which is also used in the present thesis. However, terms such as university-based companies, technology ventures, scientific spin-offs and science-based companies are often used synonymously to academic spin-offs.

Scholars vary to some degree in their understanding and scope of academic spin-off creation. While some scholars narrowly define academic spin-offs as newly founded ventures that exploit university-assigned intellectual property rights (such as patented inventions or university licenses) (Association of University Technology Managers [AUTM], 2005; Bercovitz & Feldman, 2006, p. 179; Di Gregorio & Shane, 2003, p. 209), a larger share of scholars applies a broader definition of academic spin-offs that does not involve intellectual property formally disclosed to the research institution (Aldridge & Audretsch, 2011, p. 1060; Fini et al., 2010, p. 1060; Foo et al., 2016, p. 213). According to the latter definition, academic spin-offs can be described as firms formed by university faculty or staff, start-up firms that evolve from joint research projects with a research institution, or firms that are started by students or post-docs based on conducted research at the institution (Bercovitz & Feldman, 2006, p. 179). Following this broader understanding, Rasmussen and Wright (2015, p. 783) and Rasmussen and Borch (2010, p. 602) define academic spin-offs as "*new ventures initiated within a university setting and based on technology derived from university research*".

In line with the latter definition and following Auer and Walter (2009, p. 2), this thesis defines academic spin-offs herein as *autonomous organizations that are formed by or with the help of employees of publicly funded research institutions in order to commercialize scientific findings and technological products originating in these institutions* (see also paper IV, chapter 11.2).

Since all forms of transfer at research institutions are intertwined to a certain degree and influenced by an institution's context factors, the analysis of solely academic spin-off creation, its constraints and organizational practices toward promoting it without taking into account other transfer activities would be too narrow when aiming to promote academic entrepreneurship at research institutions. Instead, the broader organizational context has to be considered. Therefore, the terms KTT, academic entrepreneurship, and academic spin-off formation will all occur very frequently in the present thesis and are intentionally mentioned together. Statements that address "transfer and academic entrepreneurship" or "entrepreneurial activities and spin-off creation precisely" mean that they hold true for all transfer activities and entrepreneurial activities or academic spin-off creation respectively.

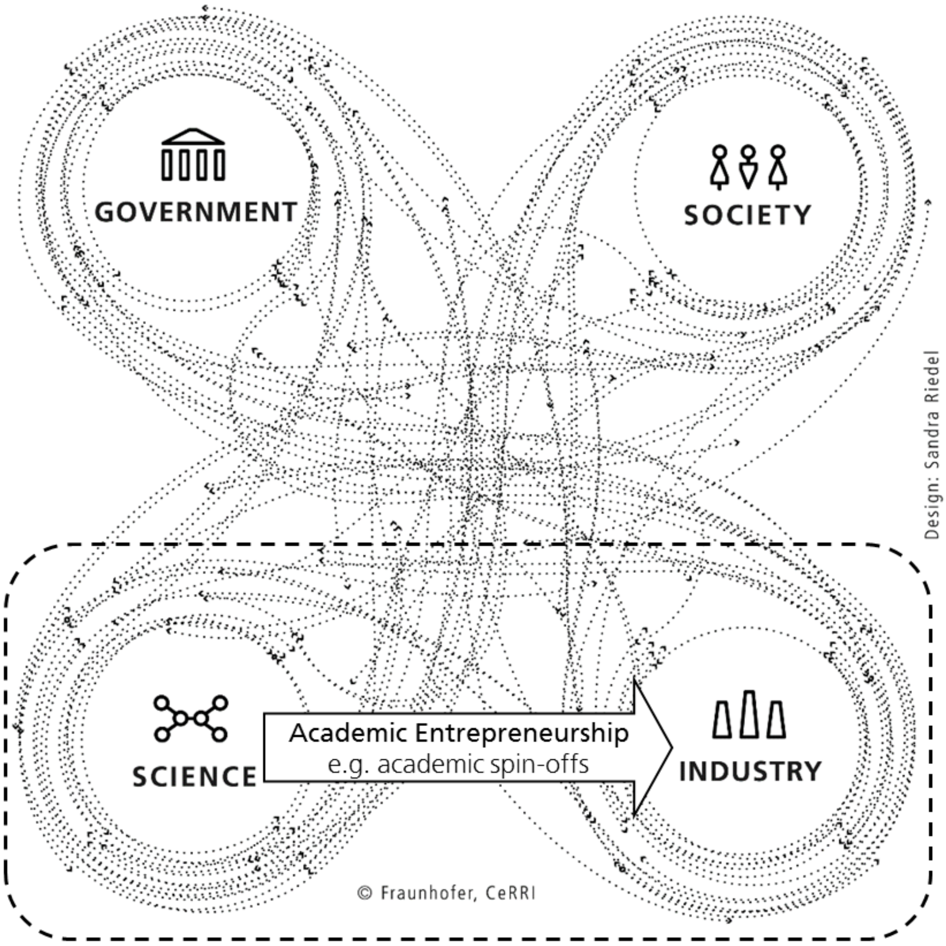


Figure 1. *Interactions amongst innovation stakeholders in the Quadruple Helix system (drawing from Carayannis & Campbell, 2009; Heidingsfelder et al., 2017).*

Figure 1 illustrates knowledge and technology transfer between the four stakeholders in innovation systems. The figure draws on the Quadruple Helix Model of innovation systems by Carayannis and Campbell (2009) and its conceptualization by Heidingsfelder, Sinell, Schütz & Schraudner (2017)[8]. It takes into account that transfer constitutes a mul-

[8] An extended version of the conceptualization by Heidingsfelder et al. (2017) was presented at the University-Industry Interaction Conference 2017 in Dublin, Ireland.

tidimensional process and does not only include science–industry interactions (Carayannis & Campbell, 2011; Meißner & Sultanian, 2007; Szulanski, 2000). The focus of the study on academic entrepreneurship and spin-off creation as a particular commercialization form is highlighted via the arrow and the dotted lines (Auer & Walter, 2009; Grimaldi et al., 2011).

2.2 Analytical framework

In their effort to reassess academic entrepreneurship 30 years after the Bayh-Dole Act, Grimaldi et al. (2011) developed an integrative framework to analyze factors affecting the development of academic entrepreneurship at universities. This frame comprises three levels of analysis: (1) *the system-level*, (2) *the university-level* and (3) *the individual level.* These levels serve as the analytical framework of this thesis in two ways: first, the related empirical findings on constraints and organizational practices impacting academic entrepreneurship are structured and presented following this framework (chapter 4). Secondly, it is outlined how the four empirical papers relate to this framework and which levels they address (chapter 5 and the respective papers).

The first level, *the system-level*, addresses specifics of the (innovation) systems in which academic entrepreneurship takes place. These specifics include governmental actions, institutional configurations and local-context characteristics (Grimaldi et al., 2011, p. 1048). Amongst governmental actions are for example new laws or regulations towards transfer and the commercialization of research as well as national funding programs. In this regard, Perkmann et al. (2013) found country specific regulations and policies to have a significant impact on the commercialization performances of universities. Other governmental support mechanisms such as substitutions of newly created ventures or tax releases for spin-off companies would also lie on the system-level. Institutional settings on the system-level include for example the percentage to which research organizations are publicly financed. While public universities are typically fully financed by the government, non-university organizations are often only partially financed by public funding agencies. This institutionalized setting significantly influences the transfer strategy of a research institution as those that face additional financial pressure are forced to approach additional funding. Transfer activities can be a lucrative source in this regard (Siegel & Wright, 2015a). Another institutional configuration on the system-level is the prevalence of venture capital in a country. Additionally, stereotypes and traditional, cultural norms would be addressed on this level. Such stereotypes for example describe the image of an entrepreneur or traditions in academia. Ultimately, characteristics of the innovation ecosystem that research institutions are embedded in are analyzed on the system-level.

As the system-level affects both the other two levels (*the university- and individual-level*), it can also be viewed as a meta-level (Lundvall, 2010).

The second level, *the university-level*, refers to aspects that describe organizational cultures, structures und practices affecting academic entrepreneurship (Grimaldi et al., 2011, p. 1048). This thesis refers to the university-level as the *organizational-level* to avoid limiting its findings only on factors that address universities. Instead, in order to widen its scope and address understudied research fields, this thesis investigates both universities and non-university organizations (see chapter 1).

Organizational structures on the second level describe internal support mechanisms and the transfer infrastructure at research institutions. The organizational transfer infrastructure can be described by the relationships among the departments, the existence of one or more transfer offices and their position within the institution. Organizational practices include proactive actions toward academic entrepreneurship as well as support services furthering scientists' transfer engagement. This includes amongst others providing them with relevant industry contacts or advising their business strategies. Also, the creation of university venture funds would be analyzed as an internal organizational support mechanism. The effectiveness of such funds is, however, controversially discussed (Clarysse, Wright, Lockett, Mustar, & Knockaert, 2007; Lerner, 2004). Proactive initiatives toward academic entrepreneurship include efforts of a research institution to discover inventions that would otherwise not have been disclosed to the transfer office or university administrators (Siegel, Veugelers, & Wright, 2007). Another such action is initializing business plan competitions on campus to encourage spin-off ideas (Barr, Baker, Markham, & Kingon, 2009). However, such business plan competitions are often targeted at graduate students who follow other business ideas lacking a scientific background. They can therefore not be seen as academic spin-offs following the definition of this thesis (see section 2.1.3). Aspects of the organizational culture that can influence the transfer performance of research institutions encompass internal values, organizational identity and an institution's history (Clarysse, Wright, Lockett, van de Velde, & Vohora, 2005; Jain, George, & Maltarich, 2009). These factors are often invisible and hard to measure. They are, however, pivotal for the encouragement of academic entrepreneurship (Huyghe & Knockaert, 2015a; Mosey et al., 2016; Mosey & Wright, 2007; Rasmussen, Mosey, & Wright, 2011). When developing strategies to foster technology transfer research institutions must take the aspects of their individual organizational culture and history into account (Grimaldi et al., 2011; Siegel et al., 2007). A qualitative approach is best suited to analyze these cultural micro-level factors (Grimaldi et al., 2011).

Ultimately, the third level addresses *individual scientists' factors*. This level is influenced by both other two presented levels and describes a scientist's willingness and propensity to actively engage in transfer activities (Grimaldi et al., 2011, p. 1050). Only if scientists' individual attitudes and organizational values toward commercialization are aligned to another, scientists are likely to actually engage in such transfer activities. This can pose a particular challenge as professors often deliberately chose to work in science instead of the industry sector (Grimaldi et al., 2011). Other factors on the third level include individual characteristics such as motivational drivers, personal incentives, educational background and demographic data. With regard to the latter two dimensions, aspects of diversity such as gender or interdisciplinary diversity are analyzed on this level. Besides individual scientists' characteristics, this thesis also refers to characteristics of research teams as well as of the TTO personnel on this third sub-level.

As all three presented levels show strong interdependencies and interactions, they all have to be considered when analyzing the dynamism and evolution of transfer and academic entrepreneurship at research institutions (Grimaldi et al., 2011, p. 1050). Figure 2 summarizes characteristics of the presented levels of analysis and illustrates interdependencies among these levels.

Similar models to the presented by Grimaldi et al. (2011), have been described and applied as analytical frames to analyze technology transfer by Murray and Kolev (2015) and Lundvall (2010). Murray and Kolev's model (2015) comprises the national level, the local level and the individual level. Although named slightly differently, their three levels describe nearly the same aspects and characteristics that are addressed at the respective levels by Grimaldi et al. (2011).

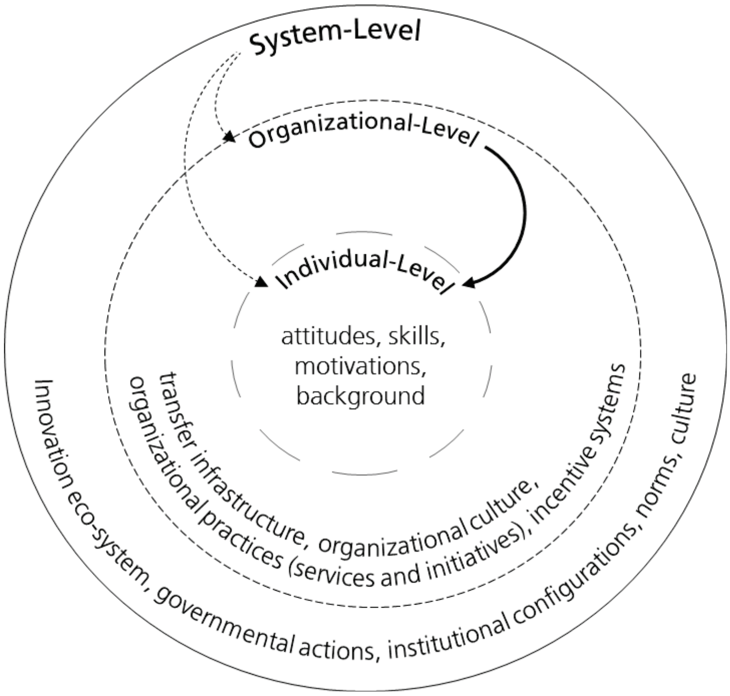


Figure 2. *The integrative framework serving for the analysis of academic entrepreneurship at three levels (Grimaldi et al., 2011). Own conceptualization.*

Lundvall (2010) describes national innovation systems on two different levels: (1) the meta-level and (2) the level of operations. The meta-level includes all presented factors that are described on the system-level by Grimaldi et al. (2011). The operational level integrates aspects of a research organization and individual scientists[9].

As outlined, Grimaldi et al. (2011) developed the presented integrative framework to serve as an analytical structure for the analysis of academic entrepreneurship. In adopting this frame to analyze constraints impacting a scientist's decision to engage in academic

[9] This differentiation between influencing factors on the meta-level and level of operations was applied in paper II and III (chapter 9 and 10).

entrepreneurship and organizational practices promoting such engagement, this thesis sets its focus on the nexus between the second and third level, the individual-organizational level nexus. In addressing this nexus, the thesis builds on the findings of Perkmann et al. (2013) who state individual discretion to be the main determinant of engagement in transfer activities: no matter of any organizational setting or given support mechanism, research organizations always rely on the independent initiative of the individual academics to engage in entrepreneurial activities and thus foster an organizations' KTT (Perkmann et al., 2013). Individual decisions are, however, always affected by the contextual environment under which the decisions are taken. Findings of Bercovitz and Feldman (2008) suggest that individual characteristics of scientists are important for describing a scientist's engagement in transfer. However, they only explain parts of it as their behavior is conditioned by the local work environment. These findings support postulations of the trait activation theory by Tett and Guterman (2000). Their interaction model describes to what degree individual traits are activated by situational influences. They found that the extent to which individuals take actions depends on environmental cues that are favorable for these individual traits. This in turn means that under unfavorable environmental conditions scientists might not engage in entrepreneurial activities despite positive attitudes toward them. The organizational context may therefore either promote or restrain the individual academic from engaging in entrepreneurial activities, above and beyond individual-related characteristics (Foo et al., 2016; Huyghe & Knockaert, 2015a). As outlined, in addressing the individual-organizational level nexus the thesis thereby responds to the fact that scientist act in particular organizational settings and are highly influenced by such organizational specifics. Context factors that lie on the system-level will be considered, they are, however, not the focus of the study.

2.3 Summary

Although literature on transfer and academic entrepreneurship has been extensively increasing in the last decade, no consensus on models has been reached that can holistically explain facilitating and hampering mechanisms within these complex areas. Instead, existing findings indicate further research gaps and reveal the demand to break down the transfer process and academic entrepreneurship in its constituent parts to allow a detailed analysis and identify underlying mechanisms (Mosey et al., 2016; Rasmussen & Wright, 2015). However, research has shown that entrepreneurial activities are always embedded in the broader context of the overall transfer activities of a research institution and its innovation ecosystem (Link et al., 2015; Siegel & Wright, 2015a). Academic entrepreneurship thereby constitutes an integral part of a research institution's knowledge and technology transfer and is highly intertwined with other transfer mechanisms. Therefore, an analysis of academic entrepreneurship at a research institution without taking into account the transfer context would be too narrow and limit the explanatory power of this thesis. When deriving managerial and policy implications it is pivotal to integrate and synthesize the topics of technology transfer and academic entrepreneurship (Link et al., 2015). Recommendations for research institutions of how to improve their entrepreneurial performances must therefore always take into account and address the broader transfer context of the research institutions. For these reasons, this thesis often addresses transfer and academic entrepreneurship together instead of stronger differentiating between the two constructs–while the focus still lies on academic spin-off creation as a particular mechanism of academic entrepreneurship.

Following various scholars (Bercovitz & Feldman, 2008; Foo et al., 2016; Huyghe & Knockaert, 2015a) who argue that individual and organizational factors must always be viewed together as they constantly interact with one another, in analyzing organizational practices and constraints scientists' engagement in academic entrepreneurship this thesis addresses the individual-organizational level nexus. With the derived recommendations for research institutions of how to develop their individual transfer strategies, this thesis aims to provide starting points for research institutions to initiate organizational change that encourages scientists to actively engage in academic entrepreneurship.

3 Research Approach

Now that research on academic entrepreneurship has come of age[10] scholars call for more in-depth and process oriented analysis to further explore subtle mechanisms and underlying processes in transfer and academic entrepreneurship (Wright, 2014). Much of the previous research that has been conducted to analyze academic entrepreneurship and specifically spin-off formation has been quantitative in nature (Grimaldi et al., 2011; O'Shea, Allen, Chevalier, & Roche, 2005; Rothaermel, Agung, & Jiang, 2007). Perkmann et al. (2013) found that qualitative research on academic engagement and commercialization constitutes less than 10 percent of all research on the topic (Perkmann et al., 2013, p. 425). However, Murray and Graham (2007) argue that "*it is only through in-depth qualitative analysis that we can reveal insights into decisions to participate in commercial science, including both opportunities and faculty responses to them*" (Murray & Graham, 2007, p. 664). Accordingly, scholars from various research fields call for more qualitative research to analyze academic entrepreneurship, particularly on micro-levels investigating individual perspectives (Bruni, Poggio, & Gherardi, 2005; Mosey et al., 2016; O'Shea et al., 2005; Rasmussen et al., 2011; Siegel & Wright, 2015a). Responding to these calls, all four empirical studies included in this thesis follow qualitative social research approaches. The essential features of qualitative research are (1) the correct choice of appropriate methods and theories, (2) the recognition and analysis of different perspectives, (3) the researchers' reflections on their research as part of the process of knowledge production and (4) and the variety of approaches and methods (Flick, 2011, p. 14). Herein, the second feature is of particular importance as constraints impacting the *individual* engagement in academic

[10] See chapter 4 for the current state of literature on factors affecting transfer and academic entrepreneurship at research institutions.

entrepreneurship are analyzed. To this end, the empirical studies analyze diverse perspectives on organizational practices and cultures as well as individual needs. A qualitative approach is state of art in this case as "*qualitative research takes into account that viewpoints and practices in the field are different because of the different subjective perspectives and social backgrounds related to them. Interrelations are described in the concrete context of the case and explained in relation to it*" (Flick, 2011, p. 16). Qualitative methods are better suited to reveal deep insights on underlying structures and procedures as they are rather flexible and allow the interviewed subjects to speak freely and articulate important aspects (Flick, 2011). They thereby follow the so-called "principle of openness" (Hoffmann-Riem, 1980). Accordingly, Kleining (1982) argues that it is necessary to keep the research process open until its end in order to enable the research object to "*present itself in its true color*" (Kleining, 1982, p. 233). When it comes to identifying individual constraints impacting transfer and academic entrepreneurship at the individual-organizational level nexus, a qualitative approach is therefore best suited to reveal such underlying assumptions by analyzing subjective perspectives (Murray & Graham, 2007). Particularly aspects of an organizational culture can only be limitedly assessed with the use of quantitative methods as underlying norms and assumptions cannot be deliberately articulated by individuals (Schein, 2010). As has been outlined above, research on academic entrepreneurship has reached a point where more in-depth analysis is need to explore new aspects and underlying mechanisms explaining it. A quantitative approach would therefore not be appropriate in this case as its primary aim is to test hypotheses and assumptions whereas a qualitative approach makes it possible to explore and reveal new findings due to its open nature (Flick, 2011).

The thesis aims to enhance validity and objectivity of the findings through data triangulation (Blaikie, 1991; Johnson & Onwuegbuzie, 2004). According to Denzin (1970) four types of triangulation exist: (1) data triangulation, which refers to data from different sources (e.g. persons, dates), (2) investigator triangulation, which involves multiple researchers, (3) methodological triangulation, which involves application of multiple methods in a research project (e.g. interviews, surveys, observations) and (4) theory triangulation, which involves taking into account multiple theoretical backgrounds for the interpretation of data. Accordingly, the four empirical studies included in the thesis combined different methodological approaches and methods of analysis, considered investigator triangulation and combined data from different research projects.

In the following, the selected methodical approaches in the four empirical studies are presented in closer detail. The following subchapters discuss arguments for the selection of the applied methods as well as relevant context features and outline sample characteristics that are not included in the publications. This thesis makes no claim to be exhaustive regarding to various opportunities to investigate the presented research questions. A detailed description of the methodological procedures is given in the published papers (chapter 8 – 11) and will not be outlined again. In contrast, description of interviewed samples will be provided as they have not been outlined in such great detail in the four empirical studies.

3.1 Study I: secondary analysis

Context and methods: The first empirical study combined data from two independent research projects: (1) the joint research project “New Careers in Academia for Women and

Men"[11] conducted by Fraunhofer Center for Responsible Research and RWTH Aachen and (2) the exploratory project "The Gender Dimension in German Knowledge and Technology Transfer"[12]. Both projects were funded by the Federal Ministry of Education and Research (BMBF). As the latter project also provides primary data for study II, its context will be outlined in chapter 3.2. The first project aimed at developing starting points for new career paths at the four German major non-university research organizations (Max-Planck-Society, Fraunhofer-Society, Leibniz Association and Helmholtz Association). To the end, a multi-level methodological approach was conducted combining different methods of empirical social research including qualitative interviews with HR managers, transfer managers and postdoctoral students as well as quantitative checklists to gather information on the offered career services at the organizations. The interviews with 112 postdoctoral students build the core data for the secondary analysis in study I. Primary to the interviews with the postdocs, the project team developed an interview guide based on the findings of the interviews with the HR managers and analysis of the checklists. These guidelines serve to structure the interviews while also allowing the interviewees to speak freely and articulate their subjective priorities. Such a half-structured, explorative approach particularly serves to analyze the so far unknown relationship and constructs that are based on individual assumptions and opinions (Lamnek, 2010). This

[11] Original title "*Karriere und Führung: Frauen in Forschungsorganisationen und Technischen Universitäten*"; project ID: 01FP1303; project duration: 06/2013-06/2015. The project was jointly conducted by Fraunhofer and RWTH Aachen. Results of the analysis by RWTH Aachen who analyzed conditions for scientific careers at technical universities in Germany (TU9) are not part of study I and regarded as a separate dimension of the project.

[12] Original title "*Sondierungsprojekt: Die Genderdimension im Wissens- und Technologietransfer*"; project ID: 03IO1309; project duration: 07/2013-11/2014. The project provides primary data for study II and serves as the exploratory phase of the project "Gender in Knowledge and Technology Transfer", which provides the data base for paper III.

so-called "principle of openness" (Flick, 2011; Lamnek, 2010) allows to investigate subjective perspectives and points of references of the individuals with regard the focus of analysis. It lets the interviewees articulate additional aspects that they regard relevant in this context (Diekmann, 2008; Kleining, 1995). The interviews lasted up to 90 minutes, were recorded and transcribed.

In addition to the interviews with postdoctoral students, the authors of study I drew on data from qualitative interviews with 16 German KTT experts, which was gathered in the "Gender Dimension"-project. These interviews were also semi-structured and followed the same principles as the abovementioned. Both analyses constitute secondary analyses[13].

Secondary analyses allow to analyze and test hypothesis and theories that did not constitute the focus of the primary analysis (Bortz & Döring, 2006). Some scholars argue that secondary analyses show greater levels of objectivity than primary analyses as the data is analyzed by another researchers than the one who gathered the data (Witzel, Medjedovic, & Kretzer, 2008).

The focus of these secondary analyses was to explore similarities and differences in academic employment and academia. To this end, the gathered interview data was analyzed with regard to working conditions, motivations and needs for further career paths in academia. In order to assess working conditions in entrepreneurship and motivational

[13] Secondary analysis refers to two types of data analysis: (1) data that is re-used and analyzed a second time with regard to a different research question than the first time (primary analysis) or (2) in the case of meta-analytic reviews that combine data from different sources to derive cross-study conclusions (which holds particularly true for quantitative data) Bortz and Döring (2006). Study II applies the former type of secondary analysis.

drivers and needs of entrepreneurs, the interview data was enriched with a comprehensive literature review. Drawing on the findings of the review, the authors "deductively derived" (Flick, 2007; Mayring, 2010) categories, which helped analyze the gathered data. In accordance with the major principle of qualitative social research, findings were presented with the aid of prototypical quotations that best illustrate the findings rather than provide a representative sample (Haas & Scheibelhofer, 1998). To enhance objectivity, the interviews were not analyzed by the same researchers who conducted them, thereby achieving investigator triangulation (Denzin, 1970).

Drawing on the findings of the literature review and secondary analyses, the authors of study I were able to derive implications that make entrepreneurship more accessible to researchers and re-define boundaries between entrepreneurship and academia.

Sample description: In both research projects, the method of theoretical sampling (Flick, 2011; Glaser & Strauss, 2010) was applied in order to identify the criteria for interviewee selection. To avoid potential gender biases (Acker, 1990) both men and women were included to approximately equal proportions in both interview samples. Postdoctoral students build the vast majority of the sample. Reasons for choosing postdoctoral students instead of senior-level scientists as units of analysis include the following: First, the role of professors and so-called star scientists has been comprehensively explored by many other scholars (see for example Lam, 2010; Perkmann et al., 2013; Zucker, Darby, & Brewer, 1998). Secondly, postdoctoral students are still at an early stage of their academic career and may be more willing to expand their capabilities as they face great uncertainty which career path to follow in the future (Schütz et al., 2016). Also, tenured or full professors may lack necessary commercial skills as they are not forced to need them in their privileged position with unlimited contracts. Thirdly, postdoctoral students are the academics of the generation that will be responsible to keep the high level research and innovation in the future. Characteristics of the interviewed postdocs are summarized in table 1.

Table 1. Sample description of interviewed postdoctoral students.

	Women	Men
sociodemographic data		
no. of individuals (n)	56	56
Ø age	37	38
relationship	83%	86%
partner full-time employed	95%	61%
partner part-time employed	5%	30%
care duties		
for children (< 18 years)	61%	58%
for elderly	7%	0%
career track		
Ø no. of years in current employment	2,8	3,0
Ø no. of years in academia	6,3	6,3
Ø no. of employers	2,6	2,4
Ø no. of research visits abroad	1,2	1,2
Ø no. of years per research visit	2,8	2,3

As has been outlined, the data on the postdocs' perceptions were combined with interview data with 16 KTT experts. This thesis follows the definition of experts by Bogner and Menz (2002) who regard experts to "*have technical process oriented and interpretive knowledge referring to their specific professional sphere of activity. Thus, expert knowledge does not only consist of systematized and reflexively accessible specialist knowledge, but it has the character of practical knowledge in big parts. Different and even disparate precepts for activities and individual rules of decision, collective orientations and social interpretive patterns are part of it. […] By becoming practically* *relevant, the experts' knowledge structures the practical conditions of other actors in their professional field in a substantial way*" (Bogner & Menz, 2002, p. 46).

The interviewed KTT experts were employed by different scientific organizations, government or private transfer agencies. These senior managers were selected (1) because of their long-term and vast experience in relevant fields, (2) their responsibilities regarding spin-off creation and/or (3) because their views carried substantial weight in setting KTT agendas due to their positions. Table 2 summarizes characteristics of the interviewed KTT experts.

Table 2. Sample description of interviewed KTT experts[14].

Variable	Women	Men
sample size	10	6
profession		
research organization	4	3
governmental agency	2	1
private transfer agency	4	2

3.2 Study II: abductive approach

Context and methods: The data of study II was gathered within the project "The Gender Dimension in German Knowledge and Technology Transfer" conducted by Fraunhofer Center for Responsible Research and Innovation and funded by the Federal Ministry of Education and Research. The project aimed to rigorously analyze gender aspects in German KTT as no comprehensive studies on the relationship of these two constructs had

[14] Please note that characteristics differ from sample characteristics of study II although both data stem from the same research project. This is due to the fact that the secondary analysis of study I does not include all interview data gathered in the research project. Study II thereby provides a more comprehensive description of the interviewed experts.

been conducted up to then. The findings of study II constitute the primary analysis of the research data.

As in study I, the authors of study II both conducted a comprehensive literature review and qualitative interviews. In contrast to study I, the literature review did not only serve to analyze the gathered data, but first of all served to deductively derive categories for the interview guidelines (Flick, 2011). The methods chapter of study II outlines the process of reviewing and structuring related literature to the topic close detail (chapter 9.3.1 and 9.3.2) and is therefore not be presented herein again. The conducted interviews lasted about 90 minutes, were recorded and transcribed.

Experts[15] in the field of knowledge and technology transfer from different sectors (academia, industry and policy) build the sample for the qualitative interviews. Such expert interviews can be applied in order to explore new research fields, to identify thematic structures in research fields and to generate hypotheses (Bogner & Menz, 2002, p. 37). Expert interviews furthermore, serve to develop typologies and theories by reconstructing the knowledge of various experts (Flick, 2011, p. 166). Further arguments for the chosen methodological approach of semi-structured qualitative interviews are presented in study I (previous chapter 3.1) and hold also true for study II. They will therefore not be outlined again.

The data was analyzed following an abductive approach, which required the authors to simultaneously analyse collected data and build hypotheses (Suddaby, 2006). This concept is called "constant comparison" and constitutes a major pillar of this methodological

[15] For a definition of "expert" in this context see previous chapter 3.1 (page 33-34).

approach (Glaser & Strauss, 1967). Such a practically-driven approach "*focuses on the interpretive process by analyzing the actual production of meanings and concepts used by social actors in real settings*" (Gephart, 2004, p. 457; Suddaby, 2006, p. 633). Despite its explorative nature, the analysis must be grounded on relevant literature (Suddaby, 2006, p. 634) and encompass more than the pure presentation of raw data (Suddaby, 2006, p. 635).

Sample description: The semi-structured qualitative interviews were conducted with 22 KTT experts who were former and current employees of either one of the four major non-university research organization or of one of the nine leading universities of technology in Germany (jointly known as the TU9 alliance). Among them, 16 were senior KTT managers or specialists and six were owners of transfer-related companies. Selection criteria included that (1) the interviewees' profession related to KTT (either in research organizations, intermediary agencies or as experienced academic entrepreneurs) and that (2) they provided long-term experience in KTT and high levels of seniority. Table 3 outlines sample characteristics in closer detail.

Table 3. Sample description of interviewed KTT experts.

Variable	Women	Men
sample size	14	8
no. academic entrepreneur	3	2
intermediary		
research organization	5	3
private transfer agency	4	2
governmental transfer agency	2	1

3.3 Study III: developing ideal types

Context and method: The data for study III was gathered within the research project "Gender in Knowledge and Technology Transfer–Encouraging Entrepreneurial Attitudes in Researchers"[16] conducted by Fraunhofer Center for Responsible Research and Innovation and funded by the Federal Ministry of Education and Research. The project seeks to develop new, more systematic and inclusive approaches that facilitate scientists' participation in knowledge and technology transfer in Germany. The long-term goal of the project is therefore to encourage more scientists, particularly women, to participate in transfer, particularly by initiating academic spin-offs and patenting their know-how. To this end, the project team conducted a best-practice analysis interviewing senior staff members within highly entrepreneurial organizations both in and outside of Germany. In order to introduce diverse perspectives into the transfer process, the project particularly focused on the following and similar matters: How can German research institutions incorporate key aspects of identified international best practice approaches and thus encourage entrepreneurial attitudes in their own employees? Do men and women approach transfer activities differently, and how? What are the differences between their ultimate transfer goals, strategies, and results? Do they respond to particular organizational practices differently, and how? Finally, how would more women participating in the transfer process affect its trajectories and results?

[16] Original title "Gender und Verwertung: Neue Ansätze und Maßnahmen zur Integration der Genderdimension in den Wissens- und Technologietransfer um gesellschaftliche Bedarfe zu adressieren"; project ID: 03IO1505; project duration: 09/2015-09/2018.

The best-practice analysis represents just one aspect of the applied methods within the project. Its primary aim was to identify, which specific practices and aspects of organizational structure and culture positively influence spin-off formation within the chosen, highly transfer-oriented organizations. In the following project stage, the project team developed a research guideline that was built on the findings of the best-practice analysis and conducted 42 qualitative interviews with experienced academic entrepreneurs of both public universities and non-university research organizations in Germany.

The data that was gathered within this best-practice analysis was re-used and secondary analyzed in study III. The study aimed to reveal subtle relationships between the organizations' transfer strategies and operational practices in order to account for their high levels of transfer productivity and academic spin-off creation. To this end, semi-structured qualitative interviews with transfer experts of highly productive transfer organizations from six different countries were conducted[17]. Arguments for this explorative qualitative methodological approach remain the same as for study I and II and will therefore not be repeated in this chapter. Methods of analysis, however, differ from those applied in study I and II as the authors of study III chose to build ideal types of transfer offices in order to reveal subtle relationships between transfer strategies and operational practices. Ideal types are "fictional" mental constructs and do not exist in the material world (Weber, 1904). The analysis method of developing such ideal types is outlined in close detail in study III (chapter 10.3) and will therefore not be repeated herein.

[17] Please note that the analysis of data for study III only focusses on five countries (Germany, Switzerland, Italy, Sweden and Israel). Belgium was excluded for the analysis as only two transfer managers were analyzed in this country.

Sample: The sample of study III comprises KTT managers in non-university research organizations and universities in Germany, Sweden, Israel, Switzerland and Italy. Selection criteria of the analyzed countries included that (1) they are all rated as industry nations, (2) their academic systems and (3) start-up cultures showed similarities. The project team identified the most productive research organizations with regard to transfer activities in the selected countries and approached the directors of the transfer offices associated to these research organizations. Therefore, it was not necessary to define another selection criteria for the interview sample. To avoid gender bias, the project team aimed to include both women and men in the sample, which posed a challenge as the senior positions were often hold by male directors (see table 4 for closer detail).

Table 4. Sample description of interviewed transfer managers.

Variable	Germany	Sweden	Switzerland	Italy	Israel	Belgium	TOTAL
no. of interviewed transfer managers (n)	12	4	5	6	8	2	37
share of women (in %)	33%	0%	20%	33%	50%	0%	30%
no. of included organizations	8	4	3	4	6	2	27

3.4 Study IV: Multiple-case study approach

Context and method: Data for study IV was gathered within the research project "The Knowledge Triangle–New Methods for Promoting multi-disciplinary, highly technological Spin-offs"[18] conducted by Fraunhofer Center for Responsible Research and Innovation and funded by the Federal Ministry of Education and Research. Based on the facts

[18] Original title "*Wissensdreieck: Evaluierung einer transdisziplinären Vorgehensmodells für technologiebasierte Ausgründungen*"; project ID: 03IO1506; duration: 2015-2018.

that innovation occurs at the intersection of different fields and perspectives and that highly technological businesses require a broad array of knowledge and skills, the project aimed to initiate highly technological start-ups by setting up transdisciplinary founding teams. To achieve this transdisciplinarity, three different professional backgrounds were integrated in these teams: design, natural sciences and business administration. These professions build the three sides of the Knowledge Triangle. The project team developed a process method by drawing on design know-how and the social sciences, which resulted in a six months incubation program. The data that was gathered through the analysis and evaluation of this incubation program serves as the data base for study IV. Research methods applied in the project included 60 qualitative interviews, three quantitative online surveys as well as regular field notes, from which only the interview data and fields notes were analyzed in study IV. The interviews lasted between 20-40 minutes, were recorded and transcribed.

In comparison to the other three papers included in this thesis, study IV followed a longitudinal case study approach (Eisenhardt, 1989a; Eisenhardt & Graebner, 2007) in order to analyze how design contributed to the development of entrepreneurial competencies in academic spin-off teams. This approach is inductive in nature and serves to derive new theoretical constructs as well as formulate new propositions. It thereby provides a means of analyzing qualitative data in unexplored research areas, with the aim of answering "how" and "why" questions (Yin, 2009). Such an exploratory case study approach is particularly useful in the given research scenario as it "[…] *would be used if you were seeking to answer a question that sought to explain the presumed causal links in real-life interventions that are too complex for the survey or experimental strategies. In evaluation language, the explanations would link program implementation with program effects. […] This type of case study is used to* *explore those situations in which the intervention being evaluated has no clear, single set of outcomes*" (Yin, 2003 cited in Baxter & Jack, 2008, p. 548).

Following the multiple-case study principle (Eisenhardt, 1989a; Eisenhardt & Graebner, 2007; Yin, 2003), study IV comprised eight cases and thereby met the requirements of the generally recommended number between four and ten cases (Eisenhardt, 1989a). Each founding team was regarded a different case and serves as a replication for the influential role of design in the development of entrepreneurial competencies. To achieve investigator triangulation and thereby enhance the validity of the findings (Denzin, 1970), the data was analyzed by different researchers than those who conducted the interviews.

Sample description: Responding to the call for more research analyzing the involvement of surrogate entrepreneurs in academic entrepreneurship (Siegel & Wright, 2015a), participants in the incubation program were not full-time employed by the research organization. However, as they acted in the environment of a non-university research organization and had access to the organization's scientific resources, their participation in new venture creation is regarded as engagement in academic spin-off creation. In addition to the interviews with project participants, the project team conducted interviews with their coaches (team and business coaches) and the jury members who assessed the quality of the final business ideas and their development stage. Data from the latter interviews were not included in the analysis of study IV. Because the participants were interviewed several times during the program, the number of interviews exceeds the number of participants (compare table 5 and table 6).

Table 5. Sample description of interviewed participants (excluding jury members and team coaches).

Variable	Design	Natural Sciences	Business Administration
sample size	10	9	7
gender			
share of women (in %)	6 (60%)	5 (56%)	2 (29%)
Ø age* (SD)		28.83 years (4.3)	
profession			
share of students (in %)	4 (40%)	2 (22%)	1 (14%)
share of employed (in %)	6 (60%)	7 (78%)	6 (86%)
Ø entrepreneurial experience*		yes: 36% no: 64%	

* holds true for n=25; differentiation between expertise not possible.

Table 6. Summary of number and dates of conducted interviews.

	1. ROUND: PARTICIPANTS	2. ROUND: PARTICIPANTS	EXIT INTERVIEWS*	COACHES AND JURY MEMBERS
no. interviews	23	16	13	8
gender				
share women	52% (12)	50% (8)	62% (8)	38% (3)
share men	48% (11)	40% (8)	38% (5)	62% (5)

* conducted with participants that quit and dropped out of the program. As participants dropped out during different stages of the program, it is possible that they were interviewed up to three times. The project team did not conduct exit-interviews with all of the drop-out candidates.

4 Empirical Background

This chapter aims to provide a comprehensive overview of the related research on academic entrepreneurship particularly focusing on studies analyzing antecedents of academic spin-off creation. To this end, findings from meta-analytic reviews, recent empirical papers as well as case studies will be presented with regard to the introduced three levels of analysis (Grimaldi et al., 2011). Chapter 4.4 provides a brief summary of these findings and outlines the identified research gaps that this thesis addresses.

4.1 System-level

As has been pointed out, the system-level contains aspects with regard to legal rules, characteristics of the innovation ecosystem, institutional settings and cultural norms and values. In the following, existing empirical findings on the relationship amongst these aspects and transfer and academic entrepreneurship will be presented.

4.1.1 Legal regulations

The most extensively studied aspects on the system-level–and maybe in the whole literature on academic entrepreneurship–are the consequences of the introduction of the Bayh-Dole Act in the US in 1980 (Murray & Kolev, 2015). The Bayh-Dole regime was initially introduced with the aim to make research advances available to the public and particularly facilitate commercialization of university research (Kenney & Patton, 2009; Link et al., 2007; Link & Siegel, 2005). The act induced a systematic change as it granted ownership of inventions from publicly funded research to the universities (Merrill & Mazza, 2011). Until early in the 20th century, the Humboldt tradition remained prevalent in Europe incarnated by the so-called Professor's Privilege (Astebro, Braguinsky, Braunerhjelm, & Brostroem, 2016). These two IPR regimes differ with respect to two major conditions: under Bayh-Dole, the university instead of the inventor holds the control rights of the inventions which grants them to retain title of the federally funded inventions. On the other hand, they have to pay the patent filing costs and are obliged to promote commercial application of the inventions (Astebro et al., 2016; Jensen & Thursby, 2001). With the professor's privilege, it is in the power of the inventor to decide how to handle his/her invention. Accordingly, under the latter regime the university has no stakes in the IP that is generated by a scientist–even though he/she is employed by the institution. The exact opposite is the case in Bayh-Dole regimes that grant full ownership of inventions and IP to the research institutions, which in turn typically grant the inventors a residual share of about 30 percent (Astebro et al., 2016; Hvide & Jones, 2016; Jensen & Thursby, 2001; Lach & Schankerman, 2008).

Partially motivated by the assumption that US universities are particularly effective at commercializing scientific findings and starting highly technological businesses (see for example research institutions as MIT or Stanford, or academic spin-offs as Google or yahoo!), similar acts to Bayh-Dole have been adopted by many other countries across Europe (e.g. Germany, Norway, Finland, Denmark and Austria) and Asia in the last two decades[19] (Geuna & Rossi, 2011; Lissoni, Llerena, McKelvey, & Sanditov, 2008).

However, the introduction of the Bayh-Dole Act and similar such regimes (the abolition of the Professor's Privilege in European countries), their consequences and effectiveness

[19] In Germany in 2002, the Employees' Inventions Act (§42 ArbNErfG) was announced to empower universities to commercialize their employees' inventions (Walter, Schmidt, and Walter, 2016).

of promoting the transfer of research results to the public particularly via commercialization of university research is highly controversially discussed. Three competing lines of arguments can be found in the literature: Those who acknowledge the act stressing its great beneficiaries and overarching importance for promoting knowledge and technology transfer (OECD, 2003; Stevens, 2004), those who are more skeptical and attribute the rise of patenting activity in the US after the introduction of the act to other legal adjustments and trends in academia (Geuna & Nesta, 2006; Lissoni, Lotz, Schovsbo, & Treccani, 2009; Proff, Buenstorf, & Hummel, 2012; Verspagen, 2006) and, ultimately, those who state that the act had even negative effects on scientists' propensity to patent or disclose their inventions to the university (Astebro et al., 2016; Czarnitzki, Doherr, Hussinger, Schliessler, & Toole, 2015; Hvide & Jones, 2016; Valentin & Jensen, 2007).

The National Academy of Sciences certainly belongs to the advocates of the act as they conclude in their report on the management of university IP in the public interest that "*the system put in place by the Bayh-Dole Act […] is unquestionably more effective than its predecessor system [...] in making research advances available to the public.*" (Merrill & Mazza, 2011, p. 61). Some scholars are even more enthusiastic about the consequences of the act and take the view that "*the Bayh-Dole Act turned out to be the Viagra for campus innovation. Universities that would previously have let their intellectual property lie fallow began filing for–and getting patents at unprecedented rates. Coupled with other legal, economic and political developments that also spurred patenting and licensing, the results seem nothing less than a major boom to national economic growth*" (cited in Aldridge & Audretsch, 2011, p. 1059; Mowery, Nelson, Sampat, & Ziedonis, 2004, p. 206; Original by Zacks, 2000). Other scholars stress these "other legal, economic and political developments" and attribute no explicit effects to the introduction of Bayh-Dole: although the US patent rate had been five times larger in 1999 than in 1980, Mowery and Sampat (2004) found no evidence for a structural breakthrough caused by the Bayh-Dole act. Instead they attributed this rise to pre-existing trends (Mowery et al., 2004). The decline of governmental funding and its replacement through competitive funds forced research institutions to access additional financial sources and can thereby also partially explain the increased patenting activity of universities (Geuna, 2001). Geuna and Nesta (2006) found evidence that university patenting activity in Europe started rising after abolitions of the professor's privilege. However, this increase is very heterogeneous in terms of disciplines and countries and can therefore not be solely explained by the introduction of new IPR regimes (Geuna & Nesta, 2006).

Critics of the introduction of Bayh-Dole-like regimes are particularly found in Europe: Studies on the transfer situation in Germany, Norway, Sweden and Denmark showed that the introduction of such IPR regimes are typically associated with significantly lower patenting activity by university scientists (Astebro et al., 2016; Czarnitzki et al., 2015; Valentin & Jensen, 2007). Critics can also be found in the US: Kenney and Patton (2011) analyzed technology transfer at six universities in Northern America and Canada and found suggestive evidence that inventor ownership universities were more effective in generating spin-offs. A recent study by Hvide and Jones (2016) showed that for the case of Norway the abolition of the Professor's Privilege in 2003 led to an approximate 50 percent drop in the rate of spin-offs initiated by university researchers. Accordingly patent rates fell by a similar percentage. Besides these quantitative numbers, the authors furthermore identified a decrease in the quality of registered patents and academic spin-offs. Patents that were registered after 2003 were cited less often and academic spin-offs of that cohort showed smaller growth rates (Hvide & Jones, 2016, p. 3). Analyzing the full population of universities in Norway, Italy and the UK, Fini, Fu, Mathisen, Rasmussen, and Wright (2017) found institutional changes both on the system- and organizational-level to facilitate academic spin-off creation. However, this increase in quantity came along with a decrease in quality of such firms, as measured by the spin-offs' capacity to attract venture capital (Fini et al., 2017, p. 377). With regard to the quantitative dimension, Fini et al.'s (2017) findings thereby contradict previous findings by Hvide and Jones (2016).

With regard to university-industry collaboration, studies show that universities become increasingly aggressive in claiming IPR and such high royalty payments. This leads to the fact that negotiations on potential cooperation projects become more time consuming and can even fall apart before initiating any cooperative activity (Bhattacharjee, 2006; Destler, 2008; Gewin, 2005).

Despite the outlined controversially discussed effectiveness of Bayh-Dole in promoting commercialization of research, the act certainly had significant managerial implications for research institutions. After the introduction of the act, the research institutions started to establish technology transfer offices (sometimes called technology licensing offices) in order to control and administrate legal duties and paperwork associated with invention disclosure and licensing. Whereas only 14 percent of US universities had a transfer office before 1980, this number rose up to over 80 percent in the 1990s (Astebro et al., 2016; Mowery et al., 2004). By now, the scope of duties and responsibilities of these transfer offices has broadened substantially (see chapter 4.2).

The influences of institutional rules on academic spin-off creation has not been studied extensively. An exception builds a recent study by Baldini, Fini, and Grimaldi (2015) analyzing academic entrepreneurship in Italy. They found that research institutions having greater autonomy in the management of IPR perform significantly better than institutions with rigid IPR regulations.

With regard to investment strategies by venture capitalists, it can be assumed that institutional regulation that grants the associated research institute equity stakes in their spin-offs substantially constrains the spin-offs' chances to raise venture capital. The technology or research finding that is meant to get commercialized typically constitutes the spin-off's unique selling point. If the IPR does not lie within the company, the value of the company would be substantially decreased. Private investors typically do not invest in such spin-offs as they seek independence and avoid relying on other investors/research institutions. If the IPR of a technology or process is owned by the research institution instead of the spin-off, the founding team will therefore most likely face challenges to raise venture capital for their company. This holds true even if they arranged exclusive licensing agreements in order to make use of the IP as such agreements already limit the spin-offs in their flexibility, speed and further development.

4.1.2 Regional environment and culture

Besides the presented consequences of the systematic legal changes and institutional conditions, influences of regional factors and local environment on academic entrepreneurship are analyzed on the system-level: these local contexts can substantially influence a research institution's transfer strategy and productivity (Baldini et al., 2015; Link et al., 2015; Siegel & Wright, 2015a).

In supportive, well-developed innovation ecosystems, research institutions face fewer transfer challenges. Commercialization of research is therefore more likely to happen.

Studies have suggested that in such environments research institutions can adopt fairly reactive and passive transfer strategies focusing on strong ties to other actors within their ecosystem (Degroof & Roberts, 2004). In contrast, in less developed ecosystems research institutions may adopt rather proactive transfer strategies that help building stronger networks among the involved actors to overcome the fragmented transfer infrastructure and help in building a strong innovation community (Clarysse et al., 2005; Clarysse, Wright, Bruneel, & Mahajan, 2014; Wright et al., 2008; Wright, Clarysse, Mustar, & Lockett, 2007). When aiming to encourage spin-off creation in such environment, research institutions would need to provide incubation of their spin-offs themselves as they could not rely on strong support mechanisms with their ecosystem. Fini, Grimaldi, Santoni, and Sobrero (2011) suggest that a research institution's impact on fragmented ecosystems is, however, stronger if they focused on building bridges and facilitating the exchange among the involved actors than by fostering spin-off creation. However, there is a need for future research analyzing the impact of academic spin-offs on the development of innovation ecosystems and the university's role within it (Clarysse et al., 2014).

Ultimately, effects of cultural values impacting academic entrepreneurship are analyzed on the system-level. In this regard, scholars have found that the systems of entrepreneurship and academia are often perceived as to different worlds. Scientists' own discouraging assumptions about these different logics in the two systems have been found to significantly reduce their entrepreneurial intent (Braun-Thürmann et al., 2010; Jain et al., 2009; van der Sijde, David, Frederik, & Redondo Carretero, 2014) (see also paper I and II). This holds particularly true for Germany, where universities have traditionally followed Humboldt's model of combining research and teaching and where university education has been associated with fulfilling the employment needs of big companies. The commercialization of research instead enjoys little appreciation (Ambos, Mäkelä, Birkinshaw, & D'Este, 2008; Astebro et al., 2016; Sass, 2011). Third stream activities are–if any–viewed as complementary to the actual tasks of research, academic advancement, training of researchers, teaching, and learning (Perkmann et al., 2015).

4.2 Organizational-level

Empirical studies analyzing academic entrepreneurship at the organizational-level are in the following. The findings are structured with regard to aspects of the organizational culture (including incentive systems, norms and values), characteristics of the university (including initiatives, program and networks) and characteristics of the transfer office (TTO).

4.2.1 Organizational culture

In order for new strategic initiatives to be sustainably effective, such initiatives have to be accepted by the individuals within the organization and integrated into the organizational cultural norms (Schein, 1990; Sullivan, Sullivan, & Buffton, 2001). Huyghe and Knockaert (2015a) studied the impact of organizational culture and climate on the entrepreneurial intentions of 437 university scientists in Sweden and Germany. Their quantitative analysis revealed three aspects of the organizational culture to significantly positively influence scientists' entrepreneurial intent: the extent to which a university articulated academic entrepreneurship in their mission statements, the existence of role models and the implementation of explicit rewards for entrepreneurial activities (Huyghe & Knockaert, 2015a, p. 138). Their study thereby supports previous findings with regard to all three identified aspects: the presence of a supportive department head and a strong commitment to academic entrepreneurship by the universities highest authorities are pivotal for establishing a transfer-friendly organizational culture (Bercovitz & Feldman, 2004; Grave et al., 2014; Lautenschläger et al., 2014; Rasmussen, Mosey, & Wright, 2014; Thursby & Thursby, 2000). The majority of the studies analyzing cultural influences on the transfer performance of universities are quantitative in nature. An exception in this respect builds the analysis of Clark (1998) who concluded from his qualitative analysis of five European universities that the existence of an entrepreneurial culture was a main indicator for their exceptional transfer performances. The meta-analytic review by Perkmann et al. (2013) on differences in academics' participation in commercialization and academic engagement (informal transfer activities) revealed that the existence of entrepreneurial peers had a significant impact on commercialization performances of universities. Peers and role models can significantly shape the individual's behavior. Accordingly, Göktepe-Hultén (2008) found serial inventors to act as role models and to be crucial for establishing an "entrepreneurial milieu" at research organizations (Göktepe-Hultén, 2008, p. 3). Such role models can act as mentor for aspiring academic entrepreneurs at their research departments (Rasmussen et al., 2014).

Considering the effects of social imprinting and social learning on adopting the new strategic approach towards entrepreneurial activities, Bercovitz and Feldman (2004) found that the disclosure behavior of their department heads and peer group as well as social norms at their institution influenced scientists' decisions to disclose their inventions. Their findings are thereby in line with previous studies of Roberts (1991) who investigated technology transfer at Massachusetts Institute of Technology (MIT) and found that prevalent social norms and the tacit approval to be critical factors for the institute's outstanding entrepreneurial success.

Following the call for more research that investigates academic entrepreneurship at the department- and research group-level (Bercovitz & Feldman, 2008; Grimaldi et al., 2011; Murray, 2004), recent findings indicate that a supportive environment on such micro-levels matters more than on the broader university level and can significantly influence the performance of the spin-offs (Rasmussen et al., 2014).

A large share of scholars investigated the role of incentives to promote transfer and academic entrepreneurship at research institutions. Findings of the meta-analytic review by Siegel and Wright (2015b) show that royalty distribution formulas, career benefits relating to promotion or tenure criteria and incentive-based compensation for TTO personnel can influence the transfer effectiveness of research institutions. Studies show that higher royalty shares for university scientists are associated to greater licensing income for the whole university (Friedman & Silberman, 2003; Lach & Schankerman, 2008; Link & Siegel, 2005). There have been conflicting findings with regard the equity ownership in academic spin-offs. While some scholars conclude that equity stakes might be an effective incentive for scientists to engage in spin-off creation (Lockett, Wright, & Franklin, 2003), other found that such distribution of ownership reduces spin-off creation at research institutions (Di Gregorio & Shane, 2003). Criticizing existing incentive schemes, Astebro et al. (2016) argue that more policies targeted at supporting younger, tenure-track scientists are needed to foster academic entrepreneurship at an early stage of the academic career. These policies may produce more benefits to society than "*general incentives for all academics*" (Astebro et al., 2016, p. 22).

In summary, studies analyzing the relationships between the organizational culture and academic entrepreneurship indicate that cultural and informal barriers can significantly constrain entrepreneurship-friendly policies and therefore play a crucial role for transfer and academic entrepreneurship at research institutions (Franklin, Wright, & Lockett, 2001; Link et al., 2007). Subsequently, Perkmann and Salter (2012) call for a stronger consideration of such informal mechanism and local norms in the analysis of influences on academic entrepreneurship at the organizational-level. Additionally, scholars wish for future research on the role of transfer "leaders" who can act as role models and mentors as there is suggestive evidence for their importance (Grimaldi et al., 2011; Mosey & Wright, 2007). Thorough research on peer academics as a valuable source of expertise and advice remains promising.

4.2.2 University characteristics

Various scholars have come to the conclusion that each research institution has to define their specific strategic approach towards transfer and academic entrepreneurship (Siegel et al., 2007; Siegel & Wright, 2015b). Analyzing differences among those universities that show high productivity in academic entrepreneurship and those who have been least productive, Lockett et al. (2003) found that universities having a clear, well-defined strategy toward the creation and management of academic spin-offs perform significantly better than those that lack such a transparent strategic approach. O'Shea et al. (2005) found five characteristics of a university to be positively related to academic spin-off formation: (1) previous success in technology transfer; (2) a high faculty quality; (3) a strong science and engineering funding base with an orientation in life science, chemistry and computer science disciplines; (4) a relatively high percentage of industry funding and (5) a strong commercial resource base–measured by the existence of an associated incubator and the size of the TTO (O'Shea et al., 2005, p. 1006). Their findings thereby support previous studies that found previous success in technology transfer such as track-record of successful spin-off formation to be a key determinant for future high entrepreneurial activity at research institutions (Lockett et al., 2003). With respect to a university's human capital, Rasmussen and Wright (2015) found high faculty quality and scientific productivity to be associated with higher transfer productivity (Foltz, Barham, & Kim, 2000; Rogers, Yin, & Hoffmann, 2000; Thursby & Kemp, 2002). Accordingly, with respect to social capital, Lockett et al. (2003) found universities with well-established, vast social networks to perform better in transfer than those who lacked access to networks. This holds also true on the micro-level of academic spin-offs. A key determinant for a spin-offs success lies in their contacts to industry and social networks (Rasmussen, Mosey, & Wright, 2015; Rasmussen & Wright, 2015).

Besides the presented university characteristics, studies reveal the importance of establishing support programs and initiatives to promote academic entrepreneurship at research institutions (Baldini et al., 2015; Fini et al., 2017; Lautenschläger et al., 2014). These critical support services include funds to cover patenting costs, not to heavy teaching and administrative duties and administrative support in the patenting and spin-out process (Baldini, 2009; Rasmussen & Wright, 2015).

In addition to support services, proactive initiatives that encourage an institution's employees to take action in academic entrepreneurship can successfully promote academic entrepreneurship (Grave et al., 2014; Lautenschläger et al., 2014). Such initiatives include the active search for potentially marketable products and research results via technology scouting (Grimaldi et al., 2011; Siegel et al., 2007) or collaboration with business schools and MBA-students that help creating business models for potentially transferable research (Siegel & Wright, 2015a; Wright, Piva, Mosey, & Lockett, 2009). Grimaldi et al. (2011) assess the latter initiatives promising and well-meaning, but since those students often also lack market knowledge, industry experience and relevant contacts they fear this might be detrimental to long-term entrepreneurial success–specifically when these business schools lack quality (Grimaldi et al., 2011).

Other initiatives encompass the implementation of associated incubators or accelerators on campus, science parks, specific venture capital initiatives, boot camps and business plan competitions (Barr et al., 2009). Many of such initiatives are developed with or sponsored by external companies which aim to get access to highly innovative ideas, technologies and high-potential employees. The impact of these initiatives is, however, hard to assess as counter parts of such programs are missing (Grimaldi et al., 2011). Nevertheless, Allen, O'Shea, Allen, and O'Shea (2014) identify "*the critical need for technology commercialization programs that promote university-based entrepreneurship on campus, and thereby increase spin-off rates.*"

It has long been feared that a shift of universities toward a focus on commercialization of research constrains scientific freedom (open culture of science) or leads to less basic research (see Larsen (2011) for a review). However, up to now, there has been little systematic evidence for that (Grimaldi et al., 2011; Thursby & Thursby, 2011; Welsh, Glenna, Lacy, & Biscotti, 2008).

4.2.3 The role of the transfer office

One of the first programs introduced by research institutions in order to facilitate transfer and academic entrepreneurship was the creation of official technology transfer offices (TTO). By now, the existence of a university's technology transfer office is mandatory in some European countries (see paper III or Baldini, 2009; Fini et al., 2017). This thesis follows Siegel and Wright (2015b, p. 2) who define such offices as "*intermediaries between suppliers of innovations (university scientists) and those who can potentially (help to) commercialize these innovations (i.e., firms, entrepreneurs, and venture capitalists)*". In their meta-analytical review on transfer performances of TTOs, they identified critical challenges and barriers that can significantly constrain the TTO's effectiveness. These challenges have led to questioning the role and capacity of the TTOs as intermediary agencies in the transfer process (Clarysse, Tartari, & Salter, 2011; Fini et al., 2017). Conducting a quantitative survey with TTO directors at US research institutions, Abrams, Leung, and Stevens (2009) found that more than half of the analyzed transfer programs show higher operating costs than the revenue they generate. Only 16 percent of the surveyed institutions generated a positive net income (Abrams et al., 2009). Some scholars go even further and claim that the existence of a TTO at a research institution impedes academic entrepreneurship as it decelerated the scientific progress, would induce misalignment in incentives among scientists and transfer managers and lead to delays in licensing (Kenney & Patton, 2009). Accordingly, Audretsch and Göktepe-Hulten (2015) found that academic inventors sometimes find it difficult to accept the role and involvement of TTO and rate their involvement as impractical and unnecessary. Despite these critics, scholars have argued that TTOs are particularly important for early support of academic entrepreneurship as their existence raises the awareness for this issue and stimulate commercialization ideas (Knockaert, Ucbasaran, Wright, & Clarysse, 2011; Rasmussen & Wright, 2015).

However, scholars found evidence explaining this variance in the performance among transfer offices and their sometimes low effectiveness[20]. Grimaldi et al. (2011) explain this to some degree unsatisfactory transfer performance with the relatively "embryonic nature of TTOs in Europe" (Grimaldi et al., 2011, p. 1047). Their lack of experience in commercialization and weak commercial capabilities of the TTO personnel would significantly limit the transfer productivity of TTOs in Europe (Lockett & Wright, 2005). These conclusions support previous studies that found the experience and greater history of a TTO–measured by the time that it was first implemented–to have a positive impact on licensing and patenting output (Siegel, Waldman, & Link, 2003).

As with growing experience, a larger size of transfer offices–measured by the number of TTO personnel–has been found to positively relate to its transfer outputs (Caldera & Debande, 2010b, 2010b; Foltz et al., 2000; O'Shea et al., 2005; Rogers et al., 2000; Thursby & Kemp, 2002). This finding, however, could not be confirmed for transfer offices in Germany: analyzing 54 higher education institutions in Germany, Lautenschläger et al. (2014) found no correlation between the size of a TTO and its performance. Instead, a high degree of heterogeneity and the existence of coherent transfer strategies are important determinants for spin-off creation at surveyed institutions.

Ultimately, one of the strongest explanatory factors for varying transfer performances of TTOs is that many scientists are failing to disclose their inventions to the TTO (Siegel

[20] Empirical findings regarding the relationship between characteristics of the TTO personnel and academic entrepreneurship are discussed in chapter 4.3.2.

& Wright, 2015b). This can be due to two reasons: On the one hand, scientists have to be willing to disclose their inventions to the TTO or the university administrators respectively (Siegel & Wright, 2015b). Often scientists prefer informal transfer channels that allow them to commercialize their inventions directly without the university noticing (Abreu & Grinevich, 2013; Perkmann et al., 2013; Siegel et al., 2003). These informal channels include academic consulting, networking and industry contacting university scientists directly (Perkmann et al., 2013). On the other hand a recent study by Huyghe, Knockaert, Piva, and Wright (2016) analyzing data of 3250 scientists across 24 European research institutions indicated that rather than deliberately bypassing the institution's transfer office the vast majority of the scientists is not even aware of their existence.

Despite the wide spread of transfer offices across Europe academic entrepreneurship remains infrequent (Baldini, 2009; OECD, 2003). The mere existence of a transfer office is therefore not enough to sustainably foster academic entrepreneurship (Clarysse et al., 2011; Lowe, 2006; Siegel et al., 2007). Instead, their implementation has to be accompanied with other support mechanisms and all of these aspects have to be integrated into a holistic strategic approach toward transfer and academic entrepreneurship.

Despite the growing body of literature investigating academic entrepreneurship, it remains unclear how organizational-level factors influence the venturing process of academic spin-offs precisely (Rasmussen & Wright, 2015) and "*evidence regarding the effectiveness of the university sector and their TTOs in promoting academic entrepreneurship remains patchy at best*" (Siegel & Wright, 2015a, p. 582).

4.3 Individual level

All above described mechanism and factors of the system- and organizational-level affect scientists' individual behavior. Therefore, the individual level is highly interwoven with both the other two levels. Empirical findings investigating influences upon academic entrepreneurship at the individual level are structured with respect to individual scientists' characteristics and team characteristics (of research and spin-off teams as well as the transfer office personnel).

4.3.1 Individual scientist's characteristics

While government policies or research institution administrators can set the ground and incentivize transfer and academic entrepreneurship, it is in the end the individual scientist who takes the decision to engage in such activities. Therefore, Clarysse et al. (2011, p. 1084) conclude drawing on their findings from a large-scale panel analysis in the UK between 2001-2009 that "*individual-level attributes and experience are the most important predictors of academic entrepreneurship*". Their findings were reinforced by Goethner, Obschonka, Silbereisen, and Cantner (2012) who examined economic and psychological factors as predictors for academic entrepreneurship using data from an online survey on German scientists. Their analysis revealed that entrepreneurial attitudes and perceived control had a positive effect on future entrepreneurial behavior. Correspondingly, Marion, Dunlap, and Friar (2015) found that–besides the level of entrepreneurial experience and participation in industry-sponsored research–the most important determinant of a scientist's active engagement in entrepreneurial activities is her/his personal inclination toward commercialization and entrepreneurial intend (Marion et al., 2015). Accordingly, a study on scientists at Max Planck Society–a German public, non-university research organization with a strong focus on basic sciences–found that the conception of science being a public good significantly lowers the probability of scientists to engage in commercialization (Krabel & Mueller, 2009). Recent findings by Walter et al. (2016) limit the explanatory power of scientists' entrepreneurial intentions as predictors of the engagement in academic entrepreneurship. Analyzing the individual-organizational level nexus, the authors found that strong organizational regimes can overrule the influence of scientists' entrepreneurial orientation and that only patenting norms predict entrepreneurial behavior whereas academics' entrepreneurial orientation does not seem to have significant effects in strong organizational regimes. These findings illustrate the importance of considering broader context factors and to not only focus on a single level of analysis.

Analyzing the construct of entrepreneurial intent more closely at the individual-environment nexus, Foo et al. (2016) found that high promotion focus predicts entrepreneurial intentions of academics, only when family and work environments are favorable towards commercialization activities. They highlight the vital role of environmental factors that influence individual intentions to engage in entrepreneurial activities and conclude that without supportive organizational settings and despite their high entrepreneurial intend, scientists are highly unlikely to engage in entrepreneurial activities. In addition to the entrepreneurial intend, a recent study by Huyghe, Knockaert, and Obschonka (2016) reveals "*entrepreneurial and obsessive scientific passions*" as motives behind academic entrepreneurship. Their survey of 2308 scientists from 24 European research institutions showed that higher levels of entrepreneurial passion–passion related to their entrepreneurial identities–as well as obsessive scientific passion–passion related to their scientific identities–are both associated with higher individual spin-off intentions.

As presented in chapter 4.2, role models in the organizational context by entrepreneurial peers can significantly foster academics' entrepreneurial intentions (Fritsch & Krabel, 2012; Hayter, 2011; Huyghe & Knockaert, 2015a; Moog, Werner, Houweling, & Backes-Gellner, 2015). In line with these findings, self-employment among family members and particularly parents have found to positively influence of the entrepreneurial intentions of scientists. Several studies have found that individuals whose parents have owned a business are more likely to develop entrepreneurial attitudes (Lu & Tao, 2010; Scherer, Adams, Carley, & Wiebe, 1989). Foo et al. (2016) found a similar correlation between scientists' spin-off intentions and their parents' employment models.

A wide share of scholars have analyzed scientists' engagement in different transfer mechanisms resulting in a long debate how entrepreneurial engagement (specifically patenting behavior) and scientific productivity (measured by numbers of publications) interact (see for example (Geuna & Nesta, 2006; Larsen, 2011). While some have feared that the engagement in entrepreneurial activities would prevent researchers from their scientific research and publishing activities, scholars have found evidence for the opposite. Research shows that there is a general tendency toward a positive correlation between different transfer mechanisms, indicating that those scientists who actively engage in one transfer activity (such as patenting) are more likely to be involved in other forms of transfer as well (D'Este & Patel, 2007b; Ding & Choi, 2011; Landry et al., 2006; Perkmann & Walsh, 2008). The most comprehensive study on these interrelations to date provides the meta-analytic review by Perkmann et al. (2013) who found that different transfer activities–including patenting, licensing, consultancy, publishing–would facilitate each other. This holds particularly true for the relationship between collaborative research and patenting

(Agrawal, 2006; Jensen & Thursby, 2001). Analyzing publication productivity and patenting rates, Baldini (2009) found inverted U-shape correlation and assessed this effect as "*still largely positive, given the current publication levels*" (Baldini, 2009, p. 1217). His study thereby adds on previous findings that suggest scientists with a high publication productivity also show greater patenting behavior (Azoulay, Ding, & Stuart, 2005; Dietz & Bozeman, 2005; van Looy, Callaert, & Debackere, 2006). A recent study by Walter et al. (2016), however, could not confirm this positive correlation. Their analysis showed no significant link between scientists' publishing and patenting behavior indicating that both domains rather co-exist than facilitate or constrain one another. Crespi et al. (2011) analyzed the relation between patenting and other transfer channels including participation in spin-off creation, joint research agreements with industry, contract research agreements, consultancy activities and joint supervision of PhD students. Their analysis reveals a similar inverted U-shape to that of Baldini (2009) indicating that this positive relation only holds true until a certain threshold (7-8 patents). Scientists showing a particularly strong patenting behavior and crossing this threshold are likely to interact with industry through the presented transfer channels (Crespi et al., 2011). Analyzing the relation of publication productivity and collaboration with industry, Banal-Estanol, Jofre-Bonet, and Meissner (2010) found once more a positive relation to a certain limit–indicating that extensively high levels of industry-interaction would negatively affect scientific productivity.

This co-occurrence of different forms of transfer can partially be explained by the fact that close ties to industry raise scientists' awareness for the commercialization of scientific research and contribute to their better understanding of the marketplace, its demands and needs (Shane, 2000; Siegel et al., 2003). Consequently, studies have shown that scientists who were previously employed by industry (Abel-Koch, 2015; D'Este & Perkmann, 2011), comprised entrepreneurial experience (Mosey & Wright, 2007) or gained relevant experience through research collaboration with industry (Carayol, 2007; Landry et al., 2006) were more likely to engage in commercialization. These findings are in line with scholars who argue that human capital and social networks are closely related to scientists' propensity to engage in academic entrepreneurship (Aldridge & Audretsch, 2011; Audretsch, 2000; Link et al., 2007; Mosey & Wright, 2007; Siegel & Wright, 2015a). Perkmann et al.'s (2013) review on scientists' engagement in informal and formal transfer activities reveals that those who are well-established and connected in the scientific community tend to engage more often in transfer and academic entrepreneurship. Correspondingly, these scientists hold more senior positions at their institutions, have more publications, gain more government grants and more social capital (Perkmann et al., 2013, p. 429).

Their review reinforces empirical findings on so-called star scientists and technology transfer. Such key scientists in their fields tend to engage particularly often in commercialization (Vohora, Wright, & Lockett, 2004; Zucker, Darby, & Armstrong, 1998; Zucker, Darby, & Brewer, 1998). Ambos et al. (2008) provide a possible explanation for this positive correlation as they argue that star scientists are better at handling ambidextrous challenges that occur when managing teaching, research and entrepreneurial activities. Adding on these arguments, Perkmann et al. (2015) claim that scientists nowadays had to "*wear many hats and act as researchers, teachers, mentors, entrepreneurs, supervisors, managers and public personalities*" (Perkmann et al., 2015, p. 9), thereby reinforcing complaints that scientists are expected to be "*five legged sheep*" as faced publishing, teaching, funding, commercializing and public engagement duties (van den Brink & Benschop, 2012, p. 507). Constraining these arguments to some extent, Moog et al. (2015) found that diversified working tasks and a balanced skill set would significantly foster scientists' entrepreneurial intentions.

The identified correlation between scientific seniority and entrepreneurial engagement induces the fact that male scientists are more likely to engage in commercialization than their female colleagues. Previous studies on the gender gap in academia found that senior position are typically occupied by men who are therefore more likely to obtain wider networks and relevant resources for commercialization activities (Etzkowitz, Uzzi, & Kemelgor, 2000; Gupta, Kemelgor, Fuchs, & Etzkowitz, 2005; Murray & Graham, 2007). This gender gap in academic entrepreneurship has been shown by many quantitative analyses and holds particularly true for informal transfer activities (Abreu & Grinevich, 2013, 2014; Kulicke, 2006; Perkmann et al., 2013; Rosa & Dawson, 2006). In this regard, Abreu and Grinevich (2014) found that female scientists were eight percent less likely to engage in academic consultancy analyzing micro-data on 1108 UK scientists. An additional explanatory factor for the presented gender gap provides the fact that academic entrepreneurship is more likely to happen in applied research fields where women typically tend to be under-represented (Haeussler & Colyvas, 2011; Kulicke, 2006; Sellenthin, 2009).

Summarizing the presented, findings show that scientist engaged in academic entrepreneurship tend to be male, well-experienced in commercialization through previous activities, scientifically highly productive and provide wide-ranging networks as well as a diversified skill set. Those academics that engage in entrepreneurial activities are typically involved in more than just one activity.

Motivational drivers for scientists to engage in spin-off creation have not been studied extensively. An exception in this regard builds the study by Shane (2004) who identified the desire to bring research into practice, the desire for wealth and for independence as key motivations impacting entrepreneurial behavior. Adding on these findings, Hayter (2011) found technological furthering, peer motivation and financial gain as individual motivational drivers for commercialization of research (Hayter, 2011). Transfer behavior–particularly the engagement in patenting activities–is well analyzed for the group of top scientists, while little is known about the transfer and entrepreneurial engagement of junior scientists from different research fields. As more stakeholder become involved in academic entrepreneurship (Siegel & Wright, 2015a) the focus of analysis from senior researchers (professors, principle investigators) should shift to junior researcher who are typically on a non-tenure level and to different research fields. Engaging in entrepreneurial activities at an early stage of the (academic) career can open up career alternatives outside academia where opportunities are limited and researchers face the publish-or-perish culture.

4.3.2 Team characteristics

Research on academic entrepreneurship has so far neglected identifying the most effective configurations of entrepreneurial teams for commercialization (Markman, Siegel, & Wright, 2008; Visintin & Pittino, 2014). Addressing this research gap, Knockaert et al. (2011) conducted a longitudinal inductive case study and analyzed the development of nine academic spin-offs in Belgium. Their analysis showed that a diverse knowledge composition in academic founding teams (mainly relating to the combination of technical and commercial mindsets) enhances the transfer of tacit knowledge within the team and thereby leads to higher speed in first product to market (Knockaert et al., 2011). Their findings were supported by Visintin and Pittino (2014) who analyzed the performance of 103 academic spin-offs applying a multi-level approach to team demography. They found that spin-offs that provided balanced commercial and scientific perspectives and integrated academic as well as non-academic profiles performed significantly better than those that lacked such requirements.

These findings support early work on team performance and problem-solving. Teams with different functional and work backgrounds, training and cognition are more likely to have diverse perspectives, knowledge bases and expertise which can result in better decision-making (Eisenhardt, 1989b; Pelled, Eisenhardt, & Xin, 1999). Their merits include benefits in strategic change, enhanced performance and greater strategic consensus (Bunderson & Sutcliffe, 2002; Knight et al., 1999; Lant, Milliken, & Batra, 1992; Wiersema & Bantel, 1992). While homogeneous teams have been found to perform better at routine problems because of their greater relational fabric and less dysfunctional conflict (Amason, 1996; Miller, Burke, & Glick, 1998), heterogeneous teams perform better in ill-defined, novel problems. The latter conditions best describe the arising challenges in spin-off creation when research results or technology that is not market-ready has to be modified in order to meet customer needs (Di Gregorio & Shane, 2003). Indeed, academic spin-offs have been criticized for their homogeneity in terms of technical experience and background, their pure scientific networks and lack commercial experience (Ensley & Hmieleski, 2005; Franklin et al., 2001; Rasmussen & Wright, 2015).

Analyzing characteristics of the TTO personnel, scholars found a similar relevance of diversified perspectives in transfer offices in regards to their effectiveness, as was found in academic spin-off teams. The level of experience and professional heterogeneity among the employed transfer managers positively influence the overall commercialization activities of the transfer office (Caldera & Debande, 2010b; Clarysse et al., 2011; Lautenschläger et al., 2014). Industry and entrepreneurial expertise and well-established networks to industry were found to be particularly important in this regard. For the case of Italy, Baldini et al. (2015) showed that transfer offices with personnel trained specifically for technology transfer performed significantly better than those not trained in that manner. However, Lockett and Wright (2005) found that most TTO personnel did not show adequate skill sets but lacked commercial capabilities in order to successfully commercialize a university's intellectual property. The authors therefore suggest that universities must devote greater attention to recruitment, training and development of transfer officers with broad-based commercial skills. Adding on this claim, Siegel and Wright (2015a) recommend for university authorities to put efforts in upgrading personnel skills in TTOs in order to foster the university's overall transfer performance.

Summing up, the few literature on academic entrepreneurship and team composition indicates that diversified teams–in terms of educational and technical background–appear to be better suited for the complex tasks of founding a business than homogenous teams. Herein, the integration of entrepreneurial and scientific perspectives has shown to be of particular importance. With respect to team characteristics of the transfer office personnel, industry know-how and contacts are pivotal. A diversified team encompassing academic as well as industry experience has been found to be more important than the size of the transfer office. Further research questions remain how universities and TTOs can recruit and develop appropriate transfer manager to provide the necessary mix of skills, know-how and informal ties (Grimaldi et al., 2011; Siegel & Wright, 2015a).

4.4 Summary: Outlining research gaps

The previous chapters presented the extensively growing body of literature on transfer and academic entrepreneurship–meta-analytic reviews, empirical studies and case studies. Scholars agree on the fact that research institutions have been adopting a more strategic approach toward transfer and academic entrepreneurship (Foo et al., 2016; Siegel & Wright, 2015a, 2015b). However, a common model that holistically explains underlying mechanisms of transfer and academic entrepreneurship and helps institutions in defining their specific transfer strategies has not been developed up to now. The present thesis aspires to contribute to this research and management gap.

As outlined, research shows that research institutions do not only vary widely in their transfer performances across the continents, but also differ within countries. Data from the US and Europe reveal that while some universities are highly successful in their entrepreneurial performance and academic spin-off creation in particular, the majority of research institutions show rather low numbers (O'Shea et al., 2005; Rodeiro Pazos, Fernández López, Otero González, & Rodríguez Sandiás, 2012; Siegel & Wright, 2015b; Wright et al., 2007). Scholars from various research disciplines have analyzed this phenomenon trying to explain the wide variance (see for reviews Perkmann et al., 2013; Siegel & Wright, 2015b). Except for the fact that previous success in academic entrepreneurship indicates future success, no clear pattern or "*easy answer to this question*" has been found (Rasmussen & Wright, 2015, p. 785). Besides this track-record of entrepreneurial success at universities, studies reveal that individual academic success seems to reinforce academic entrepreneurship (Perkmann et al., 2013). Scientists who are scientifically very successful (so-called "star") tend to engage in entrepreneurial activities particularly often (Perkmann et al., 2013; Sass, 2011; Zucker, Darby, & Brewer, 1998). Still, the question remains why some universities and their transfer offices are more effective with their transfer activities and academic entrepreneurship than others (Lockett, Wright, & Wild, 2015). Applying the same set of support measures and strategies that may work for some research institutions to others with different context factors and characteristics–such as different ecosystems, research foci, sizes–might not lead to the desired transfer productivity (Foo et al., 2016; Grimaldi et al., 2011; Rasmussen & Wright, 2015).

As has been outlined, academic entrepreneurship can be analyzed on three different levels. As the majority of existing studies focus on a single level of analysis, Link et al. (2015, xi) and Mosey et al. (2016, p. 2) call for further research that explores interactions on the nexus of different levels of analysis. Accordingly, Foo et al. (2016) highlight the interdependency among the individual and its environment. Drawing from their analysis on the relationships between scientists' entrepreneurial intentions and family and work environment, they conclude that "*gaining more insights into the relationship between factors at the nexus of the individual and the environment is particularly interesting to practitioners such as technology transfer managers, university management and public policymakers. Without the correct incentives, structures, and programs, universities would not be able to encourage entrepreneurial activities*" (Foo et al., 2016, p. 220). In addressing the individual-organizational level nexus, the present thesis responds to these claims (see chapter 2.2).

In their position paper on current trends, Siegel and Wright (2015a) assert that future research must take account the increasing diversity of stakeholder-involvement in academic entrepreneurship. They call for a shift in the analysis of senior researchers toward junior researchers as well as "*students, alumni, on-campus industry collaborations and surrogate entrepreneurs*" (Siegel & Wright, 2015a, p. 585). Accordingly, more recent studies have called to take perspectives of junior researcher stronger into account–instead of those of the professors–when deriving practical implications to promote academic entrepreneurship at research institutions (Huyghe, Knockaert, & Obschonka, 2016, p. 352; Huyghe, Knockaert, Piva et al., 2016, p. 602).

Besides a diversification of age and experience among analyzed samples, future research needs to address other research institutions than solely universities in order to broaden its spectrum and enhance its explanatory power. Investigating organizational contexts, studies have focused on the academic sector and analyzed the multi-faceted role of universities in transferring academic knowledge to industry and society (Bishop, D'Este, & Neely, 2011; Fini et al., 2017; Lester, 2005; Rothaermel et al., 2007; Wright et al., 2008). Other academic actors such as non-university public research organizations and their specific institutional settings have been neglected so far (Perkmann et al., 2013). The four empirical studies included in this thesis contribute to these claims as their samples comprise different types of research institutions as well as scientists with different seniority levels and surrogate entrepreneurs.

Summing up, in identifying recommendations for research institutions that help them define their individual transfer strategies, the four empirical studies included in this thesis address the following outlined calls for more research in the academic entrepreneurship literature:

- A call for more research on *strategic implications* that help research institutions in developing their individual strategic approaches toward transfer and academic entrepreneurship at their organizations (Mosey et al., 2016; Siegel & Wright, 2015a, 2015b)
- The call for more research addressing the *nexus and interactions* between different levels of analysis (Foo et al., 2016; Link et al., 2015; Mosey et al., 2016)
- A call for more research responding to the increased *diversity among the stakeholders* involved in academic entrepreneurship (Siegel & Wright, 2015a)–particularly addressing junior-level scientists (Huyghe, Knockaert, & Obschonka, 2016; Siegel & Wright, 2015a) and public non-university research organizations (Perkmann et al., 2013)

5 Research Questions

Building on existing literature and addressing the presented claims for more research, this thesis analyzes potential constraints impacting transfer and academic entrepreneurship at research institutions and organizational practices that help overcome such constraints. Drawing from this analysis, the aim of the thesis is to derive recommendations for research institutions that can help them in developing their individual needs-oriented transfer strategies and thus, foster transfer and academic entrepreneurship at their organizations. Thereby, the thesis responds to two visible trends in the academic entrepreneurship literature as identified by Siegel and Wright (2015a): by specifically addressing postdoctoral students as compared to senior scientists or professors, this thesis responds to the trend that more and diverse stakeholders have become involved in the transfer process and that particularly junior research can add significant and sustainable value to it. By deriving recommendations for the development of needs-oriented transfer strategies, this thesis contributes to the fact that although research institutions have become more strategic in their approaches (Ranga & Etzkowitz, 2013b; Siegel & Wright, 2015a), they still lack experience (Link et al., 2015) and show strategic deficits toward transfer and academic entrepreneurship (The German Council of Science and Humanities, 2016).

Breaking down, this thesis analyzes the following research questions:

(A) What constraints prevent scientists from engaging in transfer and entrepreneurial activities at research institutions?

(B) How can research institutions overcome such constraints and, thereby facilitate transfer and academic entrepreneurship at their institutions?

The research questions, thereby, have two dimensions: Aiming to identify potential constraints impacting academic entrepreneurship, research question (A) follows a stronger exploration focus. Instead, research question (B) builds on these findings and follows a stronger application focus analyzing organizational practices how to reduce such constraints. Therefore, research question (A) sets a stronger emphasis on individual scientists' needs in the transfer process from the perspectives of academics and transfer managers. Research question (B), then, has a stronger management focus and addresses organizational practices and programs toward academic entrepreneurship. Drawing from the findings of these analyses, key elements will be derived that research institutions need to address in order to develop a transfer strategy that responds to their individual strengths and needs. To facilitate the application of such key elements of transfer strategies, ultimately, guiding questions will be formulated and these elements will be integrated into a transfer strategy framework. This visual template can serve as a strategic management tool to help research institutions develop a transfer strategy that responds to their institution-specific strengths, needs and context factors.

To analyze the presented guiding research questions in closer detail, I formulated sub-questions that were analyzed in the four empirical papers included in this thesis and that each tackle certain aspects of the overall research aim. Each of the research sub-questions is based on the respective literature–as presented in chapters 2 and 4–to develop an appropriate research design. A discussion of the selected research methods was provided in chapter 3. While the first two papers focus on research question (A) and aim to identify potential constraints impacting scientists' engagement in transfer and academic entrepreneurship, paper III and IV follow a management focus. Thereby, the latter two studies stronger relate to research question (B). All four papers included in this thesis contribute to deriving recommendations of how to develop institution-specific transfer strategies and thus, foster transfer and academic entrepreneurship at these institutions.

Since transfer and academic entrepreneurship is a highly interdisciplinary research field, the theories that were applied in the four research papers included in this thesis stem from different research disciplines. The first paper draws upon theory from organizational psychology and applies the concept of the person-job fit by (Kristof-Brown, Zimmermann, & Johnson, 2005) to analyze perceptional differences between academic employment and entrepreneurship. Paper II and III draw from and integrate different analytical frameworks that describe systems of innovation and the role of transfer within them. The second paper also includes literature on gender studies to develop a conceptual model that can serve as a blueprint in order to analyze the integration of diversity of perspectives in knowledge and technology transfer. Adopting a competence-based perspective and building on the entrepreneurial competency framework by Rasmussen et al. (2011) and Rasmussen and Wright (2015), paper IV investigates the role of design in spin-off processes.

Figure 3 illustrates the research foci of the four empirical papers, their relation to one another and their contribution to the research questions. The figure differentiates between two dimensions the four empirical papers relate to: the horizontal axis describes the individual-organizational level nexus. The further left a study is located the stronger is its focus on individual aspects instead of organizational settings and vice versa. The vertical axis of the figure describes to what extend a study relates to part (A) (identification of potential constraints impacting transfer and academic entrepreneurship) or part (B) (organizational practices to overcome such constraints) of the overall research questions. Therefore, the research papers on the upper scale are more application-oriented whereas the papers on the lower scale put a stronger focus on exploration and theory-building.

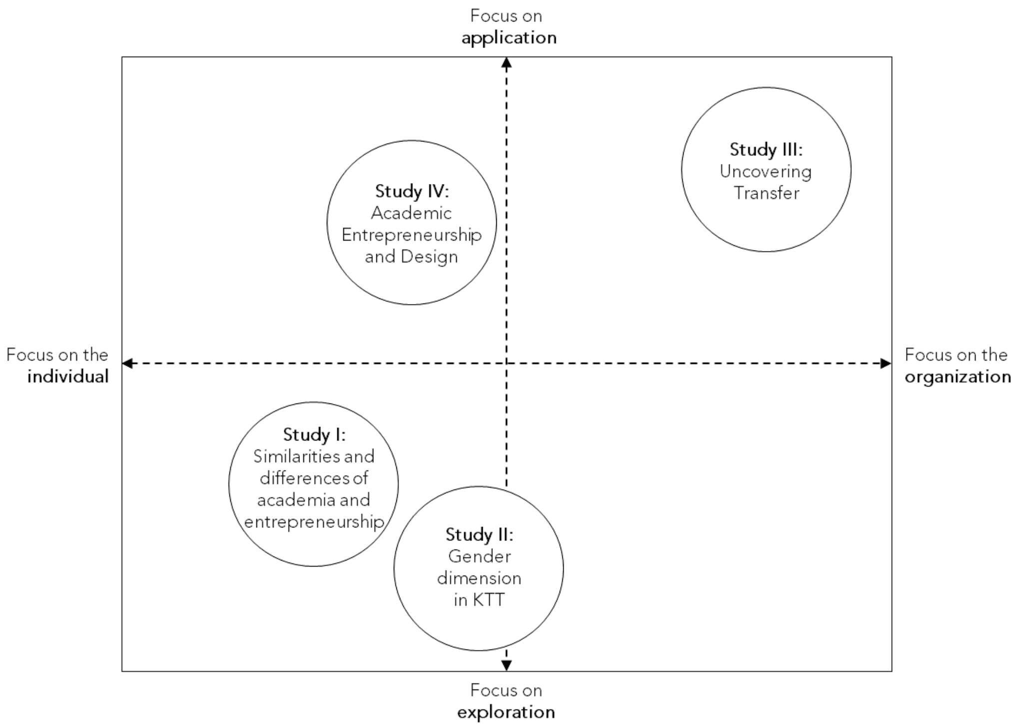


Figure 3. *Illustration of the research foci of the empirical studies and their contribution to the overall research questions, in relation to the level of analysis.*

Building upon existing studies that share the assumptions of two prevalent, widely differing logics within entrepreneurship and academia and that the gap between these systems would be extremely difficult to bridge (Braun-Thürmann et al., 2010; Jain et al., 2009; van der Sijde et al., 2014), the first paper analyzes how different employment in academia and entrepreneurship are precisely. By analyzing the perceptions of transfer managers and a large group of postdoctoral students who have not been engaged in spin-off formation yet, paper I addresses the call for demand-oriented research from junior-level perspectives. Therefore, the following research questions were formulated: *Where* *do transfer managers and postdoctoral students see the differences between academic employment and entrepreneurship and how do their perceptions match the existing common perceptions about such differences? What causes these perceptual differences? Considering job profiles, required skill sets, and existing organizational practices, how different are academic employment and entrepreneurship precisely?*

Whereas the first paper addresses the identified research gap particularly through the chosen sample, the second paper analyzes the integration of gender in KTT in general and in academic entrepreneurship precisely, as gender had played little role in research on KTT up to then. In many European countries including Germany, substantially fewer women than men participate in KTT. However, recently, decision makers from scientific, political and commercial organizations have increased their attention to the gender dimension (Bührer & Schraudner, 2010; Moser, 2007; Schiebinger, 2013). Along these lines, the second empirical paper addresses the research question *in what ways and to what degree is gender currently integrated in German KTT?*

Aiming to derive practical implications that can be adopted by research institution to foster academic entrepreneurship paper III and IV set a particular focus on management and organizational practices of transfer activities. To this end, the papers analyze existing and promising organizational approaches toward academic entrepreneurship.

As (technology) transfer offices (TTO) are often regarded key intermediary agencies between the four major elements of the innovation system–academia, industry, policy and society (Carayannis & Campbell, 2011)–they serve as the subject of analysis of paper III. As a TTO's objective has traditionally been to facilitate the transfer process, the transfer offices' main responsibilities lie at managing various transfer mechanisms and mediating between knowledge suppliers (from academia) and those potentially making use of such knowledge (industry) (Grimaldi et al., 2011; Siegel & Wright, 2015b). Up to now, only very few comparative research on national specifics in KTT exists (Fini et al., 2011; Siegel & Wright, 2015a). Despite the vast amount of scholarship on ways of supporting transfer at universities (see chapter 4 or for reviews Grimaldi et al., 2011; Siegel & Wright, 2015b), researchers have claimed the need to more closely analyze the interplay of goals, actors and modes of operation (Siegel & Wright, 2015a). Responding to this call, paper III conducted a cross-national comparative analysis examining transfer practices of highly productive transfer offices in five different countries, namely Sweden, Germany, Switzerland, (Northern) Italy and Israel. The goal of paper III was to discern subtle relationships between the strategies and operations that can help explain these organizations' high levels of transfer activity. To this end, the following research questions were addressed: *Which individual characteristics of the offices under study, such as their goals and practices, account for their high levels of transfer activity? Are there consistent relationships between these characteristics and, if so, are these relationships part of the explanation?*

Team characteristics of academic spin-offs have not been studied extensively (Visintin & Pittino, 2014) and little to no research has been carried out to analyze the role of design in such spin-off processes (Driver, Peralta, & Moultrie, 2011). Addressing this need for further research, paper IV applies a multiple-case approach (Eisenhardt, 1989a; Yin, 2009) and explores how design contributes to the development of entrepreneurial competencies in eight academic founding teams. In particular, the following research question was addressed: *How does design contribute to the development of three entrepreneurial competencies, namely opportunity development, championing and resource acquisition (Rasmussen et al., 2011; Rasmussen & Wright, 2015) in academic founding teams?*

As research on the phenomenon of transfer and academic entrepreneurship is multifaceted and highly complex, in what follows, I will shortly draw the line and point out, what lies outside the scope of this thesis: it is out of the scope of the thesis to further analyze characteristics of scientists–specifically on a senior professor-level–that have already been involved in entrepreneurial activities in university contexts, such as their motivation, their competencies, their gender or research disciplines. The thesis rather analyzes constraints impacting scientists' decision–particularly on a junior level as they constitute the majority of academics–*not* to engage in entrepreneurial activities. It is not the aim of the thesis to change the characteristics of non-entrepreneurial academics into entrepreneurial ones. By deconstructing potential constraints impacting transfer and academic entrepreneurship at research organizations, this thesis aims to identify recommendations for research institutions of how to overcome such constraints and develop their organization-specific transfer strategies, thereby setting the environmental conditions that encourage scientists to actively engage in transfer and academic entrepreneurship in particular.

The findings of the four empirical studies and their contribution to the overall aim of the thesis will be discussed in chapter 6. Their conclusions will be drawn in chapter 7.

6 Research Contributions

In what follows, I present the specific findings of the four independently conducted empirical studies, discuss them against the background of the existing literature and outline their contribution to the aim of this thesis. Building on the findings of the analysis, I will then derive key elements and guiding questions that research institutions need to address in order to develop their individual needs-oriented transfer strategies that help to reduce potential constraints and foster transfer and academic entrepreneurship. Ultimately, these key elements and guiding questions will be visually presented in form of an easily understandable tool, designed to enhance implementation of the recommendations and the transfer of this thesis (chapter 7).

A very brief summary of the four empirical research papers including their primary characteristics will be presented in the following chapter 6.1. In chapter 6.2, I will discuss the findings and present identified constraints impacting academic entrepreneurship at research institution, thereby relating to part (A) of the research questions (subchapter 6.2.1). In subchapter 6.2.2, I will discuss identified and promising organizational approaches toward academic entrepreneurship at research institution, thereby responding to part (B) of the research questions.

6.1 Summary of the empirical studies

This chapter provides a very brief introduction of the four research papers included in this thesis. Table 7 below presents the primary characteristics of the four papers in chronological order.

Table 7. Primary characteristics of the research papers included in this thesis.

YEAR	PAPER	RESEARCH QUESTION(S)	APPROACH
2015	Paper I Academic Employment and Entrepreneurship—more alike than you'd think	Where do transfer managers and postdoctoral students see the differences between academic employment and entrepreneurship and how do their perceptions match the existing common perceptions about such differences? What causes these perceptual differences? Considering job profiles, required skill sets, and existing organizational practices, how different are academic employment and entrepreneurship precisely?	Theory: Organizational psychology (Kristof-Brown et al., 2005) Method: Qualitative interviews with 112 postdoctoral students of the four major research organizations in Germany; secondary analysis of qualitative data with 16 KTT experts
2016	Paper II Gender Dimension in KTT—the German Case	In what ways and to what degree is gender currently integrated in German KTT?	Theory: National innovation systems (Lundvall, 2010) and gender studies (Schiebinger, 2013) Methods: Literature review; qualitative expert interviews with 22 key experts on KTT (abductive approach)
2017	Paper III Uncovering transfer—a cross-national comparative analysis	Which individual characteristics of the offices under study, such as their goals and practices, account for their high levels of transfer activity? Are there consistent relationships between these characteristics and, if so, are these relationships part of the explanation?	Theory: National innovation systems (Lundvall, 2010) and analytical frame by Siegel & Wright, 2015a Methods: Developing ideal types; qualitative interviews with 35 senior transfer managers
2017	Paper IV Academic Entrepreneurship and Design: The Role of Design in Spin-off Processes	How does design contribute to the development of three entrepreneurial competencies, namely opportunity development, championing and resource acquisition (Rasmussen et al., 2011; Rasmussen & Wright, 2015) in academic founding teams?	Theory: Competency-based approach (Rasmussen et al., 2011) Methods: Multiple case study (qualitative interviews, field notes)

Paper I: Entrepreneurship and Academic Employment - More Alike than You'd Think[21]

This paper presents data on perceived differences between academic employment and entrepreneurship and analyzes how different these two systems are precisely. The findings indicate that those involved in such occupations often believe that academic employment and entrepreneurship differ substantially on many levels. Both interviewed senior transfer managers and postdoctoral students considered engaging in entrepreneurial activities to be risky and a serious undertaking that would mean a significant career change. Simultaneously, the opinions and observations of postdoctoral students helped identify a wide range of similarities between academic employment and entrepreneurship. The findings can help make entrepreneurship more accessible to researchers, re-define the boundaries between scientific and commercial activities, and ultimately, foster knowledge and technology transfer.

Paper II: The gender dimension in knowledge and technology transfer - the German case.[22]

This paper presents results from a comprehensive literature review and a qualitative analysis that aimed to evaluate in what ways and to what degree gender is currently integrated in German KTT. By following an abductive approach (Suddaby, 2006) and building upon existing models of innovation systems (Carlsson, Jacobsson, Holmén, &

---

[21] The paper is the post print version and can be cited as: Sinell, Anna; Heidingsfelder, Marie; Schraudner, Martina (2015): Entrepreneurship and Academic Employment - More Alike than You'd Think. In: *Journal of Technology Management & Innovation* 10 (3), p. 1-10. DOI: 10.4067/S0718-27242015000300001. Available at: https://dx.doi.org/10.4067/S0718-27242015000300001

[22] The paper is the post print version and can be cited as: Best, Kathinka; Sinell, Anna; Heidingsfelder, Marie Lena; Schraudner, Martina (2016): The gender dimension in knowledge and technology transfer - the German case. In: *European Journal of Innovation Management* 19 (1), p. 2-25. DOI: 10.1108/EJIM-07-2015-0052. Available at: https://doi.org/10.1108/EJIM-07-2015-0052

Rickne, 2002; Klofsten & Jones-Evans, 2000; Lundvall, 2010), the authors developed an analytical framework for evaluating the position of the gender dimension in knowledge and technology transfer. The findings indicate that the gender dimension is barely integrated in German transfer, which particularly manifests itself through the fact that there are fewer than ten per cent women among academic entrepreneurs (Braun-Thürmann et al., 2010). Current organizational practices and attitudes of decision makers continue to reinforce traditional gender roles and "typically male" approaches and behaviors (Connell, 2005; Redien-Collot, 2009). The developed model can be used in order to analyze how diverse perspectives are integrated into transfer processes in general–and academic entrepreneurship precisely. The paper was the first to synthesize a variety of sources into one unified framework and to rigorously analyze gender in the German transfer landscape. This framework can help decisions makers, both in- and outside of Germany, re-envision transfer practice and create new opportunities for its diverse participants. It can serve as a blueprint for future analysis of the integration of any diversity dimension as it elucidates key components and complex dynamics of the transfer process and academic entrepreneurship.

Paper III: Uncovering transfer–a cross-national comparative analysis[23]

This paper presents data on the strategies and operations of particularly productive transfer offices in five different countries in order to account for their high levels of transfer activity. The collected protocols were analyzed in three phases: Key characteristics of the transfer practices were extracted and organized by applying rigorous method of open-

[23] The paper is the post print version and can be cited as: Sinell, Anna; Iffländer, Vivien; Muschner, Antonia (2017). Uncovering transfer - a cross-national comparative analysis. In: *European Journal of Innovation Management 27* (80). DOI: 10.1108/EJIM-01-2017-0006. Available at: https://doi.org/10.1108/EJIM-01-2017-0006

end, qualitative content analysis (Mayring, 2010). The authors then enhanced the thus collected descriptive statistics (Siegel & Wright, 2015a) and, ultimately, developed a transfer office typology by building on the concept of attribute space (Lazarsfeld & Barton, 1951).

The interviewed organizations varied by country, and to some degree within each country, with regard to what "KTT" means, what strategies it should employ and what operations it should be conducing. Simultaneously, the analysis suggests two ideal types[24] of transfer offices, distinguishable in terms of their intertwined characteristics such as their goals, practices, sources of income and positions within their associated organizations. While the primarily state-funded common good type would seek benefits to the public, the self-financed entrepreneurial type would pursue commercial success. The former would therefore create opportunities for disseminating knowledge and strengthening the local innovation ecosystem, while the latter would scout for promising ideas and cultivate relationships with industry. The goal was to uncover the individual characteristics of the offices under study and the relation-ships between these characteristics that can help explain these offices' exceptional productivity. This study is the first to propose a TTO typology, which can support inter-organizational and international transfer collaboration. The findings provide empirical evidence for the theoretical Quadruple Helix model of the innovation system and have implications for research and practice (Carayannis & Campbell, 2011).

[24] Ideal types are "fictional" mental constructs that do not exist in the material world (Weber (1904b), and did not represent any of actual transfer offices, which typically combine characteristics of both types.

Paper IV: Academic Entrepreneurship and Design: The Role of Design in Spin-off Processes[25]

This paper investigates how design contributes to the development of entrepreneurial competencies at academic spin-off teams. Building on the entrepreneurial competence framework by Rasmussen et al. (2011), the authors analyzed eight start-up teams composed of people with expertise in design, the natural sciences and business management. The paper shows that design supports the start-up process on both a conceptual and transformational level. By enhancing user research, facilitating ideation processes and early testing of ideas, design helps in identifying business opportunities. Through its ability to further vision building and experience creation, design can strengthen championing competencies. Furthermore, design contributes to resource acquisition through the use of prototypes and mock-ups that make ideas more tangible. The derived propositions can serve to guide future research, while also carrying practical implications.

6.2 Discussion

In the following, I discuss how the four research papers contribute to the overall aim of this thesis and explicitly outline identified constraints impacting academic entrepreneurship (chapter 6.2.1) and effective organizational approaches toward it (chapters 6.2.2).

---

[25] The paper was presented at 12th European Design Academy Conference in Rome in April 2017. This is the authors accepted manuscript of an article published as the version of record in The Design Journal on 6TH September 2017. http://www.tandfonline.com/. The paper can be cited as: Sinell, Anna; Brodack, Franziska; Denef, Sebastian (2017). Academic Entrepreneurship and Design: The Role of Design in Spin-off Processes. The Design Journal 20(1). S457-S468. DOI: 10.1080/14606925.2017.1352984.
Available at: https://doi.org/10.1080/14606925.2017.1352984

6.2.1 Identified constraints impacting academic entrepreneurship

In their effort to deconstruct transfer processes and academic entrepreneurship at research institutions the four empirical papers included in this theses identified multiple constraints impacting transfer and academic entrepreneurship on different levels. Such constraints prevent scientists from engaging in entrepreneurial activities and from recognizing spin-off formation as a valid career option. Whereas paper I and IV had an explicit focus on spin-off creation as a specific mechanism of KTT, paper II and III analyzed transfer activities in general. Table 8 summarizes the findings of the four papers with an explicit focus on the identified constraints.

Table 8. Summary of identified constraints impacting academic entrepreneurship at research institutions.

MAIN FINDINGS	IDENTIFIED CONSTRAINTS IMPACTING ACADEMIC ENTREPRENEURSHIP
Paper I Academic Employment and Entrepreneurship—more alike than you'd think	
The study confirms previous findings of two different logics within academia and entrepreneurship perceived by transfer managers and postdoctoral students. The analysis of the researchers' perceptions on their current working conditions in German academia, however, reveals that working in academia and in entrepreneurship might be more alike than different. *Focus on academic spin-off creation.*	• Perceived differences among science and entrepreneurship: career change, change of role identity • Perceived lack of skills, resources, necessary personality traits • Perceived lack of a marketable, applicable ideas • Focus on the downsides of entrepreneurship (risk, uncertainty) • Lack of incentives (particularly career-related) and appreciation for transfer activities • Little awareness of existing (organizational and public) supporting structures • Few institutionalization of entrepreneurial activities in university curricula
Paper II Gender Dimension in KTT—the German Case	
Gender is barely integrated into German KTT on various levels. Women's participation in	• High conformism with a male-gendered culture (cultural gender stereotypes)

academic entrepreneurship is smaller than that of men. Findings indicate potential causes for the small participation of women in academic entrepreneurship. A transfer model was developed that can serve as a blueprint for future analysis of the integration of diversity in knowledge and technology transfer. *Different transfer mechanisms under study.*	• Overrepresentation of men among stakeholders and in decision-making • Limited resources (time for research, access to money, lab time, training) • Less opportunity and access to networks • Most common employment models require full-time commitment (family obligations, career stages)
Paper III Uncovering transfer—a cross-national comparative analysis	
The organizations varied greatly in their understandings of what KTT means, their goals, services and strategies between and, to some degree, within the five countries. A common optimal approach to the venturing process of academic spin-off could not be found. All interviewees regard—particularly transdisciplinary—diversity of perspectives as crucial for success in KTT. *Different transfer mechanisms under study.*	• Lack of commitment and acknowledgement of the institutions' higher authorities for transfer and missing incentive schemes for academics • Weak transfer infrastructure within the organization: lack of networks and weak ties between transfer office and scientific departments • Narrow focus on a particular transfer format • Attracting the right TTO personnel that provides the necessary skill set and motivation for the job
Paper IV Academic Entrepreneurship and Design: the Role of Design in Spin-off Processes	
Design supports the start-up process in all three important respects identified by (Rasmussen et al., 2011) on both a conceptual and a transformational level: by enhancing user research, facilitating ideation processes and early testing of ideas, it fosters opportunity development. Secondly, it furthers championing through the creation of vision and experience. Thirdly, with the help of prototypes and mock-ups design furthers resource acquisition. *Focus on academic spin-off creation*.	• Lack of viable business opportunities to commercialize research findings [derived from literature and paper I] • [Future constraint: different working modes and misunderstandings in transdisciplinary spin-off team consisting of team members with different educational and technical backgrounds] • --

Analyzing job profiles, required skill sets and existing organizational practices in academic employment and entrepreneurship, paper I "*Entrepreneurship and academic employment–more alike than you'd think*" showed that one of the greatest constraints that prevents scientists from transferring their findings into a business idea and starting their own science-based business is the perceived difference of academic employment and work as an entrepreneur. The paper thereby confirms previous studies of two different logics within academia and entrepreneurship (Jain et al., 2009; Sass, 2011; van der Sijde et al., 2014) as the interviewed transfer managers and postdoctoral students believe both occupations to differ substantially and on many levels. According to the interviewed postdoctoral students, engaging in entrepreneurial activities would mean a serious undertaking and a significant career change that would not be worth the effort. These findings are in line with previous studies that showed that scientists had to change their role identity in order to engage in entrepreneurial activities and that this would often result in individual conflict and stress (Jain et al., 2009; Lam, 2010). The paper revealed that both the interviewed transfer managers and postdoctoral students primarily see the downsides of entrepreneurship as they associate entrepreneurship with high uncertainty and risks instead of seeing upsides and potential benefits. These negative associations represent another substantial constraint impacting academic entrepreneurship. Often scientists are not aware of public funding and support mechanisms for academic entrepreneurship that would provide them with financial support and security. Instead of seeing potential benefits, the interviewed postdocs and transfer managers argue that scientists lack necessary skills (management, financing, market knowledge), competencies, resources (time, money) and the "right" personality traits ("lacking courage", risk averseness), which makes an active engagement in spin-off formation seem nearly impossible to interviewed postdoctoral students. Additionally, they articulate a perceived lack of "the right idea" which is marketable and applicable and would allow them to spin out a company based on their research. These presented factors make founding an academic spin-off seem highly unrealistic to the interviewed postdoctoral students. Paper I thereby, supports previous findings on the role of personality traits (Caliendo, Fossen, & Kritikos, 2009;

Caliendo, Fossen, & Kritikos, 2011; Zhao, Seibert, & Lumpkin, 2010), necessary resources (Rasmussen et al., 2014; Rasmussen & Wright, 2015) and competencies (Clarysse et al., 2011; Fritsch & Krabel, 2012; Rasmussen et al., 2011; Rasmussen & Wright, 2015) for fostering academic entrepreneurship. Moog et al. (2015) showed that scientists would be more likely to engage in academic spin-off formation, if they had a balanced skill set and were flexible to allocate their work time to different activities. Various studies have analyzed the role of incentives in order to promote entrepreneurial activities at research institutions and found that greater rewards and appreciation for such activities would strengthen the propensity of scientists to engage and enhance technology transfer (Bijedić et al., 2014; Friedman & Silberman, 2003; Huyghe & Knockaert, 2015a; Kolb & Wagner, 2015; Moog et al., 2015). Paper I reinforces these findings as the postdoctoral students complained about missing acknowledgement and career benefits for entrepreneurial activities. Instead, engaging in such activities would lead to substantial disadvantages impacting their academic career: they would have to decide how to balance between the two competing demands of entrepreneurial and research activities, which would prevent them from publishing and furthering their academic career (Ambos et al., 2008). Within the academic community, publications remain the main performance indicator for scientists in order to achieve promotion or tenure (The German Council of Science and Humanities, 2016).

Paper I, furthermore, showed that support measures for entrepreneurial activities are neither well-established nor communicated to the interviewed postdoctoral students within the analyzed research organizations. Transparent support mechanisms and strong communication of such measures are, however, necessary to promote academic entrepreneurship. Previous findings showed that universities with well-established policies and procedures show more productive transfer activities (Caldera & Debande, 2010b; Kolb & Wagner, 2015). Weak communication of support mechanisms can result in the fact that researchers are not aware of existing support mechanisms or even the existence of a transfer office within their organization. This confirms recent findings by Huyghe, Knockaert, Piva et al. (2016) who showed that instead of deliberately bypassing transfer offices, academics *unintentionally* do not involve their organizations' TTOs in their entrepreneurial activities because they do not know that such TTOs exist. This might be explained by the fact that academic entrepreneurship and spin-off formation is still a young topic for research institutions–considering the long history of universities and research organizations–and is neither on their agenda nor part of the university curricula, yet (Link et al., 2015). Ultimately, paper I showed that the interviewed postdoctoral students and even the interviewed transfer managers–who should in their position as transfer managers be encouraging the scientists and promote entrepreneurial activities–see great challenges for scientists in engaging in such activities. This indicates that constraints for academic entrepreneurship are incorporated on different levels within research and may therefore, lie deeper in the research institutions than just on the surface (Franklin et al., 2001).

Aiming to evaluate in what ways and to what degree gender aspects are currently integrated in German KTT, the "G*ender dimension in knowledge and technology transfer–the German case*" paper reveals several other constraints impacting transfer and academic entrepreneurship at research institutions in addition to those of paper I.

The analysis shows that gender aspects are barely integrated into German transfer processes on various levels. Findings show that neither qualitative nor quantitative components of gender are considered in German transfer processes. This leads to the fact that female scientists face additional and greater constraints than men, which prevent them from actively engaging in such processes. As the paper reveals, these barriers are particularly strong in such activities that relate to spin-off formation: traditional stereotypes (Butler, 1997), the image of an entrepreneur typically being male (Dautzenberg, Steinbrück, Brenning, & Zinke, 2013) and a culture that favors male-gendered approaches (Benschop & Doorewaard, 1998; West & Zimmermann, 1987) make spinning-out a company seem highly unattractive to female scientists and–even if they were willing to–impede their active participation in it. According to the interviewees and considered literature, the decision to engage in entrepreneurial activities would require high conformism with the male-gendered culture (Benschop & Doorewaard, 1998). In this vein, Franklin et al. (2001) found that major constraints impacting academic entrepreneurship are rather informal in nature and lie in a research institution's organizational culture. The fact that women suffer from less opportunities and access to networks reinforces their weak participation in transfer and academic spin-off formation in particular (Ding & Choi, 2011; Schubert & Engelage, 2011).

As presented, the identified constraints impacting academic entrepreneurship encompass components of the organizational culture. This reinforces the finding of paper I indicating that instead of lying on the surface, constraints impacting the transfer of academic entrepreneurship at research institutions are based on basic assumptions that are prevalent at research institutions (Schein, 1990). Thereby, paper I and II confirm recent findings on the importance of entrepreneurship-friendly organizational cultures: Huyghe and Knockaert (2015a) showed that research institutions with such favorable organizational cultures perform significantly better in academic spin-off creation (see also Clark, 1998; Erikson, Knockaert, & Foo, 2015). Besides these cultural constraints, findings of paper II reveal that women face additional barriers on an institutional level that constrain their participation in academic entrepreneurship: (1) an overrepresentation of men among stakeholders and in decision-making positions may reinforce inflexible "men-oriented" organizational practices (Benschop & Doorewaard, 1998) and limit the opportunities for women in academic entrepreneurship. Women are significantly underrepresented in university incubators and this gender gap has not decreased over the past years (Lindholm Dahlstrand & Politis, 2013). Marom, Robb, and Sade (2016) found a positive correlation between the sex of a start-up project leader and the same sex investors. Analogously, Brooks, Huang, Kearney, and Murray (2014) found that even with identical pitches investors preferred those of men instead of women. (2) As compared to men, women face scarce resources in terms of time for research, access to money, lab time and training (Busolt & Kugele, 2009). (3) Compared to male researchers, women work significantly more often part-time (Achatz, Fuchs, Kleinert, & Roßmann, 2009); however, most common employment models that allow scientists to engage in entrepreneurial activities require full-time commitment. (4) Ultimately, women's family obligations are still perceived to be one of the major obstacles that constrain their participation in transfer activities (Busolt & Kugele, 2009).

The literature review in the paper outlined that besides these qualitative gender aspects female participation in entrepreneurial activities is quantitatively lower than that of men: female scientists engage less often with industry (Azagra-Caro, 2007; Boardman, 2008; Hulten, 2010; Link et al., 2007; Perkmann et al., 2013), submit fewer patent applications (Haller, Vrohlings, Frietsch, & Grupp, 2007; Naldi, Luzi, Valente, & Vannini Parenti, 2005) and start fewer technological start-ups (Metzger, Niefert, & Licht, 2008; Sternberg, Vorderwülbecke, & Brixy, 2013). By deconstructing organizational transfer processes, the paper identified potential reasons for the small participation of women in academic entrepreneurship.

Whereas the focus of the paper I and II lay on constraints impacting academics' participation in entrepreneurial activities, paper III and IV analyzed organizational practices to promote academic entrepreneurship and to overcome such barriers. To this end, the "*Uncovering transfer–a cross-national comparative analysis*" paper examined the strategies and operations of particularly productive transfer offices in order to account for their high levels of transfer activity. The identified organizational practices will be presented in the following chapter 6.2.2.

As found in paper I and by many other scholars (Bijedić et al., 2014; Friedman & Silberman, 2003; Kolb & Wagner, 2015; Moog et al., 2015; Siegel & Wright, 2015b), paper III also revealed that missing incentive schemes and a general lack of acknowledgement weakens scientists' propensity to engage in any transfer and in entrepreneurial activities in particular. Of such activities particularly engaging in spin-off formation requires a great amount of resources. The lack of the perspective to gain any rewards by the research institution for such an engagement makes it seem highly unattractive to scientists (Ambos et al., 2008; Belenzon & Schankerman, 2009). In order to prevent informal technology transfer and inventions from going out the back door (Huyghe, Knockaert, Piva et al., 2016; Link et al., 2007; Perkmann et al., 2013) scientists' participation in transfer activities needs to be acknowledged and rewarded (see also study I). Therefore, a top-down commitment to transfer by a university's highest authorities plays a crucial role particularly for encouraging researchers to start entrepreneurial activities (Friedman & Silberman, 2003; Grave et al., 2014; Kolb & Wagner, 2015; Lautenschläger et al., 2014). Besides the active support by the institution's central management, an entrepreneurship friendly leadership-culture needs to be established on every other level within the organization: the transfer office, the department and the research group (Rasmussen & Wright, 2015). Aside from monetary incentives, results of paper III support previous findings indicating that research institutions should implement transfer activities in their promotion and tenure tracks in order to incentivize scientists' active transfer engagement (Marion et al., 2015). Although scholars share the opinion that incentives are necessary, there have been conflicting findings concerning the role of incentives in KTT and the modes of such incentives. Whereas some findings indicate that monetary incentives promote the academics engagement in entrepreneurial activities (Bercovitz & Feldman, 2008; Friedman & Silberman, 2003; Jensen & Thursby, 2001; Owen-Smith & Powell, 2001), others find no effect of monetary incentives or soft factors such as appreciation and career-related incentives to matter more than monetary incentives (Göktepe-Hultén, 2008; Marion et al., 2015). In line with these findings, The German Council of Science and Humanities (2016, p. 41) suggests to acknowledge transfer activities in the same manner as scientific achievements to better link transfer activities to research and teaching responsibilities. D'Este and Perkmann (2011) found that academics have different motivational drivers regarding the modes of transfer they pursue. While spin-off formation and patenting are motivated by commercialization, less formal transfer activities are driven by research-related motives. The authors therefore suggest to consider a broader range of incentives than just financial rewards (D'Este & Perkmann, 2011). Since the abolition of the so-called professor's privilege and similar Bayh-Dole-type regimes (Astebro et al., 2016, p. 2) universities instead of the inventors own the intellectual property rights, which reduces the possibilities to establish monetary incentives at universities. However, there have been conflicting findings on the effect of these governmental acts (see also chapter 4.1). Scholars have found these acts to have a positive effect (Merrill & Mazza, 2011; OECD, 2003; Stevens, 2004), a negative effect (Astebro et al., 2016; Czarnitzki et al., 2015; Hvide & Jones, 2016; Valentin & Jensen, 2007) or no explicit effect (Geuna & Nesta, 2006; Lissoni et al., 2009; Proff et al., 2012; Verspagen, 2006) on universities' performances of academic spin-off formation and patenting (see also chapter 4.1).

Besides the lack of incentives and acknowledgement of transfer and academic entrepreneurship at research institutions, paper III identified three additional obstacles to those already found in paper I and II: (1) *the challenge to attract the right transfer personnel:* all interviewees regard diversity of perspectives as crucial for success in academic entrepreneurship. This confirms studies by (Lautenschläger et al., 2014) who found that a certain amount of interdisciplinary within a transfer office's staff is more important for the promotion of transfer than the size of the office (measured by the number of employees). Accordingly, the interviewed transfer managers deliberately try to integrate diverse perspectives into their transfer practices by hiring employees with different educational backgrounds and experiences in academia or industry. These results support previous findings that transfer offices with appropriate capabilities and a realistic perspective on successful mechanisms in industry and entrepreneurship enhance academic spin-off creation (Clarysse et al., 2005). All interviewees share the opinion that a diversity of personal and professional skills matters more than gender diversity. According to the interviewees, the deliberate decision toward diversity among the staff and a job profile that provides experience in industry, science and ideally entrepreneurship make finding the right personnel that is best suited for the job at a transfer office a huge challenge (Siegel et al., 2003; Siegel & Wright, 2015b). Less qualified and homogenous personnel may impede transfer processes as they could not respond to the different needs of academics and industry partners (Siegel & Wright, 2015b).

(2) *Weak infrastructure within the research institution:* the paper revealed the pivotal role of networks both on the individual and organizational level. According to the interviewed transfer managers, a transfer office must provide well-established networks to the different, independent scientific departments within the research institution in order to be aware of and close to potentially transferable inventions. Such strong ties between scientific departments and the associated transfer office also fosters the scientists' awareness of the TTO, which has proven to be necessary in order to encourage scientists to disclose their inventions at all (Huyghe, Knockaert, Piva et al., 2016). A weak transfer infrastructure hence leads to fewer transfer activities and constrains transfer and academic entrepreneurship at the institutions (Bijedić et al., 2014; Minguillo & Thelwall, 2015). Rasmussen and Wright (2015) showed that access to resources from within the university such as advice from colleagues and research networks would significantly contribute to the spin-off's resource acquisition competency. This competency along with the opportunity development and championing competency build the three necessary competencies an academic spin-off needs to provide in order to successfully operate (Rasmussen et al., 2011, 2014).

(3) *A narrow focus on a particular transfer format*: ultimately, paper III indicates that a narrow focus on a single transfer mechanism within the transfer office and the research institution (such as for example exceptionally managing spin-offs) is likely to reduce the total outcome of transfer activities. This contradicts to certain degree recommendations by Siegel & Wright, 2015b that "*universities need to make strategic choices regarding the mode of commercialization they wish to emphasize–that is, licensing, start-ups, sponsored research and consulting, and other mechanisms of technology transfer*" (Siegel & Wright, 2015b, p. 30). However, their

recommendation relates to the amount of resource allocation to certain modes of commercialization. According to the interviewed transfer managers in paper III, all forms of transfer need to be united and managed by a single office in order to operate efficiently and create synergies. It would constrain their modes of operations substantially, if the different transfer mechanisms were handled in separate units within a research institution (such as entrepreneurship centers, patenting offices and licensing offices). Such a single head transfer office can be most effective in gathering comprehensive information about all transfer mechanisms and their impacts and in communicating this information. Simultaneously, findings of paper III suggest that establishing additional, small transfer units or at least single transfer managers at department level (at the independent scientific department or faculties) holds great potential to promote transfer activities directly and raise the awareness for the topic (see the identified constraint above "*weak infrastructure*"). Such a "decentralized" unit or manager would be closer to potential inventions and would foster the transfer infrastructure of a research institution. Paper III, however, showed that up to now, this combined approach of a transfer head office and decentralized units is not common practice at research institutions (Grimaldi et al., 2011; Siegel & Wright, 2015b).

Aiming to develop an approach that fosters spin-off creation at research institutions, paper IV investigated the role of design in eight academic, transdisciplinary spin-off teams. As the team members under study had already decided to actively engage in academic entrepreneurship, potential initial constraints impacting their decision were not part of the study. This limits to some degree the paper's contribution to part (A) of the overall research question of this thesis as it aims to explore potential constraints impacting transfer and academic entrepreneurship at research institutions in general and the academics' attitude toward academic entrepreneurship precisely. Instead, paper IV builds on the already presented major constraint impacting scientists engagement in academic entrepreneurship: the lack of market-knowledge and a viable business idea to commercialize their research findings (see paper I and Bercovitz & Feldman, 2008; Marion et al., 2015; Rasmussen et al., 2011). The paper investigates how the transdisciplinary team composition–and particularly the integration of design in such teams–supports reducing this identified constraint.

With regard to potential constraints impacting future performance of academic spin-off teams, paper IV reveals additional challenges evolving from such transdisciplinary team constellation. Results show that those participants in the spin-off program who had different educational or technical backgrounds varied in their working methods. One of the participating teams fell apart because those team members who had an educational background in design preferred to keep the ideation process open and generate more business ideas, while the involved natural scientists and business managers preferred to stick to the original application scenario and further that. This illustrates just one of the challenges that may occur in academic founding teams composed of team members with various different educational and technical backgrounds. Other such challenges found in previous studies on the team performance of interdisciplinary teams include misunderstandings and weak communication structures because of not speaking a common language (Janich & Zakharova, 2011).

As the focus of the "*Design and Academic Entrepreneurship*" paper lay on developing and evaluating an organizational approach toward academic entrepreneurship, no other than the above presented constraints to academic entrepreneurship was identified. The lessons learnt from the program that help in fostering the development of entrepreneurial competencies at research institutions will be presented in the following chapter 6.2.2.

6.2.2 Organizational approaches toward academic entrepreneurship

In their effort to deconstruct transfer processes and academic entrepreneurship, the four research papers included in this thesis analyzed organizational practices and approaches impacting transfer and academic entrepreneurship at research institutions. Based on this analysis several recommendations of how to overcome the identified constraints were derived in the four empirical studies. Table 9 summarizes the identified practices and their specific effects.

Paper I found a *perceived* gap and *perceived* two different logics within entrepreneurship and academia (van der Sijde et al., 2014). At the same time, the analysis of the scientists' perceptions on their *current* working conditions in German academia, its infrastructure, the job characteristics and motivational drivers point out that working in academia and in entrepreneurship might be also very much alike. Such a comparative analysis from the perspective of postdoctoral students had so far not been conducted. The study revealed that academic employment and entrepreneurship share similar characteristics on different levels. By applying the theory of the person-job fit (Kristof-Brown et al., 2005) the authors of paper I were able to identify several overlaps and analogies between the two occupations.

Table 9. Summary of the identified organizational practices and their specific objectives.

PRACTICES TO REDUCE CONSTRAINTS IMPACTING ACADEMIC ENTREPRENEURSHIP	OBJECTIVE
Paper I Academic Employment and Entrepreneurship—more alike than you'd think	
Provide opportunities for researchers to reflect on working conditions and tasks in entrepreneurship and academic employment Establish collaboration among academics and entrepreneurs through joint projects Create opportunities for academics to identify themselves with entrepreneurial peers Develop organizational-specific support measures and actively communicate them Communicate analogies rather than differences and downsides of entrepreneurship Establish incentives to reward researchers for their engagement in entrepreneurial activities (financially and career-related) Recognize the importance of support and communication of transfer activities early in a scientific career (PhD-level) Communicate existing institutionalized support programs	• Reduce the perceived gap between academia and entrepreneurship • Make entrepreneurship more accessible for researchers by re-defining boundaries between entrepreneurship and science • Reduce perceived uncertainty • Prevent role-identity conflicts emerging from changing from scientist to entrepreneur • Raise the researchers' awareness for commercialization opportunities and necessary competencies at the beginning of their scientific career • Enhance appreciation and value of transfer activities
Paper II Gender Dimension in KTT—the German Case	
Deliberately promote academic entrepreneurship to both male and female researchers Provide men and women to equal parts with access to networks Re-envision organizational practices to encourage more women to participate in transfer activities Introduce gender-sensitive reward systems Provide gender-balance in decision-making bodies Communicate gender-based constraints to transfer managers and university authorities	• Incorporate diversity aspects into aspects of the organizational culture • Raise awareness of hidden (gender) barriers • Overcome male-gendered cultures • Provide organizational conditions for an equal participation of men and women in knowledge and technology transfer
Paper III Uncovering transfer—a cross-national comparative analysis	
Develop strategies that respond to specific needs and context factors Align transfer strategies and modes of operations Strengthen internal cooperation among TTO and scientific departments Actively scout transferable inventions Manage all transfer activities in a single organization while simultaneously establishing decentralized transfer units/mangers at department level Deliberately hire TTO personnel with industry experience	• Establish a strong transfer infrastructure within the organization • Strengthen the external network and foster ties to industry partners • Create synergies among different actors and forms of transfer • Establish trust among involved actors • Facilitate communication between actors from academia and industry • Prevent or reduce role-identity conflicts

Recognize the importance of highly skilled TTO personnel and its transdisciplinary composition Establish incentives for academics (beyond financial rewards) and TTO personnel Interpret "transfer" rather as "translation" to establish trust among different actors Provide opportunities to let surrogate/external entrepreneurs exploit scientific findings Consider multiple actors as clientele and addressees (from academia, industry, policy and the public)	• Prevent informal transfer and inventions from "going out the back door" • Make research results applicable and accessible to the public • Avoid unprofitable services • Create synergies with and new connections to external partners
Paper IV Academic Entrepreneurship and Design: The Role of Design in Spin-off Processes	
Set up transdisciplinary (research and spin-off) teams with different educational and technical backgrounds Integrate design expertise in such teams Integrate seniority and industry experience Provide a protected environment and room for experimentation Provide certain guidance: Require milestones in the program Integrate design at an early stage of research and transfer projects (particularly at spin-off activities) Implement such a program early at an academic career	• Foster development of entrepreneurial competencies at research institutions: - Identification of viable business opportunities through enhanced user research, ideation processes and early testing; - Championing through vision building, experience creation; - Resource acquisition with the help of prototypes and mock-ups • Generate multiple ideas and scenarios for the commercialization of research findings • Support the start-up process on both a conceptual and transformational level • Help scientists develop skills and capabilities that are relevant outside academia

The study showed that with their current working experiences scientists might as well fit considerably well into the entrepreneurial world. It furthermore showed that scientists in German academia typically face job uncertainties and lack opportunities of long-term career perspectives (Kahlert, 2013; Schütz et al., 2016; Trübswetter, Sinell, Schütz, & Schraudner, 2015)—both of which they fear in entrepreneurship (van der Sijde et al., 2014). Simultaneously, the paper showed that the job characteristics in academia are similar to those in entrepreneurship: scientists do project management, work long hours, have to meet targets and deadlines and do fundraising (write proposals for third-party funds)—all of which they fear not being capable of in entrepreneurship. These findings challenge the perception of entrepreneurship and academic employment being two completely different occupations (Jain et al., 2009; Sass, 2011; van der Sijde et al., 2014) and suggest that it might rather be a widely-shared and self-perpetuating illusion. Paper I showed that potential causes for the perceived differences between academic employment and entrepreneurship may include the lack of opportunities for researchers to identify with entrepreneurial activities and peers and to reflect on working conditions and job profiles in academia and entrepreneurship. Organizational settings and joint projects with entrepreneurs and academics can help re-define the boundaries between scientific and entrepreneurial activities and make entrepreneurship more accessible for researchers. Shared projects between entrepreneurs and researchers can help them to reflect on their own activities and identify with entrepreneurial peers. Entrepreneurial peers and the existence of role models have proven to have a significant effect on researchers' propensity to start an own company: entrepreneurial peers at the host research institution (Bijedić et al., 2014; Fritsch & Krabel, 2012; Huyghe & Knockaert, 2015a) and the research departments in particular (Lautenschläger et al., 2014; Rasmussen et al., 2014) as well as in the family (Foo et al., 2016) have all proven to positively influence researchers' propensity to engage in entrepreneurial activities. Thereby, such joint projects can help open up the career perspectives of scientists to entrepreneurship and help them to recognize entrepreneurial activities as a valid career option, for which they already provide several necessary skills and working experience. These projects go beyond existing research-industry collaboration which has also been proven to enhance transfer and academic entrepreneurship (Ding & Choi, 2011; Foo et al., 2016; Perkmann et al., 2013; Perkmann et al., 2015). This type of collaboration typically constitutes of a research organization and large industry partners and is thereby different from joint projects among researchers and entrepreneurs. With such joint projects research organizations could provide opportunities for researchers to experience the entrepreneurial working environment and would allow them to identify with entrepreneurial peers. Establishing such programs at an early stage of an academic career (at the PhD-level) may be of particular interest as researchers typically do not have set distinct career plans at that point (Kahlert, 2012; Schütz et al., 2016; Trübswetter, 2017). Implementing the idea of academic entrepreneurship and its opportunities early on can raise the researchers' awareness for commercialization opportunities in their future career (Astebro et al., 2016; Perkmann et al., 2015). The competency of opportunity refinement has proven to be a necessary factor for successful spin-off creation (Rasmussen et al., 2011, 2014). Astebro et al. (2016) suggest that support measures targeted at younger, tenure-track academics may produce more benefits for society than general incentives.

By communicating similarities instead of differences, transfer managers and university authorities can contribute to and help in opening the perspective of entrepreneurship as a valid career option. Outlining these analogies and similarities can also help to reduce the associated downsides of entrepreneurship as they are similar to those in academia. Exhibiting similarities between academic employment and entrepreneurship can help to prevent researchers from having to change their role identity (completely), which has been proven to be a challenge and constraint for engaging in entrepreneurial activities (Goethner et al., 2012; Jain et al., 2009; Sass, 2011).

As presented above, academic entrepreneurship is strongly associated with a high amount of risks and uncertainties. If scientists were better aware of existing support mechanisms both within the organization and at the system-level (e.g. governmental programs such as "EXIST-Gründerstipendium", or "Hightech-Gründerfonds" in Germany), the perceived financial risks that are associated with academic entrepreneurship might be reduced to a certain degree. Research institutions should therefore put stronger efforts in the communication of such institutionalized and organizational support measures.

Based on the assumption that gender diversity enhances innovation processes (Bührer & Schraudner, 2010) paper II analyzed the integration of gender aspects in knowledge and technology transfer in Germany. The authors of paper II developed a transfer model that may serve as an analytical frame to analyze the integration and representation of certain diversity aspects in transfer processes. The results reveal a weak representation of women in the German transfer landscape. Female researchers as compared to their male colleagues would face additional and greater challenges that impede their engagement in German KTT and academic entrepreneurship in particular (see previous subchapter 6.2.1). Obviously, not every diversity dimension can be represented to equal numbers in the KTT process. However, organizational structures and conditions should allow every researchers for an equal participation in transfer processes and should not contain barriers that hit some harder than others. Therefore, organizations must set the ground for their diverse researchers to equally engage in academic entrepreneurship. In order to achieve this, several recommendations for organizational practices were derived in paper III. As shown in paper II, the organizational culture plays an essential role pursuing transfer and academic entrepreneurship effectively, particularly for women. In order to tackle gender-based constraints impacting KTT and academic entrepreneurship, research institutions need to start raising the awareness for the topic and to acknowledge the importance of it. Diversity aspects must be incorporated into every aspect of an organizational culture, in order for their employees/scientists to unfold their full potential (Schein, 1990). To overcome male-gendered cultures (Benschop & Doorewaard, 1998), organizations need to introduce gender-sensitized reward systems and provide men and women to equal parts with access to networks. Networks have proven to have an significant effect on the researchers' propensity to engage in spin-off creation (acatech – Deutsche Akademie der Technikwissenschaften, 2010; Ding & Choi, 2011; Ding, Murray, & Stuart, 2010; Göktepe-Hultén, 2008). Both gender-sensitive reward systems (Best, 2016; Kaiser, Hochfeld, Gertje, & Schraudner, 2012) and access to networks (Kaiser, 2014; Welter, Brush, & Bruin, 2014) have proven to help in reducing gender barriers in organizations and entrepreneurship.

In order to incorporate diversity in every aspect of their organizational culture and, ultimately, to encourage more women to participate in transfer activities, research organizations must re-envision their organizational practices. The paper suggests that raising the awareness for (hidden) gender barriers can be a starting point. As both the analyses of paper II (in Germany) and paper III (in Sweden, Italy, Switzerland, Germany and Israel) showed, only very few interviewees had ever thought about the topic "gender in knowledge and technology transfer". Raising the awareness of the topic has proven to be a first lever to initiate change (Best, 2016; Froese & Schraudner, 2010; Kaiser, 2014). Therefore, the research institutions' authorities need to actively communicate existing gender-based constraints as well as deliberately promote academic entrepreneurship to both male and female scientists.

In order to account for their high levels of transfer activity, paper III analyzed the strategies and operations of particularly productive transfer offices in five different countries. The analysis revealed several–both national and cross-national–practices and activities conducted by research institutions and their associated transfer offices aiming to promote transfer and academic entrepreneurship. However, a common optimal approach toward transfer and academic entrepreneurship was not found. Instead, the analysis showed that between and to some degree within the five countries the examined organizations varied greatly in their understandings of what KTT means, their goals and their strategies. These findings were reinforced by the fact that the services provided by these institutions' transfer offices varied similarly, while the volume of the offered programs and initiatives indicates the importance of transfer and academic entrepreneurship to the analyzed research institutions. The offered services for spin-off creation include incubators and accelerators on campus, open lectures, networking events, individual and team consulting, technology scouting and entrepreneurial education.

Simultaneously, further analysis of the collected data suggests two ideal types of transfer offices, distinguishable in terms of their positions within their associated organization, their strategies and operations. These characteristics are intertwined: (1) the primarily state-funded, integrated type would seek benefits to the public and, therefore, be creating opportunities for training and strengthening the local ecosystem. (2) The self-financed, independent type would, in contrast, be pursuing primarily commercial success and therefore, be actively scouting for potential inventions and cultivating relationships with industry. These the two ideal types help explain the subtle relationships between the organizations' strategies and operations. Moreover, with the help of these two ideal types, paper III revealed the importance of aligning transfer strategies and modes of operations (such as offered services, skills of personnel, networks) with one another in order to effectively pursue transfer and promote academic entrepreneurship.

By comparing the organizational transfer practices, the analysis showed that in order to tackle organizational-specific problems and constraints, every research institution has to develop its individual transfer strategy and respective modes of operations that respond to their specific needs and characteristics of the local ecosystem. Various scholars have outlined the role of such context factors and the regional environment in the transfer landscape (Belenzon & Schankerman, 2009; Grimaldi et al., 2011; Kulicke & Leimbach, 2012; Rasmussen et al., 2014). These factors, however, only explain part of the variance of the universities' transfer performances (Mosey et al., 2016) and the reasons why the majority of universities particularly struggles to effectively promote spin-off creation (Rasmussen & Wright, 2015). Findings of paper III indicate that such "underperforming" research institutions might not follow a transfer strategy that responds to their particular strengths and needs and addresses those constraints impacting transfer and academic entrepreneurship that are prevalent at their organizations. By adopting a demand side perspective, Rasmussen and Wright (2015) were the first to analyze the challenges scientists face during the spin-off process and identified university support mechanisms that respond to the needs of the spin-offs. Following their arguments and adopting a demand-side perspective (Rasmussen & Wright, 2015), paper III suggests that transfer strategies have to respond to both the needs of the research institutions, its context factors as well as the individual needs of their employed scientists.

In addition to the necessity of developing an individual, organization-specific transfer strategy and aligning the organization's operations with it, paper III outlines the pivotal role of networks and personal contacts in order to overcome constraints impacting transfer and academic entrepreneurship. According to the interviewed transfer managers of particularly productive transfer organizations, strong connections both within the organization to the scientific staff and outside the organization to external partners are of essential value for effectively promoting and pursuing academic entrepreneurship. These external partners can include any (for the organization) relevant actor within the innovation ecosystem such as large companies, political bodies, start-ups, spin-offs, venture capitalists and other research institutions. At the organizational-level, networks within the organization help to establish a strong transfer infrastructure (see previous subchapter 6.2.1) as they strengthen internal cooperation among different organizational bodies (such as the transfer office, scientific departments, PR agencies and other transfer-related units). As transfer, and particularly academic entrepreneurship, is growing increasingly complex with more actors being involved and new forms of transfer being developed (Siegel & Wright, 2015a), it becomes beneficial to establish a transfer head-office that coordinates all transfer activities. Thereby, efficiency can be enhanced, synergies among the different forms of transfer are more likely to occur and monitoring and reporting of transfer activities can be facilitated (see subchapter 6.2.1). However, findings of paper III indicate no need to enhance all modes of academic entrepreneurship equally. In fact, trying to excel all different aspects of knowledge and technology transfer, research institutions can lose focus which can lead to a poorer overall transfer performance. Instead, research institutions have to define their optimal portfolio of transfer activities while taking into account their specific prevailing constraints for academic entrepreneurship in their unique context.

Findings of paper III suggest that strong ties among transfer managers and scientific departments contribute to a higher visibility of the transfer office within the different departments of the organizations. At the same time, transfer managers are better aware of existing technologies and inventions at those departments. Close connection between a transfer office and the associated research departments also creates trust among the involved actors. Trust has found to have an essential impact on scientists' decisions to disclose an invention to their employer institution (Bok, 2003). Transfer managers should therefore be aware of potential misunderstandings and deliberately try to establish and prove trust among involved actors. Especially regarding financial and IP issues, trust among the actors has proven to lower the risks of conflicts (Bok, 2003).

In addition to the role of internal networks, interviewees rated strong external partnerships as highly important. Thereby, paper III supports Rasmussen and Wright (2015) who found that access to resources from outside the university was necessary in order to develop a spin-off's resource acquisition competency. Such networks, furthermore, strengthen the transfer offices' positions within the (regional) innovation ecosystems: innovation ecosystems are formed by different actors, comply with different regulations regarding research, provide different funding (public or private) and therefore contain different challenges and potential for transfer processes and academic entrepreneurship (Adner & Kapoor, 2010; Autio & Thomas, 2014; Lundvall, 2010). All such factors impact the performance of a transfer office and respectively their strategies and operations. Therefore, transfer offices must consider characteristics of the (regional) innovation ecosystem they interact with and define their strategies and modes of operation responding to these characteristics.

Along these lines, the transfer offices under study pay particular attention to networking skills of their employees. According to the interviewed transfer officers, effective transfer can only occur if all involved actors from different sectors see the benefits of it. Thereby, paper III supports previous findings on the existence of different key agents in the transfer process: previous studies showed that perspectives of three key agents–namely the scientist as the research representative, the transfer manager or any other university authority as the intermediary and the corporate manager or venture capitalist as the industry representative–have to be accommodated in the transfer process (Siegel et al., 2003; Siegel & Wright, 2015b). In their assessment of the academic impact at Imperial college, Perkmann et al. (2015) found that the strongest barrier for scientists to engage in transfer activities refers to the perceived difficulty in finding appropriate partners for collaboration. Along these lines, paper III showed that according to the interviewed transfer managers, their employees' working experience in industry significantly facilitates research-industry collaboration and, thereby, fosters academic entrepreneurship. These findings support previous studies on the role of networks in knowledge and technology transfer at the organizational-level (Abel-Koch, 2015; Bijedić et al., 2014; Minguillo & Thelwall, 2015; Rasmussen & Wright, 2015) and the individual level (acatech – Deutsche Akademie der Technikwissenschaften, 2010; Ding et al., 2010; Ding & Choi, 2011; Foo et al., 2016; Göktepe-Hultén, 2008). In addition to these networking capabilities, the interviewees regarded industry experience and an interdisciplinary TTO staff as highly important for its success. In order to reduce the identified challenge to find the right personnel for transfer activities, findings of paper III suggest to establish further incentives for transfer managers in order to strengthen their motivation and attract high-potentials for such jobs. Job profiles of such positions are similar to those in industry where typically higher salaries are paid. Paper III reinforces findings of Siegel and Wright (2015b) and Siegel et al. (2003) who argue that establishing additional incentives for transfer managers is necessary in order to attract highly-skilled and well-contacted employees from industry.

Results of paper III outline that the interviewed research institutions' higher authorities and transfer managers show considerable proactive behavior toward the promotion of transfer and academic entrepreneurship. Those organizations that are particularly successful in research commercialization actively search transferable technologies and have introduced various initiatives to further academic spin-off formation in order to tap the full commercial potential of their scientific research. To this end, they have established so-called scouts–transfer managers, experienced entrepreneurs or consultants from industry–to identify commercialization potential on campus. Scouting helps in building a stronger transfer infrastructure and strengthens internal networks–both of which have proven to be necessary in order to facilitate academic entrepreneurship at research institutions (Bijedić et al., 2014; Minguillo & Thelwall, 2015; Siegel et al., 2007). Scouting, furthermore, helps to prevent inventions from exiting the university without notice (Huyghe & Knockaert, 2015a; Link et al., 2007; Perkmann et al., 2013). Paper III showed that particular strong transfer-oriented institutions would often match academic inventor teams with so-called "surrogate entrepreneurs" who help initiate academic spin-offs. These external entrepreneurs would be responsible for managing the business, whereas the scientists would keep working in their research fields. This model allows the scientists stick to their research fields while their inventions still get commercialized with all potential benefits assumed with science-based venture creation (Auer & Walter, 2009; Braun-Thürmann et al., 2010; Dickel, 2009; Rasmussen & Wright, 2015). Thereby, the surrogate-model prevents them from having to balance between entrepreneurial and scientific activities (Ambos et al., 2008) or experiencing any role identity conflicts (Goethner et al., 2012; Jain et al., 2009). Paper III supports findings by Franklin et al. (2001) who found particularly transfer-oriented universities to be significantly more predisposed to surrogate entrepreneurs. Paper III also follows suggestions by Astebro et al. (2016) that academics may not prefer full-time efforts in spin-off ventures as they fear a significant earnings decline and hence may serve those businesses better as loose co-owners or advisors (Braunerhjelm & Svensson, 2010; Nicolaou & Birley, 2003).

Ultimately, findings of paper III suggest that in order to establish a common ground among the involved actors and to establish an understanding of their goals and needs transfer managers should interpret the transfer process rather as the “translation” between different systems. The findings suggest that successful transfer does not only mean to provide access to research but rather to make research applicable and accessible to the public. Translating research findings, thereby, goes beyond “merely” transferring them in terms of making them available to the public. In order to translate and facilitate the interactions between actors from academia and non-academic environments, transfer authorities need to understand the different needs and perspectives that are prevalent in these two systems. It has been found that scientists are more likely to be involved in transfer and commercialization activities, if they understand the needs and logics outside the science system (Clarysse et al., 2011; Fritsch & Krabel, 2012). However, in order to promote multi-directional transfer processes transfer managers should not limit their efforts to the translation between industry and science only, but also include other sectors such as policy and the society (Miller, McAdam, Moffett, Alexander, & Puthusserry, 2016; Siegel & Wright, 2015a).

Integrating academic entrepreneurship literature and innovation studies (Krippendorff, 2005; Leavy, 2010; Rust, 2004), paper IV explored the role of design in spin-off processes. Analyzing the evolution of entrepreneurial competencies in academic founding teams, the paper provides several implications for the development of organizational practices that help in fostering academic entrepreneurship at research institutions. To this end, eight transdisciplinary spin-off teams were analyzed in the context of a six-month incubation program, each team comprising expertise from design, the natural sciences and business administration. Derived recommendations for such organizational practices both regard individual characteristics of the spin-off teams and the conditions of such an incubation-initiative.

(1) Team characteristics: the findings indicate the great potential of building transdisciplinary teams at research institutions in order to develop entrepreneurial competencies and, thereby, fostering academic entrepreneurship at research institutions. By having integrated knowledge from theoretically- and practically-driven research fields in spin-off teams, participants stated that new ideas would automatically emerge very quickly. The paper shows that design particularly fosters the necessary entrepreneurial competence of identifying a viable business opportunity (Rasmussen et al., 2011) as design helps to better understand the broader contexts in which technologies and users interact. Results show that the integration of design in academic founding teams supports the spin-off process on both a conceptual and transformational level: it helped the spin-off teams in generating diverse concepts for the commercialization of their technologies and in remaining open to create further ideas. This opportunity development competence was also furthered by the facilitation of ideation processes and early testing of ideas. Opportunity refinement competence refers to the need to develop a viable business opportunity exploiting the commercial potential of the research results or technologies (Rasmussen et al., 2011; Rasmussen & Wright, 2015). Research has shown that the lack of such a marketable idea often constrains academic entrepreneurship (see paper I and Bercovitz & Feldman, 2008; Marion et al., 2015). The presented findings suggest that integrating design expertise into spin-off teams–and to an earlier stage into research teams–can help

overcome this constraint and help to establish an environment where academic entrepreneurship is more likely to happen.

Additionally, findings of paper IV show that by fostering vision building and enhancing experience creation and empathy, design furthers championing competence which has also deemed necessary for academic spin-off creation to occur (Rasmussen et al., 2011; Rasmussen & Wright, 2015). Ultimately, the findings indicate that with the help of prototypes and audio-visual aids design helps making (abstract) ideas more tangible and easier to grasp, thereby furthering resource acquisition competency. In summary, the paper suggests that the integration of design into academic founding teams furthers the evolution of all three entrepreneurial competencies identified by Rasmussen et al. (2011) and confirmed by Rasmussen and Wright (2015).

In addition, findings also reinforce previous studies outlining the role of industry experience in academic founding teams (Dietz & Bozeman, 2005; Wennberg, Wiklund, & Wright, 2011). One of the winning teams of the incubation program provided the most elaborated network to relevant industry contacts. The team members were able to win relevant experts in their field for their advisory board, which would not have been possible, if they did not have established strong ties through their previous industry experience to them. In addition to industry experience, results of paper IV reveal the importance of a certain degree of seniority within the spin-off teams. Both winning teams provided the highest degree of seniority–both teams had at least one team member with a doctor's degree–and also showed a high amount of working experience. This findings may be of particular value for future studies as the call for student start-ups and junior researchers in academic entrepreneurship is increasingly growing (Foo et al., 2016; Siegel & Wright, 2015a).

(2) Program conditions: the participants particularly appreciated the protected environment and organizational conditions that allowed and encouraged them to freely experiment with business ideas and different commercialization scenarios. Providing a protected environment that allows scientists and students to freely experiment with new ideas in order to encourage academic entrepreneurship has been far too less recognized by research institutions and universities in particular (Grimaldi et al., 2011). Simultaneously, certain guidance was found necessary so that teams would follow a given development speed and accelerate their project. Such guidance can be provided by requiring the teams to meet targets, to set milestones and by regularly project presentations during the program. According to the participants, the most valuable service provided to the teams were the individual and team coaching sessions.

As has already been pointed out in the *team characteristics* chapter, findings of paper IV show that design helps to generate diverse ideas and to remain open for different commercialization scenarios–thereby supporting the spin-off process on a conceptual level. Integrating design at an early stage of transfer projects therefore affects the conceptual approach toward the commercialization of research findings and can strengthen the commercial output of research findings. By integrating design already into early stages of research projects the broader contexts of the technologies can be better explained, which might enhance the likelihood of technologies getting transferred to the public (Rust, 2004).

Establishing such an incubation program early at an academic's career can hold particular value as untenured, junior researchers are often unsure about their future career path (Astebro et al., 2016; Kahlert, 2012). The early implementation of such a program can help them develop capabilities and skills that are necessary and valuable for careers outside academia and, furthermore, open their mindsets to alternative career paths. Particularly, at universities and non-applied science institutions creating careers for academics outside their host institution seems pressing (Kahlert, 2012; Schütz et al., 2016).

In summary, recommendations that aim to build strong *teams for the commercialization* of scientific findings include: (1) create transdisciplinary research and spin-off teams, (2) integrate design expertise and (3) seniority and industry experience in such teams. With these findings Paper IV provides implications on potential configurations of effective entrepreneurial research teams that had been neglected so far (Knockaert et al., 2011; Markman et al., 2008).

Derived recommendations regarding an *institutionalized program* that aims to support the commercialization of scientific findings through spin-off creation include: (1) create a protected environment and room for experimentation, (2) find the right balance between freedom to let the teams evolve and guidance to monitor the process and provide necessary support (by requiring i.a. milestones, preliminary presentations) and (3) implement such a program early a scientist's academic career.

7 Conclusions

This chapter presents the conclusions derived from the above presented findings. By integrating and jointly reviewing them, I derive recommendations for the development of needs-oriented transfer strategies that can help in fostering academic entrepreneurship at research institutions. To this end, I develop a visual template–the Transfer Strategy Framework–comprising key elements and guiding questions for transfer strategies. This framework can serve as management tool and help research institutions in developing transfer strategies that respond to their individual strengths, needs and context factors. The visual tool and derived elements including their theoretical origin (the findings they are built on) are presented in the following chapter 7.1. Clearly this thesis is not without limitations, which are discussed in chapter 7.2. Ultimately, I will complete this thesis with an outlook toward further research and managerial issues that may occur in future (chapter 7.4).

7.1 The Transfer Strategy Framework

Universities have found to vary greatly in their transfer performances and particularly in their performances of founding research-based academic spin-offs. Although contextual factors such as the regional environment (e.g. proximity to industry partners), stable organizational setting (e.g. its scientific orientation or its size) and institutional factors (e.g. cultural norms, governmental support programs) are key influencing factors of the entrepreneurial performance of universities, they only explain parts of it and reasons behind these variations are multifaceted (Rasmussen & Wright, 2015). One explanatory factor behind these variations in transfer performances is that universities have adopted transfer strategies that do not respond to their individual strengths, needs and contexts factors (Grimaldi et al., 2011)–or have not established their transfer strategies, yet (Grave et al., 2014). The German Council of Science and Humanities (2016) accredits the German transfer landscape a general "*strategic deficit*" as research institutions would be lacking systematic approaches to it (The German Council of Science and Humanities, 2016, p. 8). As most institutional characteristics are rather stable and hard or impossible to change, research institutions must develop transfer strategies that respond to these characteristics and adapt their strategies to exploit the given opportunities.

With the Transfer Strategy Framework I aim to provide an easily understandable tool that can help research institutions define their specific transfer strategies with a particular focus on fostering academic entrepreneurship at their organizations. This visual tool comprises six elements that need to be addressed in transfer strategies and guiding questions that relate to these elements and help organizations to adjust the elements to their respective needs. The template can therefore be applied by various research institutions such as non-university research organizations, universities and polytechnics. No claim is made for the six elements to be comprehensive. As has been outlined, they particularly serve to define transfer strategies that aim to foster the entrepreneurial dimension of transfer. It can obviously be further developed in future to stronger address other transfer dimensions such as for example science-society interactions. The objective of the developed template is to illustrate how research organizations can make use of the findings of the four research papers included in this thesis and thereby serves as the "transfer product" of this thesis itself.

Drawing from the presented findings, I derived six key elements that–when being addressed in their specific transfer strategies–can help research institutions in promoting academic entrepreneurship and fostering knowledge and technology transfer at their organizations. The components build on the above discussed findings regarding constraints and organizational practices toward transfer and academic entrepreneurship. As these findings and their contribution to existing literature were already discussed (previous chapter 6), I will compile and break them down and only present *additional* literature that the elements contribute or theoretically relate to and have not been mentioned before. These elements take into account that multiple factors on different levels within and outside research institutions have to be addressed when developing an organization-specific transfer strategy. Therefore, the Transfer Strategy Framework addresses these different levels: the central university, the transfer office, the departments, the research group, individual factors and regional environment (Rasmussen & Wright, 2015). When combined and adapted to the institutions' specific strengths, needs and contexts, the Transfer Strategy Framework can contribute to reducing potential constraints impacting academic entrepreneurship and help in establishing an entrepreneurship friendly culture at the research institutions. Figure 4 illustrates the derived elements included in the framework, their relation to one another and theoretical origin–which one of the four papers included in this thesis they stem from. Their contribution to the development of transfer strategies will be described in the following.

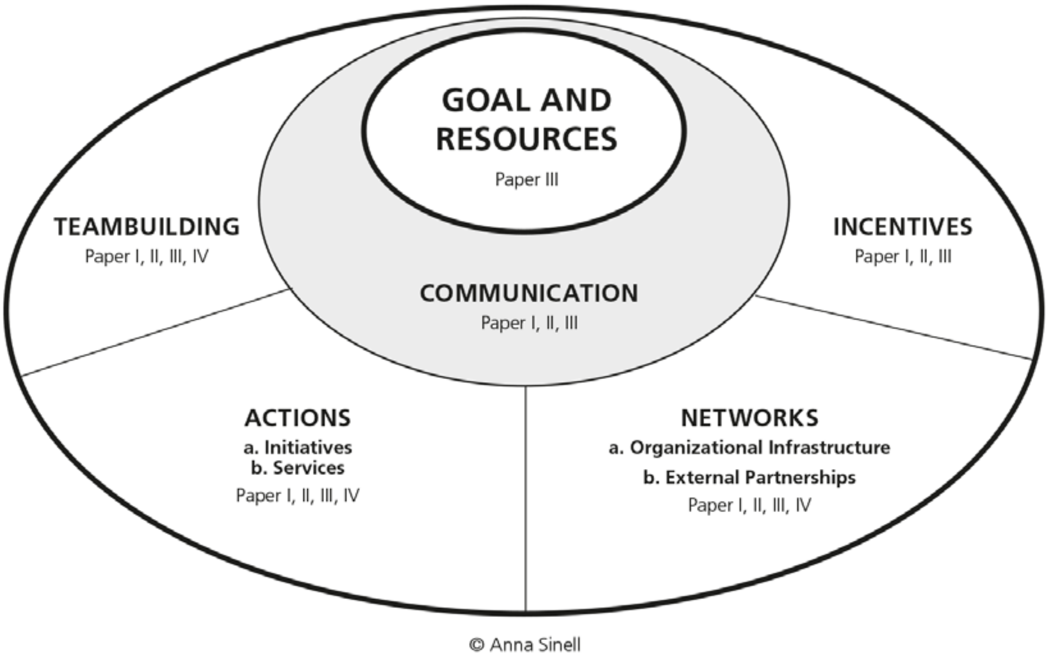


Figure 4. *Derived key elements of transfer strategies with regard to their theoretical origin in the empirical studies. Own conceptualization.*

7.1.1 Goal and resources

Every strategy needs an accurately defined goal that it aims to achieve. Findings of the "*Uncovering transfer*" paper indicate that in order to set specific goals on what to achieve with their transfer strategies, transfer managers and university authorities must develop a shared understanding of what knowledge and technology transfer and academic entrepreneurship means to them and their research institution. In this regard, the *impact* of research has gained increasing attention within policy and academia in the last two decades (Bornmann, 2013; Martin, 2011). When allocating grants for research projects, national and international funding organizations prefer projects that are intended to promote transfer and achieve an impact with their research (European Commission, 2016b; Federal Ministry of Education and Research, 2010; Research Excellence Framework [REF], 2011). As transfer activities (such as patenting, licensing, spin-offs etc.) constitute the main mechanisms through which research can achieve an impact on society (Bornmann, 2013), impact and transfer are highly intertwined. When defining their transfer strategies, research institutions need to take into account that impact is a multidimensional construct that comprises different dimensions affecting the economic, social and cultural development of societies (Bornmann, 2013). Research institutions need to make strategic choices toward the forms of transfer that best support their research impact. Therefore, they need to consider these different dimensions and align their transfer activities with those impact dimensions they focus to address (*paper III*). If a research institution, for instance, aims to achieve primarily an economic impact, they should understand transfer basically as the commercialization of research. Commercialization constitutes a prime example for achieving impact as it generates "*immediate, measurable market acceptance for outputs of academic research*" (Markman et al., 2008; Perkmann et al., 2013, p. 423). If, for example, strengthening the local environment is a research institution's main objective of transfer activities, a mere focus on commercialization activities would be too narrow in order to achieve this impact. Having defined their rationale for transfer activities, research institutions need to determine the position of the transfer office that is best suited for achieving these goals–it can be integrated or independent from the research institution (*paper III, see also (3) Activities*). Along these lines and in order to monitor their activities, it is necessary to define what "successful" transfer and academic entrepreneurship means to the research institutions–both at the long- and shorter term. Paper III showed that success of KTT and academic entrepreneurship remained rather diffuse. Without a shared understanding of successful KTT and academic entrepreneurship research institutions can, however, hardly evaluate their actions taken to promote such activities. In addition, paper III showed that when defining their transfer objectives research institutions must consider the necessary resources and match them with their accessible resources (Clarysse et al., 2005; Wright et al., 2008). Fini et al. (2011) showed that in contexts that lack a strong entrepreneurial ecosystem, universities are more likely to achieve an impact through strengthening the ties to industry partners instead of encouraging spin-off creation and start-up policies (*see also (2) Networks: external partnerships*). Research institutions must therefore consider the development stage of their local transfer and innovation ecosystem when defining the rationales of their transfer strategies. Building on these findings, research institutions need to address the following guiding questions in order to define the goals of their transfer strategies:

- ***Goal****: What impact do we want to achieve with technology transfer?*
- ***Performance Indicators****: When do we consider transfer successful?*
- ***Resources****: What resources (e.g no. of employees, expertise, financial resources, fields of research) can we provide to achieve the defined transfer goals?*

7.1.2 Communication

Findings of paper I, II and III indicate that communication is a key factor that can substantially influence scientists' decisions to engage in transfer and entrepreneurial activities and thereby, can either constrain or foster transfer and academic entrepreneurship at research institutions. Research institutions should therefore integrate aspects of internal and external communication procedures into their transfer strategies. Aspects of addressing communication in transfer strategies include defining target groups, communication measures and appropriate communication channels. In order for the transfer activities (*see (4) Actions*) to be successful, scientists must be aware of them–which has shown to not always be the case (*paper I and III*). Such activities therefore have to be well communicated and actively promoted (*paper I and III*). This does not only apply to the internally provided support services, but also includes communication of institutionalized, external support programs–such as governmental funding for academic spin-off creation. When integrating these communication aspects into their transfer strategies, research institutions need to define the target group they aim to address with their communication measures. As shown in paper II, research institutions need to consider the various needs of their target group such as gender aspects and make sure they promote academic entrepreneurship to all scientists to equal parts. In order to reduce gender barriers impacting transfer, identified gender-based constraints (e.g. stereotypes, access to networks, different working models) need to be communicated to transfer managers and university authorities to raise their awareness for the topic (*paper II*). Depending on the desired research impact and the addressees of the communicated measures, findings of paper I and III suggest that transfer offices should interpret "transfer" rather as "translation" among different actors and communicate analogies rather than differences and downsides between academic employment and entrepreneurship. Understanding the needs and perspectives of one another can help establish trust among different actors (*paper III*) and encourage scientists to disclose their inventions to the transfer office or university authorities (*paper III)*. When defining the addressees of the communication measures research institutions should not only consider their academic employees and existing external partners, but should also be aware of other actors in their innovation ecosystem who may be interested in the institution's research and could contribute to enhancing the institution's transfer performance (*paper III*).

Furthermore, research institution should consider integrating their public relations office into the central transfer office or establish closer cooperation among these departments in order to create synergies and foster internal as well as external communication of transfer activities (see also *(5) Networks: organizational infrastructure*).

Guiding questions for developing an institution-specific transfer strategy with regard to appropriate communication styles include:

- ***Target audience:*** *Who do we internally and externally inform about transfer?*
- ***Channels****: What channels do we need to use to reach our target group(s)?*
- ***Partners****: What communication partners help us to broaden communication?*
- ***Internal Interaction:*** *How do our public relations and transfer offices work together?*
- ***Content****: What can we report about transfer projects and spin-off companies? How do we report success stories and learnings from failures?*

7.1.3 Teambuilding

Despite the importance of context factors, it is the individual that has to take the decision to engage in transfer activities such as spin-off creation. To reduce barriers to take that plunge, all four papers revealed the relevance and great potential of setting up highly diverse teams. By combining different disciplines and professional backgrounds from industry and entrepreneurship, scientists have the opportunity to identify with entrepreneurial peers (*paper I*), broaden their access to networks and industry partners (*paper III*) and develop innovative, needs-oriented ideas (*paper IV*). Forming teams and combining professional expertise and access to different networks should therefore be part of a research institution's transfer strategy. Findings of paper II, III and IV indicate that research institutions should recognize the importance of diversity of perspectives to master the complex phenomenon of academic entrepreneurship. At the same time, however, they have to raise the awareness for the different needs that diversity in an institution's personnel comes along with–gender and otherwise (*paper II, III and IV*). Setting up interdisciplinary teams can, furthermore, address the issue that some research disciplines tend to generate more spin-offs than others (Kenney & Patton, 2011) and create opportunities for scientists to identify themselves with entrepreneurial peers and role models. Particularly for academic spin-off creation it is of essential value to set up the right team to provide the necessary team competencies and develop a viable business opportunity (*paper IV*). Paper I and III showed that a possible model to strengthen academic spin-off creation is to provide opportunities to let surrogate entrepreneurs exploit scientific research findings. Such a model–where scientists and entrepreneurs with industry experience jointly work together–would also provide opportunities for scientists to reflect on their working conditions in academia in respect to entrepreneurship.

Beyond the academic level, combining different expertise and backgrounds also applies to the work of transfer managers and institution administrators: in order to find the right transfer personnel, research institution need to establish a well-defined job profile for their TTO personnel, their competencies and responsibilities (*paper III*). These defined job profiles illustrate the importance of highly skilled TTO personnel and its transdisciplinary composition. Therefore, research institutions should deliberately try to set up transdisciplinary teams in their TTOs and hire personnel with either industry/entrepreneurial experience and/or a scientific background. Findings of paper II and III suggest that in order to prevent discrimination on the one hand and allow diverse points of view on the other hand, it deems necessary to establish transdisciplinary, gender-balanced committees and decision-making bodies to decide over patent registrations and support measures for academic founders. By integrating diversity of perspectives into decision making processes, the trend of registering as many patents as possible could be prevented and gender barriers could be reduced.

Summing up, research organizations should consider the following aspects regarding the issue of teambuilding in their transfer strategies:

- ***Diversity:*** *How can we create diversity in research and transfer manager teams–addressing inter-disciplinary, transdisciplinary, gender- and race-balanced backgrounds? How can we describe our transfer managers' job profiles?*
- ***Judgement:*** *What are necessary skills of decision makers and transfer officers to support fair chanced? Are outlined diversity dimension reflected in decision-making bodies (such as patent committees)?*
- ***Role models:*** *How can entrepreneurial scientists become role models for others?*

7.1.4 Actions

All four papers identified relevant actions that help research institutions to overcome potential constraints impacting transfer and academic entrepreneurship. These actions can be divided into two dimensions *(a) initiatives* undertaken by institutions to proactively create new transfer opportunities and *(b) services* supporting scientists who are already engaging in entrepreneurial and transfer activities. As shown in paper III, research institutions provide a wide variety of activities to foster transfer and academic entrepreneurship. The key challenge is, however, to define and establish those activities that best respond to the institution's strategies and scientists' needs (*paper III*). Therefore, research institutions have to make strategic choices toward a selection of transfer forms and activities as well as a strategic decision about the position of the transfer office as either being integrated in or independent from the research institution (*paper III, see also (1) Rationale*).

a. Initiatives: findings suggest that a proactive approach toward transfer and academic entrepreneurship helps research institutions in enhancing the transfer offices' visibility and the general acknowledgement of transfer and academic entrepreneurship and reduces informal technology transfer (*paper I, III and IV*). A proactive behavior toward transfer and academic entrepreneurship includes the active search for technologies and inventions that can potentially become commercialized. Aiming to identify entrepreneurial ideas and to enhance the refinement of such ideas, research institutions could establish "scouts" on campus who regularly meet scientists and get to know their research. These scout should be experts in fields of technology commercialization and/or entrepreneurship and provide elaborated industry experience while also having a minimum amount of knowledge about the respective research field. Technology scouting thereby precedes other transfer initiatives that involve external entrepreneurs–such as for example assigning so-called "surrogate entrepreneurs" to exploit already disclosed inventions (*paper I and III; see also "Teambuilding"*). The advantage of the "surrogate"-model is that research institutions do not have any effort with building the company nor do they lose their employees who become entrepreneurs. Instead, they still hold the inventions' IPR and let other entrepreneurs do the business. Another such proactive initiative can be establishing joint research projects among scientists and entrepreneurs: integrating an entrepreneur's perspective into early stages of research projects can enhance the probability of identifying commercialization opportunities throughout the further research process.

The interaction with entrepreneurs would allow scientists to identify with entrepreneurial peers, reflect on their working conditions and thereby may ultimately change their attitude toward entrepreneurship (*paper I)*. As has been shown in paper IV, integrating design expertise in such joint projects shows particularly great promise for developing entrepreneurial competencies in these transdisciplinary teams. Implementing such joint projects into curricula at the beginning of academic careers–for example at PhD level–may have the biggest impact on scientists' attitudes and future decisions to engage in entrepreneurial activities (*paper I, III and IV*). Similar to the model of surrogate entrepreneurs, research institutions could start cooperating with business schools and offer case studies and research opportunities that MBA students needed to develop commercialization strategies for. Such projects would allow the MBA students–whose expertise is building up businesses–identify business ideas for "real" research findings and create commercialization scenarios that may inspire scientists for future entrepreneurial engagement (*paper I and III*).

Research institutions should address the following questions when defining transfer initiatives in their strategy:

- ***Form of Initiative**: Which initiatives support the defined transfer goals and respond best to the local innovation ecosystem? Which forms of transfer are best suited in order to achieve our transfer goals and defined impact dimension(s)?*
- ***Innovation Scouting**: Do our transfer activities include actively seeking technologies and inventions? To what degree do scientists (actively) share inventions with the transfer office–is the transfer office reliant on the active approach from scientists toward them?*
- ***External Stimulation**: How can cooperation initiate further exploitation of research findings?*

- ***Career Stage**: Do our initiatives address and encourage junior scientists and thereby open up entrepreneurial perspectives at an early stage of an academic career?*

b. Services: in order to reduce potential constraints impacting scientists' decisions to engage in entrepreneurial activities, research institutions need to establish support services that respond to the scientists' needs and are in line with the institutions' transfer goals. Paper III suggests that needs-oriented, specific support measures are more effective in promoting academic entrepreneurship than a wide variety of services that are not aligned to one another and follow the same objective. Training programs, for instance, have proven to promote entrepreneurial learning and thinking (Marion et al., 2015). However, if entrepreneurial education does not lie within the scope of a research institution's transfer rationale it is unlikely to contribute to the defined goals. Despite the fact that every research institution has to establish its individual set of transfer services, findings of paper III indicate some general trends for the establishment of such services. With regard to all offered services, research institutions should re-envision, if they showed gender barriers and motivated women to make use of the offered services. As junior scientists and post-doctoral students typically constitute the majority of a research institution's employees, activities that promote transfer and academic entrepreneurship should therefore particularly address the needs of scientists at an early career stage. These scientists still have to decide which future career path to follow. Such activities would raise their awareness for transfer early in their academic career and can help develop skills and capabilities that are also relevant outside academia. Early support measures may be particularly effective to promote spin-off creation as a valid career option as they may prevent scientists from recognizing entrepreneurship as a "completely different world" (*paper I)*. As has been shown in paper IV, participants particularly appreciated the protected environment that allowed them to freely experiment and further the development of their spin-off ideas. These findings suggest that research institutions should consider establishing such a protected environment that allows scientists to develop and experiment with entrepreneurial ideas and commercialization strategies. It seems to be of particular value to establish such a space–similar to a co-working lab or hub–that is deliberately different from the usual science office in order to help scientists to break out of their routine work. This space can help scientists to think outside the box of their usual daily scientific routine and open up perspectives for transfer solutions. It can serve as a safe environment where scientists can work on entrepreneurial activities without having a bad conscious because they do so in their working time. Simultaneously, this would require research institutions to allow their employees to spend some of their working time on entrepreneurial activities.

It is furthermore a signal that the research institution highly values their scientists' transfer and entrepreneurial engagement. Therefore, it is essential that an institution's higher authorities support and acknowledge this "protected environment"–their commitment is a key aspect of calling this environment protected. The space should be open to every employee of the research institution, so that interdisciplinary teamwork within the institution can be fostered. Such activities can also contribute to the employer branding of the research institution and attract high potentials who would not have considered working in science. They can thereby contribute to fostering an entrepreneurial culture at the institution–in case that is desired and part of the transfer rationale.

Obviously, the introduced initiatives and services do not come without costs. All activities require different amounts of resources by the research institution. Again, the commitment of a research institution's highest authorities to such investments is pivotal for these activities to be sustainable.

When defining their transfer strategies, research institutions should address the following guiding questions concerning the offered support services*:*

- ***Form of Service***: *What services support our transfer goals and thereby help to achieve the defined impact dimension(s)?*
- ***Target group(s)****: Who are the addressees of our provided support services? How can we provide equal access to men and women and scientists at different career stages?*
- ***Integration****: How can we provide services to external parties?*
- ***Transfer office****: Which position best supports the transfer office to achieve the defined rationale – an independent or integrated type? When is the transfer office considered to be successful?*

7.1.5 Networks

All four studies revealed the pivotal role of well-established networks in order to reduce constraints impacting transfer and academic entrepreneurship. Networks are important on two different levels: (*a) the organizational infrastructure* referring to internal organizational mechanisms and processes and *(b) external partnerships* to industry and the regional environment. With regard to the individual-organizational level nexus, both the individuals with their skills and personal contacts as well as the organization with established cooperation partners contribute to building a strong organizational transfer infrastructure and external partnerships.

a. Organizational infrastructure: with regard to the individual level, all four empirical studies reveal the necessity of personal contact among different actors within the institution–for both scientists and transfer managers. Research institutions need to provide their scientists with access to networks–and deliberately address male and female scientists and different research disciplines–in order to foster transfer and particularly academic entrepreneurship (*paper I, II and III)*. In order to provide opportunities to identify with entrepreneurial peers, research institutions need to strengthen the connections among those scientists that frequently engage in entrepreneurial activities and scientists that have not been involved in such activities (*paper I*). Inter- and transdisciplinary teamwork in research projects can facilitate such an exchange among experienced scientific entrepreneurs and unexperienced (junior) scientists (*paper I, II, III and IV; see also (6) Teambuilding*).

On the organizational level, research institutions should aim to concentrate all transfer activities in a single unit in order to create synergies and to optimally exploit existing technologies and inventions. By uniting all transfer activities in a central transfer head-unit, a transfer office's overall visibility can be enhanced as it would gain size and scope (*paper III*). Additionally, the integration of a research institution's public relations department into the transfer office can contribute to create further synergies and strengthen internal and external communication of transfer activities. Despite the presented potential of a transfer head-office, findings show that simultaneously research institutions should follow an additional decentralized approach: aiming to foster internal cooperation among the transfer office and scientific departments, research institutions should consider establishing mandatory, monthly meetings between transfer managers and department authorities. Such meetings can help strengthen the ties among the transfer office and the departments, establish trust and promote the visibility of the transfer office and its activities (*paper I and III*). In addition to these meetings, research institutions should consider establishing a local transfer unit or at least a single responsible transfer manager at each research department/institute. The mere presence of such a local unit/manager can help raising the awareness for transfer, which holds particularly true for large research institutions where scientists are often not aware of existing support mechanisms or do not know the right persons to contact (*see also (4) Communication*). Such local units/managers would act as promotors for transfer activities and stay in close contact to the respective scientists. Thereby, they would be better aware of inventions that may potentially become commercialized (*see also (3) Activities: Technology scouting*; *paper I and III*). Along these lines, *paper III and IV* revealed the importance of certain guidance during spin-off processes through regular face-to-face meetings and (direct) personal support for scientists who are engaging in such activities. A decentralized, personal management style allows the transfer managers to align support measures more closely to the individual needs of the scientists (Debackere & Veugelers, 2005; Siegel & Wright, 2015a). This suggested combination of decentralized (smaller) local transfer offices in addition to a (larger) central transfer office that manages and monitors all different transfer activities seems particularly important for large research institutions that consist of many different and locally-spread institutes and departments.

Guiding questions that should be addressed when aiming to foster the organizational transfer infrastructure include:

- ***Internal Partners:*** *Who is internally involved in transfer activities, who is responsible?*
- ***Knowledge Sharing:*** *What internal transfer experience can we share with equal access for diverse audiences? How can we establish interaction among transfer managers and research department authorities on a regular basis? How can we facilitate organizational learning processes–among transfer managers, scientists and university authorities?*
- ***Cross-department Interaction:*** *How can we foster the exchange among relevant actors involved in transfer processes–such as scientists and entrepreneurial peers from different research fields,*

transfer managers and PR managers? Do we have at least one transfer manager at every research department who acts as transfer promotor and is physically present at a regular basis?

b. External partnerships: at the individual level, industry experience and close relations to industry partners have shown to enhance the scientists' propensity to engage in entrepreneurial activities (*paper I and III*). By providing access to such partners and to entrepreneurs, research institutions can reduce the scientists' lack of market and industry experience and provide opportunities for them to identify with entrepreneurial peers (*paper I and II*). As some research disciplines tend to have stronger networks to industry experts (Mosey & Wright, 2007) and women tend to have less access to networks (*paper II*), research institutions need to approach this imbalance and deliberately support those scientists with fewer industry contact.

With regard to the TTOs personnel, research institutions should hire transfer managers that provide access to external partners and complement its existing partnership portfolio (*paper III*). Transfer managers with former industry experience and strong ties to venture capitalists and entrepreneurs are better able to "translate" between the two worlds of academia and industry and to identify opportunities for commercialization (*paper I and III*). At the organizational level, it has been proven that research organizations with long-term cooperation to industry partners (e.g. labs that are financed by industry) tend to perform better at entrepreneurial activities. By starting cooperation with external partners (industry, research and development departments, intermediary agencies), research institutions can get access to industry expertise and market knowledge that complement their research portfolio. Again, considering the development stage and characteristics of the regional innovation ecosystem is of particular importance when identifying and approaching external partners (*see (1) Rationale for Transfer, paper III*). Strategic, long-term partnerships among different actors in the innovation system gain increasing relevance in order for them to be innovative (Commission of Experts for Research and Innovation [EFI], 2017, pp. 57–61). Research institutions should therefore put effort in identifying those (few) partners that complement their research fields and establish partnerships where both partners benefit from long-term cooperation. Such strategic partnerships help creating trust among the actors, which has proven to facilitate transfer activities (*paper III*). In order to strengthen the ties to the partner companies, the involved organizations should consider different employment models that allow researchers to both work in industry and academia. Such employment models include traditional internships, researcher mobility (e.g. time-limited exchange programs) or flexible solutions that allow scientists to work part-time in academia and industry. When implementing such flexible part-time models, the individual needs of the scientists, research institutions and industry companies have to be taken into account. Considering only large companies as long-term partners may be too narrow, as it has been shown that other actors such as start-ups, incubators and business consultancies gain more importance within the transfer and innovation ecosystem (EFI, 2017; Stifterverband für die Deutsche Wissenschaft, 2017) (*see also (3) Activities*). Besides such industry partners, research institutions should also consider establishing cooperation to technology parks and create opportunities for the society to contribute and participate in research projects (*paper I and III*). Thereby, research institution can strengthen multidirectional knowledge flows and produce forms of innovation that are driven by public needs and are thus more likely to be valued by the public (*paper I*). Interactions with the public can help scientists to identify market needs and thus open their perspectives to entrepreneurial activities and business ideas (*paper I*).

Questions that should be addressed in order to establish networks to external partners and strengthen the research institutions' position in the (regional) ecosystem include:

- ***Fitting Partners:*** *Which industry partners complement our transfer goals and thereby help us achieve our defined impact (with respect to long-term strategic partnerships)? How can these partners benefit from cooperation?*
- ***Partner Management:*** *Who manages contacts to these partners–scientists, department authorities or transfer managers?*
- ***Ecosystem:*** *How can we benefit from and develop the local innovation ecosystem (consider ecosystem characteristics)?*
- ***Exchange:*** *How can we establish flexible employment models and exchange programs for industrial exchange–that go beyond internships?*
- ***Knowledge Exchange:*** *What opportunities do we provide for the public (entrepreneurs, societal agencies, political bodies) to contribute to and stimulate our research thereby allowing external experts to identify entrepreneurial ideas? Do our transfer managers provide industry experience and contacts to industry partners? How can we encourage our researches to reflect on working conditions in academia and entrepreneurship?*

7.1.6 Incentive systems

As shown in paper I, II and III, missing incentives and a lack of acknowledgement for entrepreneurial activities lower the scientists' propensity to engage in transfer activities. Findings of paper I and III suggest to consider scientists' engagement in transfer activities as criteria for career promotion and tenure. Paper II shows that establishing gender-sensitive incentive schemes relating to promotion, tenure or remuneration can reduce gender barriers in academic entrepreneurship. Paper II and III showed that an essential constraint impacting scientists' engagement in transfer activities is the lack of the department head's support for such activities as they fear to lose their best researchers. In order to overcome this constraint, research institutions should establish incentives that address the needs of the department heads by rewarding his/her department for its entrepreneurial performance. Besides monetary and career-related incentives, the transparent commitment of an institution's highest authorities, individual department heads and research group leaders toward transfer and academic entrepreneurship is critical to establish a transfer-friendly culture. At the same time, this top-down approach has to meet a bottom-up movement by the individual researchers to conduct transfer and entrepreneurial activities. Incentives are one lever that can help foster such bottom-up movement. Besides addressing the needs of scientists and their department heads, paper III suggests to also establish (monetary) incentives for the TTO personnel in order to increase the value of the job profile and to reward their performances. The introduction of such incentive schemes may lower the risk of not finding suitable personnel (*paper III*).

Guiding questions that should be addressed in transfer strategies are:

- ***Reward:*** *How do we reward scientists, their department heads and transfer managers for transfer engagement?*
- ***Implementation:*** *How do we implement transparent reward systems and raise awareness for them?*
- ***Career Development:*** *How is entrepreneurial engagement represented in scientific career tracks? How can we raise awareness for transfer engagement early in a scientific career? Do our incentive schemes address different dimensions–such as remuneration, career-relation and acknowledgement?*

7.1.7 Summary

All of the six presented elements contribute to establishing a transfer-friendly organizational culture at research institutions. The culture of an organization substantially influences its members' behaviors (Schein, 2010). According to Schein's model (1985) an organizational culture is characterized by the interplay between factors on three different levels that are all intertwined: (1) artefacts, (2) norms and values and (3) basic assumptions. While the artifacts-level can be deliberately created by the institution as it contains visible symbols and practices, the other two levels can only be indirectly addressed by the organization. Shared organizational norms and values are less visible as they are expressed by the behaviors within the organization. Ultimately, the bottom level comprises underlying basic ideologies that are prevalent at the organization but remain largely invisible as most of the organizations' members are not even aware of them. Changes in these subconscious assumptions can only be achieved indirectly and in a long-term period. To encourage scientists to embrace transfer activities and integrate transfer in the organizational culture, transfer strategies need to address all three levels and initiate change toward transfer-friendly cultures. While the presented dimensions *Activities, Communication and Incentives* directly contribute to establish visible transfer-friendly artefacts, the other dimensions, namely *Rationale, Networks and Teambuilding*, influence organizational norms and values rather indirectly. The bottom level can only be addressed through gradual changes on both the above levels. The relation between strategy selection and culture is, however, bidirectional. Not only does the transfer strategy influence the organizational culture, strategy selection is, in return, partially influenced by the culture of individual universities (Grimaldi et al., 2011, p. 1047).

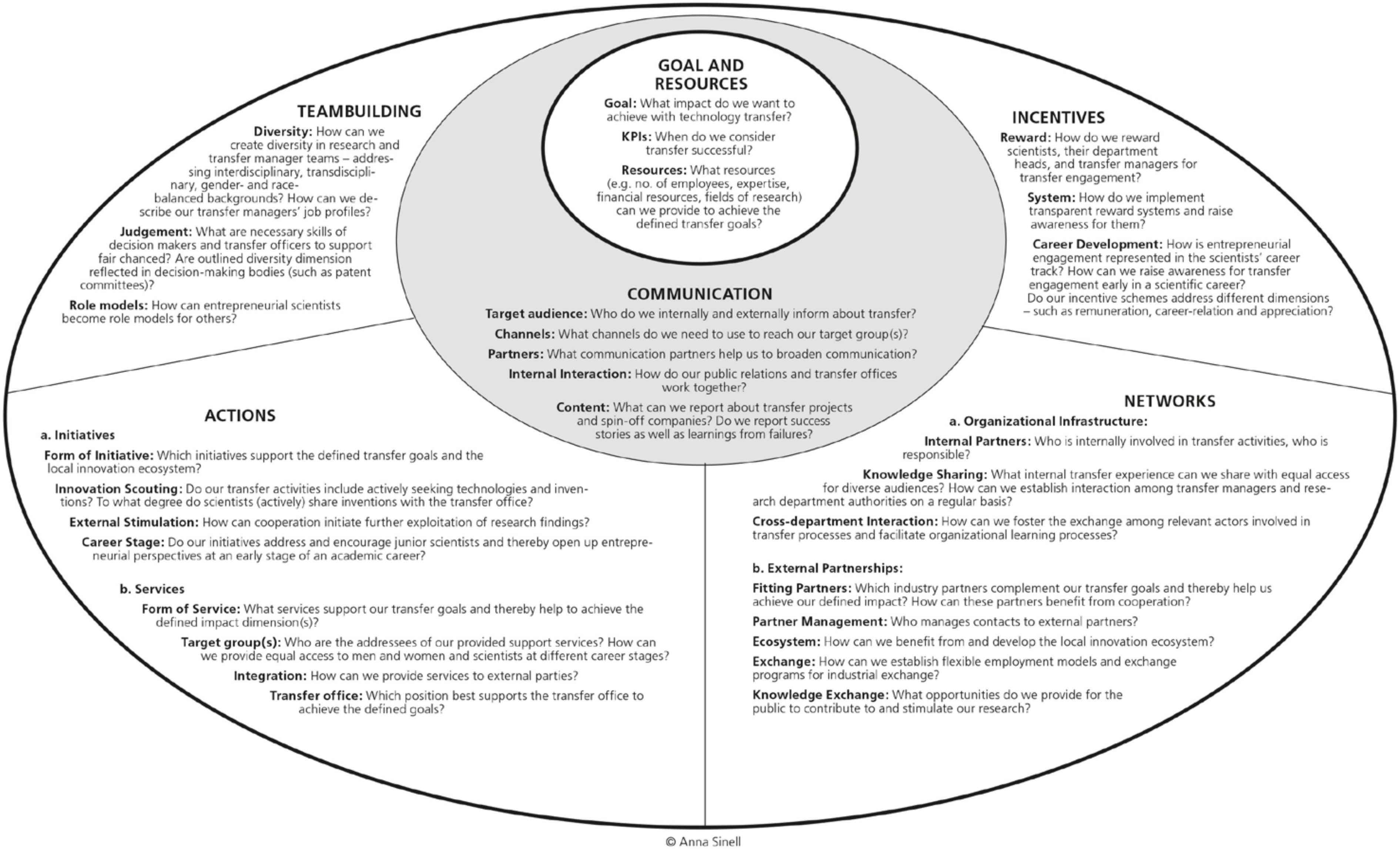


Figure 5. *The **Transfer Strategy Framework**: guidelines on creating individual, needs-oriented transfer strategies.*

7.2 Limitations

Given the complexity and dynamism of the phenomena KTT and academic entrepreneurship, this thesis can only contribute to the burgeoning literature on the topic and shed some light on the interwoven structures and influencing factors in a field where multiple agents are involved. As has been pointed out, this thesis sets a particular focus on academic entrepreneurship and spin-off creation in particular. This focus thereby, limits to some extent the overall explanatory power of the derived recommendations and developed template as not all mechanisms of knowledge and technology transfer have been analyzed equally. Further limitations of this thesis will be discussed following five guiding questions with regard to the applied methods, data base and research approach. The majority of these issues will be taken up in the following future research-section (chapter 7.3.1).

Is the focus on a qualitative research approach justified for the analysis of the complex phenomenon of transfer and academic entrepreneurship? As has been pointed out in chapter 3, the majority of research on transfer and academic has been quantitative in nature (Grimaldi et al., 2011; Perkmann et al., 2015). Therefore, a qualitative approach was chosen to analyze underlying assumptions and invisible constraints impacting transfer and academic entrepreneurship at research institutions in closer detail. A qualitative approach has been found to be best suited for such in-depth analysis (Bruni et al., 2005; Murray & Graham, 2007). However, the lack of quantitative can data reduce the explanatory power of this thesis. Additional quantitative analyses could enhance methodological triangulation and the validity of the findings (Flick, 2008; Johnson & Onwuegbuzie, 2004). Paper I and III would particularly benefit from additional quantitative analysis. Paper I conducted qualitative interviews with 112 postdoctoral students in order to explore similarities and differences between academic employment and entrepreneurship. An additional quantitative online survey with postdocs of the analyzed four non-university research organizations would contribute to a more comprehensive database. Such a survey would allow for the statistical analysis of gender differences and otherwise (e.g. differences among research disciplines, basic and applied sciences and others) with regard to attitudes toward academic entrepreneurship, career perspectives and engagement in transfer activities (see also chapter 7.3.1). As in Paper I, an additional quantitative analysis could substantially contribute to enhancing the explanatory power of the research finding of paper III. An online survey that explores the entrepreneurial intentions and the engagement in transfer activities of scientists employed by the analyzed research institutions would help shed light on the correlation between the organizations' transfer activities and the scientists' actual transfer engagement. Such a research design combining qualitative interviews with transfer managers and a quantitative survey with scientists have been applied in the analysis of academic entrepreneurship (Huyghe & Knockaert, 2015a). However, the interviews in such studies have typically been conducted for informative reasons to serve as the basis for the developed online surveys. They have therefore not been qualitatively analyzed applying methods of the social sciences.

In addition to methodological triangulation, data triangulation could be enhanced with research designs that included the analysis of control groups. Paper IV would particularly benefit from a research design that included the analysis of control groups. The paper analyzes the role of design in academic founding teams and suggests that the integration of design expertise in such teams furthers the evolution of entrepreneurial competencies.

However, the paper only analyzed founding teams that comprise design expertise. A research design that allows to compare such teams with a control group that lacks such expertise can significantly strengthen the explanatory power of the study. Paper III analyzed the strategies and operations of particularly productive transfer offices in five different countries in order to account for their high levels of transfer activity. Again, a randomized control group of transfer offices that do not show such high levels of transfer productivity in the respective countries can substantially contribute to enhanced explanatory power of the study.

Why are the constructs transfer, academic entrepreneurship and academic spin-off creation always addressed together? Would a stronger differentiation between the two constructs contribute to a better understanding of their underlying mechanisms? As has been outlined in the definitions-section (chapter 2), in cases when I relate to "transfer and academic entrepreneurship", the statements hold true for the broader construct of transfer and its commercialization dimension (academic entrepreneurship) in particular. However, the fact that the constructs "transfer" and "academic entrepreneurship" are often analyzed and mostly addressed together limits the explanatory power this analysis. The managerial implications of the thesis are to some extent limited to foster commercialization and academic spin-off creation in particular. A stronger and more consistent differentiation between the construct could further the informative value of underlying mechanisms that help explain their complexity. This combination of the two construct can be explained by the fact that existing research and the empirical analysis has shown that academic entrepreneurship is always embedded in the broader context of the overall transfer activities of a research institution. This constrains the differentiation of the transfer construct into single aspects that can be analyzed separately. Additionally, the four empirical papers included in this thesis followed slightly different research foci. While paper I and IV particularly analyzed academic spin-off creation as a form of academic entrepreneurship, paper II and III analyzed transfer processes in general, however, still addressing aspects of academic entrepreneurship. The joint analysis of all four papers with regard to the research questions of the thesis revealed that academic entrepreneurship is an integral part of knowledge and technology transfer. This was reinforced by the fact that the related literature provided differing definitions of the two constructs as the terms are often used synonymously or under the broader understanding of third stream activities. Furthermore, the empirical data showed that a common understanding of these constructs was not prevalent at the research institutions under study. In fact, the transfer managers sometimes varied widely in their understandings what transfer and academic entrepreneurship means to them and their institutions. A clear focus on a particular aspect of transfer such as only commercialization activities could enhance the in-depth findings of the study. However, it was a deliberate decision to analyze academic entrepreneurship as part of the broader construct "knowledge and technology transfer" in order to assess related aspects more comprehensively. Potential uncertainties that come along with this open approach were therefore accepted. With regard to the claim of an holistic analysis, it has been noticed that other transfer mechanisms such as publications in scientific journals, daily press or magazines, science blogs, open doors, science days, contributions to radio or television or participatory research events have not been analyzed in this thesis. These mechanisms, however, also constitute highly relevant transfer processes to the public. This constitutes another main limitation of the research findings.

Does the sample under study provide relevant diversity aspects in order to derive a universally applicable transfer strategy framework for research institutions? The majority of the empirical data of this thesis is gathered in the context of non-university public research organizations. Private universities or universities of applied sciences ("Fachhochschulen") have not been under study, which limits the explanatory power of this thesis substantially. As has been shown by previous studies (Grimaldi et al., 2011; Siegel & Wright, 2015b), strategies and support mechanisms that help strengthening transfer performances of some universities cannot just be applied at other universities that may have different contextual settings. To take into account the different context factors, future studies could analyze how the institutional settings of university and non-university public research institutions differ from one another and influence their transfer activities. In this regard, future research could analyze differences in transfer activities of research institutions that have the obligation to teach and educate students (such as university and higher education institutions) and those that have a pure research focus (non-university research institution such as the Fraunhofer- or Helmholtz-Society in Germany).

As has already been pointed out with regard to enhancing data triangulation, the four studies did not analyze low-performing research institutions. Instead, paper III focused on best practice approaches in order to identify underlying mechanisms that account for the high levels of transfer productivity of research institutions. However, an analysis of the challenges and constraints impacting academic entrepreneurship at research institutions that show particularly low levels of transfer productivity could add substantial value to the explanation of the transfer and academic entrepreneurship, thereby contributing to the explanatory power of this thesis.

Besides institutional settings, similarities and differences in challenges and constraints impacting academic entrepreneurship at research institutions in different research disciplines has not been explicitly analyzed in this thesis. Research, however, suggests that a single policy may not fit to the various co-existing disciplinary science departments at a research institution (Grimaldi et al., 2011). Only paper I indicates that scientists of the applied sciences tend to consider academic spin-off creation as a valid career option more often than scientists from basic science disciplines. As pointed out, inter- and transdisciplinary composition of research teams can help to bridge this gap and reduce such differences, thereby fostering the transfer of research findings to the public (Jong, Wardenaar, & Horlings, 2016). However, this thesis analyzed transdisciplinary team work just in the context of spin-off creation and not with regard to other transfer mechanisms, which limits the scope of the findings. A closer analysis of similarities and differences in constraints impacting scientists' engagement in transfer activities in different research disciplines would substantially contribute to enhance the explanatory power of this thesis.

Do all empirical papers included in this thesis address the individual-organizational level nexus as has been argued with regard to the analytical approach? Despite claims otherwise, the four papers do not follow a research approach that analyzes constraints impacting transfer solely on the individual-organizational level nexus. The foci of all four studies lie on the nexus of the individual-organizational level, however, other factors that may influence transfer and academic entrepreneurship and on the system-level are not controlled for. As has been pointed out, transfer is a multidirectional process with multiple actors being involved (Carayannis & Campbell, 2009; Ranga & Etzkowitz, 2013b; Siegel & Wright, 2015a). Therefore, characteristics of the innovation ecosystem have to be taken into account in the analysis of transfer strategies and operations that lie outside the individual-organizational level nexus. The claim of this thesis to analyze constraints impacting transfer and academic entrepreneurship only on this nexus is thereby limited. The findings showed that some of the identified constraints address the system-level as they include cultural stereotypes, IP-laws and regulations, traditional norms and values in the science systems and national funding programs (paper I, II and III). The aspect of two differing logics within the two worlds of academia and entrepreneurship is just one example for a substantial constraint impacting spin-off creation on the system-level (paper I). This can limit the explanatory power of the studies with respect to in-depth analysis regarding organizational constraints only. At the same time, it once more indicates the complexity of transfer in an innovation system with multiple stakeholders involved (Carayannis & Campbell, 2009; Siegel & Wright, 2015a).

Has the application of the developed template been tested or validated by experts in the fields of knowledge and technology transfer and academic entrepreneurship? The developed transfer strategy template has not been evaluated by transfer practitioners, yet, which limits to a certain extent the scope of the findings. The perspectives of experts on the usability and comprehensiveness of the developed management tool would add significant value to it. The derived key elements of the framework are mainly based on explorative analyses. No claim is therefore made that these elements are exhaustive. In order to enhance validity of the findings, focus groups with transfer managers and/or university authorities who are the addressees of the Transfer Strategy Framework could be conducted to discuss potential challenges and benefits of the template. The template can therefore be seen as a first version of such a management tool that helps research institutions in defining their specific transfer strategies and allows for further development. The integration of diverse perspectives into the further evaluation process can substantially contribute to further the comprehensiveness of the template. To this end, the following diversity aspects should be included in the evaluation and validation process: transfer managers with different educational and technical background (e.g. industry and/or science background, different research fields), authorities from universities and non-university research organizations, transfer managers from different countries, different innovation ecosystems and different types of transfer offices. Ultimately, institution authorities of research institutions from different research fields (basic- and applied sciences) and a wide variety in terms of their transfer performance should be included in the furthering of the template.

7.3 Future research

With their increasing relevance, transfer and academic entrepreneurship have come of age and scholars "*are no longer debating how it should be defined, and whether it is important, but should focus upon how best to investigate, analyze and share how technology entrepreneurship can be encouraged across the myriad of international regions and universities that seek to do so*" (Mosey et al., 2016, p. 7). This thesis shed light on constraints impacting transfer and academic entrepreneurship at research institutions and identified organizational practices and strategies that help in reducing such constraints. Simultaneously, the findings indicate need for further research on the topic. I will structure these research implications along the analytical framework introduced above (chapter 2.2). Despite the fact that all three levels are intertwined, I differentiate between these levels and discuss future research aspects with regard to the level they are associated with the strongest.

7.3.1 System level

The findings of this thesis reveal the importance of taking into account the specific characteristics of the innovation ecosystems the research institutions are embedded in. Findings of this thesis reinforce the importance of transfer offices as an intermediary to foster the exchange between the actors involved in innovation and transfer processes on the organizational level. However, further research is needed on the role of other intermediary agencies on the system-level. What TTOs are on a smaller scale, research-science-technology (r-s-t) parks constitute on the system-level (Link & Scott, 2015). Those r-s-t parks enable interactions among different actors from science, industry and policy, thereby furthering multidirectional knowledge flows. Their role in national innovation systems and regional ecosystems have not been under detailed study up to now (Link & Scott, 2015). With regard to the fact that multiple actors become involved in innovation processes it could be analyzed how the integration of such diverse stakeholders can promote social entrepreneurship as an emerging new form of academic entrepreneurship (Siegel & Wright, 2015a). In this regard and building on existing studies on the effects of participatory research projects (Jørgensen, Jørgensen, & Clausen, 2009; Stilgoe, Lock, & Wilsdon, 2014), it could be analyzed if stronger participation of public agents (such as unions, schools or associations) in research projects foster the development of social businesses as it has been shown that it enhances socially relevant innovation (Heidingsfelder, Kimpel, Best, & Schraudner, 2015; Jong et al., 2016).

This thesis outlined that in order to explain the researchers' engagement in transfer activities, the institutional contexts of research organizations have to be taken into account. Investigating such institutional settings, previous studies have analyzed the multi-faceted role of universities in transferring academic knowledge to industry and society (Bishop et al., 2011; Fini et al., 2017; Lester, 2005; Rothaermel et al., 2007; Wright et al., 2008). Other academic actors such as non-university research organizations and their specific institutional settings have been neglected so far (Perkmann et al., 2013). Future research could address this gap more precisely and analyze the institutional environment of public non-university research organizations and its researchers' engagement in transfer activities as compared to public universities. A case-study approach would be best suited for such an analysis to explore potential differences and derive propositions for further analysis. Specific aspects of these institutional settings that could be addressed in future research include the funding structure of the institution (fully- and partially-funded), its teaching responsibilities and research focus (basic science and more applied science institutions such as Max-Planck-Society and Fraunhofer-Society).

In summary, this thesis proposes future research analyzing transfer on a system-level with regard to the following aspects: (1) role of science and technology parks in innovation ecosystems, (2) enhancement of social entrepreneurship through the integration of different (societal) actors in innovation procedures and (3) influences of institutional regulations on transfer at different research institutions (with regard to teaching responsibilities and funding structures).

7.3.2 Organizational level

Most research that aims to identify success factors for academic entrepreneurship at research institutions has focused on the analysis of best practice approaches and high-performing transfer offices as units of analysis. This thesis identifies constraints impacting academic entrepreneurship at research institutions in general–not limited to a particular form of research institution. Findings on organizational practices that help reduce such constraints, however, mainly stem from the analysis of highly productive transfer offices and research institution. As has been pointed out in the limitations-chapter, there is need for future research analyzing organizational structures and practices of low-performing transfer offices as well as research institutions that show low levels of transfer productivity.

Findings of the thesis indicate first insights on differences of constraints impacting transfer and academic entrepreneurship in different research disciplines–particularly basic and applied sciences–and the potential of inter- and transdisciplinary team work to reduce such constraints. However, these findings are far from comprehensive. In-depth analysis of different organizational cultures (e.g. norms, traditions, history), institutional challenges (e.g. lack of resources, industry contacts) and individual characteristics (e.g. skills, gender) could add significant value to understand disciplinary constraints impacting transfer in the respective research fields. Qualitative case studies would be best suited for such an analysis as they allow to identify underlying mechanisms and basic assumptions that are prevalent at the different research departments (Flick, 2011; Lamnek, 2008).

As has been pointed out, every research institution needs a well-defined transfer strategy that responds to its specific needs and contexts (Grimaldi et al., 2011; Link et al., 2007; Mosey et al., 2016; Siegel & Wright, 2015a). With the developed template, I aim to provide recommendations for research institutions that help them define their individual transfer strategies. However, transfer constitutes just one of a research institution's main responsibilities in addition to the traditional ones of conducting research and providing education. Clearly, research institutions must also make strategic choices toward these responsibilities. Future research could investigate how aspects of all three responsibilities can be integrated into the overall strategic orientation of a research institution. Particularly the nexus between education and transfer–such as student entrepreneurship–has not been well studied up to now (Siegel & Wright, 2015a). In this regard the introduction of entrepreneurial education programs and its effects on the entrepreneurial attitudes of students as well as scientists could be analyzed by future studies. Also, further research is needed that investigates whether entrepreneurial education programs can impact organizational cultures at research institutions and thereby induce higher levels of sensitivity toward academic entrepreneurship.

Summing up, this thesis proses future research analyzing transfer and academic entrepreneurship on the organizational level with regard to the following aspects: (1) organizational structures and practices of low-performing TTOs and research institutions (also in context of fragmented innovation ecosystems), (2) constraints impacting transfer and academic entrepreneurship in different research disciplines (particularly organizational cultures) and (3) the integration of transfer strategies into the overall strategic orientation of a research institution (particularly the education-transfer nexus).

7.3.3 Individual Level

Findings of this thesis contribute to shedding light on the integration of diversity aspects in knowledge and technology transfer. The thesis showed that research on gender aspects in transfer and academic entrepreneurship in particular remains very rare. Analyzing the literature on gender and entrepreneurship in the time period of 1979-2016, Link and Strong (2016) only identified eight studies that addressed gender aspects in academic spin-off creation as a particular form of entrepreneurship and have been cited at least 25 times. Studies on gender and academic spin-off creation has been mainly quantitative in nature, indicating the under-representation of women in this field (Abreu & Grinevich, 2013, 2014; Perkmann et al., 2013; Rosa & Dawson, 2006; Treanor & Henry, 2010). The most comprehensive study up to now has been conducted by Abreu and Grinevich (2016) who analyzed determinants for the gender gap in academic entrepreneurship. To this end, they conducted a survey with 22.000 academics across higher education institutions in the UK. Their analysis showed that the following determinants explain the lower participation of women in academic entrepreneurship: women are more likely "*to be involved in applied research, to more junior positions, to work in the health sciences, social sciences, humanities and education, to have less prior experience of running a business, and to feel more ambivalent about research commercialization*" (Abreu & Grinevich, 2016, p. 1). Analysis of gender and academic entrepreneurship that can help explain these "ambivalent" attitudes toward research commercialization is lacking up to now. A qualitative approach would be best suited for such in-depth analysis and could reveal insights into decision-making processes and motivations to participate in the commercialization of science (Bruni et al., 2005; Murray & Graham, 2007). Research on gender and entrepreneurship in general has shown that women tend to apply business and growth strategies that are rather stable and show smaller growth rates that, however, provide sustainable economic success (Dalborg, Friedrichs, & Wincent, 2012; Lauxen-Ulbrich & Leicht, 2005). Building on these findings, future research could analyze if female scientists apply similar growth strategies and business ideas to their spin-off ideas. Such analysis could contribute to deriving propositions about female participation in spin-off creation and the potential diversification of business models and market orientations. Conducting such research, however, poses a non-trivial challenge as it relies on the identification of a suitable sample of experienced female academic entrepreneurs who are still very rare. Research questions that could be addressed in future research include: does female participation in academic entrepreneurship lead to different transfer outputs in terms of business models, addressed target groups, market needs and offered services? What motivations drive female scientists who engage in entrepreneurial activities? Do men and women differ in their incentive schemes with regard to entrepreneurial activities?

As has been pointed out with regard to future research at the organizational level, this thesis contributes to identifying constraints impacting transfer and academic entrepreneurship in different research disciplines. These findings are again far from being comprehensive. Existing research on academic entrepreneurship has to a large degree focused on technology-related fields such as biomedical sciences, engineering, physical sciences, mathematics and statistics (Grimaldi et al., 2011). Research on academic entrepreneurship in the arts, social sciences and humanities remains very rare up to now (Abreu & Grinevich, 2016). However, in times when innovation is not only based on research and development but occurs at the interface between different disciplines with multiple actors being involved, there is need for future research on how academic entrepreneurship can be fostered in these non-technological disciplines. Findings of this thesis suggest that interdisciplinary cooperation among research institutions/departments from these technological and non-technological fields can help reducing constraints, thereby furthering academic entrepreneurship. However, further research is needed on forms of cooperation among the institutions and characteristics of the outcomes of such cooperation. The analysis of academic entrepreneurship in these non-technological research disciplines where women tend to be overrepresented can also contribute to better "*explaining the choices of female academics [in spin-off creation], and their resulting career outcomes.*" (Abreu & Grinevich, 2016, p. 2). With regard to the integration of interdisciplinary diversity in spin-off processes, future research could analyze if and how such diversity of perspective can contribute to enhancing needs-orientation in such processes and lead to more socially-relevant spin-off venturing. Siegel and Wright (2015a) propose that social entrepreneurship is a new emerging form of academic entrepreneurship and that appreciation of the different needs and of commercial and social ventures is required. Research on antecedents and consequences as well as different types of support measures of this particular form still lags behind and requires further investigation (Mair, Battilana, & Cardenas, 2012).

Ultimately, with regard to individual scientists' characteristics findings of this thesis suggest that senior and junior scientists differ in their needs and motivations toward academic entrepreneurship and therefore need different support programs and incentive schemes. However, the precise differences in their needs has not been analyzed so far. Such an analysis could provide valuable insights on how research institutions had to adapt their support programs to the different generations and help to reduce conflicts within research teams that heterogeneous in terms of age and seniority.

In summary, this thesis suggests additional research on academic entrepreneurship at the individual level with regard to the following aspects: (1) gender aspects in academic spin-off creation (e.g. motivation, business models, barriers, incentives), (2) constraints impacting scientists' decisions to engage in transfer and academic entrepreneurship in different research disciplines and (3) differences with regard to needs and motivations between junior and senior scientists.

7.3.4 Methodologically

Longitudinal studies analyzing the impact and dynamic development of transfer activities and academic entrepreneurship at European research institutions remain very rare. Numbers and statistics on academic spin-off creation are particularly hard to gather. In the US, the annual survey on licensing activity by the Association of University Transfer Managers (AUTM) constitutes a unique database with information on numbers of invention disclosures, patent applications, newly founded spin-offs, new products and the generated revenue through licensing deals based on these new products (AUTM, 2005).

Such a systematic collection of commercialization data is missing in Germany–and in Europe on a cross-national level. Data on spin-off characteristics is particularly scarce. Such data should include information on the share of academic spin-offs on a country's total number of start-ups, founding-team characteristics such as educational backgrounds and gender, performance of these spin-offs in term of growth and life cycle, business ideas and models. This lack of systematic data may be explained by the fact that there is no consistent definition or shared understanding of academic spin-offs in Europe and Germany. While some universities include student entrepreneurship (such as EXIST I-funded start-ups) as university spin-offs, other research institutions follow a narrower definition and state that either a scientist of the organization had to be involved or the spin-off had to be based on the research institution's IP. This might just be one explanation for the wide variance in amount of university-based spin-offs among the institutions. Establishing such a cross-level database can significantly enhance the transparency of the research institutions' transfer productivity and allow for different kinds of analyses. Such a database would for example allow for the statistical and longitudinal analyses of gender and disciplinary diversity among spin-off projects. In this regard, it could be analyzed if female-led academic spin-offs show rather small, but stable growth rates as has been shown for general female-founded businesses (Dalborg et al., 2012; Reichborn-Kjennerud & Svare, 2014). In general, such a database would make female participation in spin-off projects actually visible (and thereby provide role models for other female academics) and allow for the analysis of long-term trends. Besides gender diversity, such a database would allow for the analysis of inter- and transdisciplinary diversity in spin-off teams. There have been studies suggesting that such disciplinary diversity is crucial for a spin-off's success, however, reliable, longitudinal, statistical data investigating such effects is missing. Such a database would provide the actual number of interdisciplinary spin-off teams as a share of all spin-off projects.

Besides these micro-level analyses, influences of the macro-economic situation of a country could be better addressed with such a cross-national, longitudinal database. As has been shown by previous studies, the economic situation and conditions on the labor market influence self-employment and venturing rates (Singer, Amorós, & Arreola, 2014). In labor markets with a high share of unemployment, venturing rates tend to be significantly higher. However, such businesses are more likely to be founded by necessity founders who do not face any other opportunity than either being unemployment or self-employment. However, up to now, data on macro-economic influences on the entrepreneurial attitudes of scientists is scarce (Göktepe-Hultén, 2008). Obviously, establishing such a comprehensive database does not come without costs and most likely relies on public funding by the government. The quality of such a database always relies on the data that research institutions provide it with. This in turn means for research institutions to start gathering comprehensive information about their spin-off projects, which would require additional resources and work that they might not be willing to invest in. In Germany, the "Gründungsradar" by Stifterverband (Grave, Hetze, & Kanig, 2017) is a first step toward establishing such a database, however, it is far from being comprehensive and analyzes a different target group (student entrepreneurship) than suggested by this thesis.

With its High-Tech Strategy, the German Federal Ministry of Education and Research (BMBF, 2014) aims to establish a culture, in which transfer activities receive appropriate acknowledgement and appreciation. Comprehensive–quantitative and longitudinal–

data on the scientists' attitudes toward transfer and particularly the commercialization of research is scarce. An online survey addressing a large, representative sample of scientists in Germany (including institutional characteristics such as universities with different research foci, different forms of research institutions, and individual scientists' characteristics such as different disciplines and gender) could provide such data and thereby allow for the analysis of changes in the entrepreneurial attitudes of scientists. Such a survey could provide answers to the following research questions: how can the general attitudes of the scientists toward transfer and commercialization of research be described? What role does the commercialization of research play at research departments? How important do scientists rate the transfer and commercialization of their research? What role does the transfer of their research play in their daily work? Which transfer mechanisms are most attractive to engage in? Which transfer activities are scientists most likely to actively engage in? Are scientists regularly in contact with their transfer offices? In order to analyze mid- and long-term trends and changes in scientists' attitudes toward transfer such a survey should be conducted on a regular base. Particularly with regard to the discussion about the prevalence of traditional norms in German academia–with Humboldt's idea of science being only research and teaching–such large-scale quantitative survey on individual attitudes can add significant value for university authorities and policy makers in Germany.

As has been claimed by many scholars (Bornmann, 2013; Perkmann et al., 2013), there is a general need for further research on the measurement of the impact of research. Up to know, no standardized, reliable methods to assess the impact of research have been established so far and it is debatable if research impact can be assessed with standardized instruments at all. Findings of this thesis specify this general call for future research on impact assessment and suggest that new methodological approaches are needed to measure the impact of transfer strategies. As has been pointed out, the developed Transfer Strategy Framework has not been evaluated, tested nor discussed by transfer managers or KTT experts from other sectors up to now. As transfer constitutes the main mechanism through which research can achieve an impact (Bornmann, 2013), every research institution has to establish a well-defined transfer strategy that responds to its specific characteristics in order to enhancing its research impact. Assessing the impact of such transfer strategies (and its related activities), however, constitutes a challenge for several reasons: first, there is no standard that indicates to which degree a research institution's transfer performance is appropriate (Siegel & Wright, 2015a). As pointed out before, it is impossible to compare for example MIT's transfer performance with that of TU Berlin. Also, there is no counter-part for the implemented initiatives, which makes it impossible to measure the actual effects without controlling for potential influencing factors. In other words, without a control group no standardized experiments can be conducted measuring the actual effects of the implementation of transfer strategies and operations at a research institution. Future research therefore need to adopt a qualitative approach and analyze multiple case studies of research institutions that have adopted needs-oriented transfer strategies longitudinally. Such a research approach, however, is very resource-intensive, time-consuming and relies on research institutions to be willing to cooperate and reveal insights on their transfer strategies.

Summing up, this thesis proses future research on new methodological approaches with regard to the following aspects: (1) establishing a comprehensive data base with detailed data on transfer outputs on either a national (Germany) or cross-national level (Europe),

(2) conducting a regular online-survey assessing the entrepreneurial attitudes of scientists in Germany and (3) assessing the impact of transfer strategies and activities.

7.4 Implications for industry and policy

In this chapter, I will point out practical implications for industry and policy derived from this thesis. The introduction of the Transfer Strategy Framework (chapter 7.1) encompasses detailed practical implications and recommendations for research institutions that help them develop their individual transfer strategies. Implications for practitioners at research institutions will therefore not be outlined again.

For industry: findings of this thesis indicate the importance of elaborated ecosystems for innovation and transfer. The developed Transfer Strategy Framework can help enhance the transparency of transfer strategies and reveal starting points for cooperation. Particularly with regard to strategic partnerships, it can help identifying blind spots in existing innovation networks of companies and research institutions and facilitate communication among cooperation partners. Applying the developed Transfer Strategy Framework can help in identifying potential partners for strategic partnerships and then facilitate the process of setting the rationale, regulations and rules for such partnerships. It can help enhancing the transparency and communication among the partners and provide opportunities to strengthen interactions among the involved partners. Findings of this thesis suggest that an effective option to facilitate transfer among industry companies and research institutions are vocational training programs such as shared PhD-programs where employees both work in industry and academia–thereby, fostering the so-called "transfer over heads". However, these programs are up to now far from being exhaustive and often do not respond to the different needs of all actors being involved in such processes—the company, the research institutions and the individual scientist/employee. This thesis therefore suggests to enhance existing models and establish new forms of employment that facilitate such flexible working models and exchange formats. One such model that holds particular benefits for strategic, long-term university-industry partnerships for example constitutes a flexible part-time model, which allows the employee to both work in a company and a research institution. The Karlsruher Institute for Technology (KIT) has established such models as it recently introduced "*shared professorships*", "*shared research groups*" and "*industry fellowships*" that provide researchers with a limited four year contract and allow them to work in a selected company and the university (Karlsruher Institute for Technology [KIT], 2010). However, these models mainly address senior researchers whose scientific careers are already very well established. Similar models need to evolve that particularly address junior researchers.

What academic entrepreneurship means to research institutions, intrapreneurship constitutes for private companies. As has academic entrepreneurship for research institutions, the phenomenon of intrapreneurship has gained increasing value for private companies—although for slightly different reasons. In face of the increased pace of today's innovation cycles and the competitive pressure of new actors entering the private sector (such as start-ups), large, established companies are under increasing pressure to re-frame their business models and adapt to these dynamic market changes. As necessary organizational changes in a firm's practices and structures are rather long-term, companies have started to implement activities that aim to encourage the entrepreneurial thinking and acting of their employees as well as to attract external entrepreneurs for their company.

These activities include ideas competitions, entrepreneurial sabbaticals or the implementation of company incubators that shall enable the company's renewal, foster strategic change and, ultimately, enhance its profits and growth in domestic and international markets (Zahra & Hayton, 2008). While there has been some literature that analyzes performance differences of academic and company-based spin-offs (Wennberg et al., 2011), research that analyzes differences in the *strategic approaches* toward entrepreneurship of research institutions compared to private companies remains very rare. This may be explained by the fact that these companies' intrapreneurial activities have just emerged in the past few years, are not well coordinated and companies often lack a strategic, compatible approach toward them (Weiblen & Chesbrough, 2015). This often results in companies failing in their efforts to promote intrapreneurship (Weiblen & Chesbrough, 2015). Findings of this thesis suggest that research institutions should strengthen their strategic approaches toward transfer and academic entrepreneurship and identifies recommendations of how such strategic approaches can be fostered. These findings also apply to some extent to private companies: when defining their strategic approach toward establishing an entrepreneurial culture at their organizations, companies need to address the six outlined elements *Rationale, Communication, Networks, Actions, Incentives and Teambuilding*. Obviously, companies face other constraints impacting their intrapreneurial activities and different context factors as they play a different role in innovation ecosystems than research institutions. They therefore need to adjust their entrepreneurial strategies to these key elements in a different manner than research institutions need. Again, no claim is made that these elements are exhaustive nor are the characteristics and particular recommendations of the Transfer Strategy Framework aligned to the needs of companies in the private sector. However, the outlined six dimensions can serve as an orientation for companies when defining their strategic approach toward intrapreneurship–particularly when it comes to identifying and defining strategic partnerships with other actors in their innovation ecosystem.

For policy: The emerging importance of innovation ecosystems requires adaptions in innovation and transfer policies. As has been pointed out, in order to enhance the multidirectional transfer process, policy makers need to address the different needs of the involved actors in their innovation and transfer policies. In order to foster transfer processes, this thesis suggests that policy makers should particularly address the creation of safe environments that provide room for experimentation and enable actors to jointly work together in innovation projects, thereby allowing an open transfer of their knowledge, skills and expertise. The issue of ownership of IPR that is generated in such open environments poses a particular challenge that needs to be addressed in new innovation policies. Policy makers can substantially contribute to creating such a local space that enables personal interactions among different stakeholders of the innovation system. These findings support the call by The German Council of Science and Humanities (2016, p. 41) who suggest to establish forms of participatory research (such as "community based research" in the US) in order to integrate diverse perspective from the society and industry in research processes and simultaneously foster the transfer of research into the public.

With respect to individual scientists' aspects, findings of this thesis propose the following policy implications: although the issue of gender equality has long been recognized in research policies (European Commission [EC], 2013), findings of this thesis show that women face different and additional constraints impacting their decision to participate in transfer activities such as academic spin-off creation in particular, thereby impeding knowledge and transfer in general. Policy makers need to address this issue and take actions toward fostering gender-sensitive transfer structures in academia. Such actions can include policies toward the gender-balancing of committees and in incubators. Furthermore, findings show that (junior) researchers are often not aware of existing governmental programs for academic spin-off creation. Policy makers should therefore reconsider their communication strategies and should adopt more proactive communication approaches of these programs.

Findings of this thesis reveal that transdisciplinary research—often defined as collaboration between academics and societal actors (Jong et al., 2016)—can help to facilitate the transfer of research findings as it integrates different perspectives from the beginning into research projects and thereby broadens the spectrum of application scenarios of the research findings. Policy makers should therefore address the issue of transdisciplinary research consortia in research programs and integrate such criteria in funding programs.

Ultimately, as has already pointed out in the future-research chapter (chapter 7.3.4), findings of this thesis suggest that policy makers should consider funding (1) the establishment of a comprehensive database that allows for the monitoring and longitudinal analysis of developments in transfer outcomes and (2) an online survey to assess trends in the general attitudes of scientists toward transfer and commercialization of research.

7.5 Toward a new understanding and forms of transfer in innovation ecosystems

Up to now, research institutions have rated knowledge and technology transfer as an additional, third responsibility that is separate from their "main" responsibilities of providing education and conducting research. Findings of this thesis suggest, however, that in order to sustainably foster it, knowledge and technology transfer must be embedded in the research mission, in the organizational culture and even on the micro-level in every research project. Transfer should therefore not be interpreted as an additional mission–but rather as an integral part of the other two missions, thereby, lying in parallel to them. Following this argumentation, research would then be understood as the search for solutions that can be applied in other contexts. Teaching would be interpreted as enabling students to apply new knowledge for their individual ideas–instead of providing new knowledge. This would lead to enhancing skills and qualification of scientists and open up career perspectives to them outside academia, which is urgently needed (Schütz et al., 2016; The German Council of Science and Humanities, 2016). Particularly in Europe and Germany, this can result in a deep cultural shift at universities as they have conducted education primarily with the aim to enable students to fulfill the employment needs of large companies (Grimaldi et al., 2011; Mustar & Wright, 2010). As paper IV has shown, an approach that offers a protected environment for students and employed scientists to freely experiment with business ideas and application scenarios for technologies can support the shift to an entrepreneurial university. However, new organizational approaches toward the establishment of such "room for experimentation" that support such an environment still have to be analyzed and developed. The role of providing such a protected environment for encouraging academic entrepreneurship has been far too less recognized by universities (Grimaldi et al., 2011).

The creation of such a safe environment where different actors can experiment with new ideas and help innovation to emerge is also vital in the broader context of innovation ecosystems: the fast pace of today's innovation cycles puts particular pressure on knowledge-based industries that are highly dependent on a high degree of research. Innovation today does not follow linear research and development patterns, instead, it occurs at the interface of different sectors with multiple actors being involved. These trends manifest themselves in increasing research and development (R&D) budgets and changes in the characteristics of the R&D investments. In Germany, expenditure for R&D doubled over the past 20 years (BMBF, 2016) with an increasing share of these R&D investments in external partnerships, which facilitate innovation networks (Dolata, 2015). However, the major part of the companies' external R&D budget remains in the private sector as it is invested in partnerships with private partners including other research-intensive companies, start-ups and consultancies instead of public research institutions (Dolata, 2015). This trend can indicate both a decreasing importance of research that is generated by public research institutions or the lack of appropriate forms of cooperation that respond to the needs of public research institutions and private industry actors. Perkmann and West (2015) found three main modes of direct interaction between industry and public research–IP licensing, research services and research partnerships–and highlight the significant role of the direct interactions of the latter two. New forms of formal cooperation among industry and research other than these three have not evolved over the last decade. The significant shifts in R&D budgets and expenditures, however, indicate that new modes of cooperation have to be established. Building on Perkmann and

West's (2015) findings that open source knowledge acquisition plays a significant role in these new forms of cooperation, this thesis suggests that the *open transfer* of knowledge, skills, expertise and resources among the actors are pivotal in these new forms of cooperation. Following the logic of the Quadruple-Helix approach (Carayannis & Campbell, 2009), in order to foster innovation that is socially relevant and, thereby, more likely to be accepted by the public, societal actors need to have the possibility to participate in these new open cooperation formats. Ultimately, actors from all sectors of the innovation system–from policy, industry, science and the society–have to be actively involved in defining characteristics of such innovation environments and thereby all contribute to its creation.

Part B

8 Paper I: Entrepreneurship and academic employment—more alike than you'd think[26]

8.1 Introduction

As the lines between science, industry, and government grow increasingly blurry (Etzkowitz et al., 1998; Etzkowitz & Leydesdorff, 2000; Ranga & Etzkowitz, 2013a), the role of knowledge and technology transfer, KTT, in the utilization of research findings continues to increase (Bozeman, Rimes, & Youtie, 2015; von Kortzfleisch, Bertram, Zerwas, & Arndt, 2015). In view of these developments, both the scientific and political communities have begun paying greater attention to academic entrepreneurship (O'Shea, Chugh, & Allen, 2008; Shane, 2004; Wright et al., 2007). To this end, the European Commission initiated the European Institute of Innovation and Technology, EIT, as a part of its Horizon 2020 program (European Commission, 2014a, p. 28). In Germany, the High-tech Strategy of the German federal government is intended to foster knowledge and technology transfer, to increase the national capacity for innovation, and, in particular, to increase the commercialization activity of national research institutions (Federal Ministry of Education and Research, 2010, p. 10).

[26] The findings were presented at the Annual conference 2015 of the Technology Transfer Society in Dublin. The paper is the post print version and can be cited as: Sinell, Anna; Heidingsfelder, Marie; Schraudner, Martina (2015): Entrepreneurship and Academic Employment - More Alike than You'd Think. In: *Journal of Technology Management & Innovation* 10 (3), p. 1-10. DOI: 10.4067/S0718-27242015000300001. Available at: https://dx.doi.org/10.4067/S0718-27242015000300001

Academic entrepreneurship can help more efficiently utilize research findings, create jobs, and provide economic benefits (Dickel, 2009). Germany's capacity for innovation is currently estimated as very high (Frietsch, Rammer, Schubert, Bührer, & Neuhäusler, 2012; Poirson, 2013). Simultaneously, a relatively small number of businesses are initiated every year (Brixy, Hundt, Sternberg, & Stüber, 2009; Schubert, Rammer, & Frietsch, 2014) and only approximately one percent of these businesses are initiated by researchers (Braun-Thürmann et al., 2010, p. 9). Seeking to increase the number of such businesses and to generally reduce the existing gap between academia and business, the government and many research organizations have recently initiated a range of programs.

The impact of these programs, however, has remained low. In 2013, only 45 businesses were initiated by the employees of the four major national research organizations (Fraunhofer-Gesellschaft, 2014; Helmholtz Association, 2014; Leibniz Association, 2015; Max Planck Society, 2014). Such small proportions of academic spin-offs can be explained, for example, by potential entrepreneurs being unclear about their objectives and strategies and lacking necessary information and skills in business administration (Franklin et al., 2001; Hemer, Schleinkofer, & Göthner, 2007; Riesenhuber, Walter, & Auer, 2006; Vohora et al., 2004). Especially during the start-up stage, such lack of information and skills can lead to poor decisions (Spath, Winter, & Pape, 2010). One structural barrier, identified by Braun-Thürmann et al., 2010, is the lack of support by the employing organization.

Many of the publications on the subject share the assumption that the gap between academic employment and entrepreneurship would be extremely difficult to bridge and that for a scientist to engage in commercialization activities would be a non-trivial undertaking (Braun-Thürmann et al., 2010; Jain et al., 2009; van der Sijde et al., 2014). In line with these findings, we have formulated the following research questions: *Where do transfer managers and postdoctoral students see the differences between academic employment and entrepreneurship and how do their perceptions match the existing common perceptions about such differences? What causes these perceptual differences? Considering job profiles, required skill sets, and existing organizational practices, how different are academic employment and entrepreneurship precisely?*

Our findings suggest that this "tale of two logics" (van der Sijde et al., 2014) might largely be a widely-shared and self-perpetuating illusion.

8.2 Theoretical background

8.2.1 Existing paradigms

By commercializing innovations, academic spin-offs have the potential (Bollinger, Hope, & Utterback, 1983; Gottschalk, Fryges, Metzger, Heger, & Licht, 2007) to re-shape the existing technological landscape (Breznitz, O'Shea, & Allen, 2008). Scholars have explored the challenges that potential academic entrepreneurs might face (Franklin et al., 2001; Hemer et al., 2007; Riesenhuber et al., 2006; Vohora et al., 2004). While their studies vary substantially in approach and method, these scholars share the view that academic employment and entrepreneurship belong to two different worlds, which are opposite of one another in a variety of ways and each of which has clear boundaries. Crossing these boundaries would require fundamental changes in social and symbolic order (Braun-Thürmann et al., 2010). Braun-Thürmann et al. (2010) distinguish between three types of such boundaries, which define (1) research types and contexts, (2) organizations, and (3) individual identities. From individuals, crossing these boundaries would require, respectively, (1) resetting their priorities, (2) developing new professional identities outside of their current organizations, and (3) conforming their behavior to norms that are compatible with entrepreneurship. According to Jain et al. (2009), engaging in commercialization activities typically require individual scientists to modify their role identity, which entails norms, processes, and outputs (Jain et al., 2009, p. 924). The transition between the two worlds can be achieved gradually and will result in the scientists adopting a hybrid role identity (Jain et al., 2009) and the development of a new community with its own norms and practices (Braun-Thürmann et al., 2010, p. 24).

Merton (1959) identified the four following components of the scientific ethos: (1) universalism, implying that scientific observations should be verifiable and independent of the observer, (2) communism, implying that scientists share their work for the common good, (3) disinterestedness, implying that scientists have no emotional or financial attachments to their work, and (4) organized skepticism, implying that scientists should wait until they have gathered all the facts before they make a judgment about a particular theory. These norms are often incompatible with those of entrepreneurship (Jain et al., 2009, p. 924). A scientist's notion of universality is in conflict with an entrepreneur's belief in the unique selling point (Barney, 1991). Communism is incompatible with the definition of private property, while the academic ideal of skepticism contradicts the entrepreneurial ideal of passion (Baum & Locke, 2004; Camerer & Lovallo, 1999). While delayed dissemination of findings in academia would conflict with the principles of universalism and communism (Merton, 1959), from an entrepreneurial perspective, a premature disclosure of certain findings might violate patent protection and compromise potential intellectual property (Ndonzuau, Pirnay, & Surlemont, 2002). Given these incompatibilities, reconciling both worlds poses a non-trivial challenge and requires a substantial amount of "identity work" from an individual scientist engaging in entrepreneurial activity (Bird, Hayward, & Allen, 1993; Jain et al., 2009). Other factors that such scientists might need to consider include planning, risks, management styles, and money (Samsom, 1990). As compared to entrepreneurs, scientists usually have the opportunity to make longer-term plans, face fewer risks, have the opportunity to appreciate more consensus-oriented management styles, and place a lower value on money (Samsom, 1990).

Some recent studies, however, challenge this "tale of two logics" by indicating that some of these incompatibilities might be relative. Sass (2011, pp. 55–57) demonstrates that commercialization activities and patent applications have long become part of academic occupation (see also (Lee & Rhoads, 2004). In some cases, the principles of communism are not strictly adhered to and findings are disseminated with restrictions or not at all, especially when different groups research in similar directions and are considered mutual competitors (Blumenthal, Campbell, Anderson, Causino, & Louis, 1997; Campbell et al., 2002). Some studies indicate that more scientists would potentially be interested in commercializing their findings if they had the time (Braunerhjelm, 2007). In a group studied by van Looy et al. (2006), those who were more open to entrepreneurship usually demonstrated higher academic productivity. All these findings challenge the above-described paradigms.

8.2.2 Beyond the paradigms

Since the late 1930s, scholars in different research fields have explored how individuals related to their work (Ekehammar, 1974; Kristof-Brown et al., 2005; Lewin, 1935; Murray, 1938; Murray & Kolev, 2015). While their studies vary in approach and method, most of them address individual values, preferences, aspirations, skills, and personality traits in relation to occupation and workplace. Drawing on their literature review, (Kristof-Brown et al., 2005) have developed probably the most comprehensive model of person-environment fit. This model has four dimensions. The first dimension, Person-job, refers to individual knowledge, skills, abilities, and job responsibilities. The second dimension, Person-organization, refers to fundamental organizational norms, values, and practices including organizational culture. The third dimension, Person-group, refers to relationships with co-workers, team composition, and work atmosphere. Finally, the fourth dimension, Person-supervisor, refers to organizational hierarchies and relationships between employees and their superiors.

For the purposes of our research, we have slightly adapted this model. Kristof-Brown et al. (2005) regarded supervising activities as part of group dynamics, and egalitarian work relationships and loose hierarchies are common practice in both academia and entrepreneurships. Our model therefore regards the third and fourth dimensions as one. We also expanded the second category and renamed it Person-structure to shift the focus toward more structural aspects of organizations.

Drawing on this model, we analyze the perceptions of transfer managers and postdoctoral students about differences between academic employment and entrepreneurship and analyze possible causes of these perceptions. By considering job profiles, required skill sets, and existing organizational practices, we precisely discuss the differences and similarities of academic employment and entrepreneurship.

8.3 Method

In order to explore similarities and differences between academic employment and entrepreneurship, we conducted a comprehensive literature review and 128 qualitative interviews. We used the review and the method of theoretical sampling (Glaser & Strauss, 2010) (1) to identify the criteria for interviewee selection, and (2) to "deductively derive" (Flick, 2007; Mayring, 2010) categories, which helped develop semi-structured questionnaires for the interviews and later helped analyze the gathered empirical data.

For the interviews, we selected 112 postdoctoral students from the four major German research organizations and 16 senior transfer managers from scientific organizations and government agencies, including former researchers, whose responsibilities included spin-off facilitation. The managers were selected (1) because of their long-term and vast experience in KTT and academic entrepreneurship and (2) because, due to their positions, their views carried substantial weight in setting KTT agendas.

The 112 individual problem-centered interviews (Witzel, 2000) with postdoctoral students focused personal aspirations, career drivers, career development strategies, career paths both within and outside of academia, and existing practices in research organizations including shared norms, values, and basic assumptions (Schein, 1985). The questionnaire contained both yes/no and free-response questions in order to approach the subject at hand from different angles. Each interview was recorded, and these records were transcribed and analyzed. For this analysis, we utilized a range of qualitative methods from empirical social research, including that of Mayring (2010). By adhering to "the principle of openness" (Flick, 2010; Lamnek, 2010), these methods enabled us to assess individual perspectives and points of reference. With the purpose of theory building (Eisenhardt & Graebner, 2007), this analysis focused on individual perceptions of self and others and behaviors typical within different types of KTT teams. Finally, we utilized the gathered data to "inductively restructure and expand" the above-mentioned categories (Mayring, 2010).

The following chapter presents our findings, including a selection of interview quotations. In accordance with the major principle of qualitative research, these quotations are intended to illustrate the findings rather than provide a representative sample (Haas & Scheibelhofer, 1998). For reasons of confidentiality, only the sexes and positions of quoted interviewees are revealed.

8.4 Findings

In this chapter, we show where interviewed senior transfer managers and postdoctoral students saw differences between academic employment and entrepreneurship, present the students' perceptions about their jobs and workplaces, and describe the similarities between the two worlds that we established based on these perceptions.

8.4.1 Academic entrepreneurship as perceived by interviewed senior transfer managers and postdoctoral students

Scientists are scientists to the core, they don't start businesses. (Senior manager, female)

Most of the aspects of academic employment and entrepreneurship addressed by interviewed senior transfer managers can be referred to person-job and person-structure fit and only few can be associated to person-group fit (Kristof-Brown et al., 2005). These managers most often spoke about the individual traits of scientists and entrepreneurs and their intrinsic motivations. This chapter presents the managers' observations, and quotations supporting these observations.

Many interviewed managers explained the low number of national academic spin-offs by scientists being too averse to risk and "lacking courage," as illustrated by the following quotation.

[It] is because too few are that open to risk and ready to do it. For a scientist to leave his or her organization and to start a business, I think, the stretch would be too big. He or she would also need much endurance. (Senior manager, male)

Many studies indicate that business owners often exhibit high risk tolerance and more risk adverse individuals are less likely to start a business (Ekelund, Johansson, Järvelin, & Lichtermann, 2005; Stewart, Watson, Carland, & Carland, 1999; Wagner, 2003). Unlimited-term employees have been shown to be particularly unlikely to start a business (Caliendo et al., 2009), and women have been shown to be more risk averse than men (Caliendo et al., 2009; Wagner, 2007).

German research organizations mostly provide limited-term employment contracts, which often cover at most two years. Nonetheless, many researchers appear to regard academic employment as "the more secure option" and would rather endure its hardships than expose themselves to the risks of entrepreneurship.

Many research organizations provide business support programs, including the training of managerial skills. Simultaneously, interviewed managers observed that potential entrepreneurs in their organizations often did not find themselves "fit for surviving in the free market" (senior manager, female) and possessing necessary business management skills and understanding of the law. These findings match those of many empirical studies (Franklin et al., 2001; Vohora et al., 2004). Within their samples, Walter, Auer, and Ritter (2006) and Dickel (2009) discovered that those new academic entrepreneurs who put a higher value on networking and cultivating entrepreneurial spirit were usually more successful in general and with their first product in particular (Dickel, 2009). To summarize, interviewed senior transfer managers identified the following two major issues related to person-job fit: most scientists are too averse to risk and lack necessary skills.

Similarly in relation to person-structure fit, many interviewees identified significant barriers that one might face while switching from "relatively secure" academic employment to "insecure" entrepreneurship. Some even referred to the latter as "the risky area", as illustrated by the following quotation.

"To say, I am entering the risky area, where I have to face all these completely different problems and possibly, a bankruptcy, that would be a really big deal." (Senior manager, male)

In German academia, working extra hours on top of normal hours required in the office is standard practice. Simultaneously, many interviewees believed that entrepreneurship was more demanding and that it would be nearly impossible to combine entrepreneurship with family obligations and interests outside work. In view of the fact that women usually carry a larger load of family responsibilities it is perhaps not surprising that in 2008, for example, only eight and two percent of highly technological start-ups in Germany were founded by all-female and mixed-gender teams respectively (Metzger et al., 2008).

While the government and many research institutions provide different business support programs, including help with networking and the development of business plans, finance remains an issue, in particular when a potential new business requires complicated equipment. Many interviewed managers identified access to external finance to be another major challenge, as illustrated by the following quotation.

"I mean, there are opportunities [to find investors]. But you have to know about them. At the beginning, you need to be very… incredibly motivated and to want, want, want to find all this information." (Senior manager, female)

Many of the managers identified certain cultural beliefs to be a substantial barrier. As compared to other nations, Germans might be more prone to the fear of failure (Singer, Ernesto Amorós, & Moska, 2015) and more willing to believe in the gap between science and business, as illustrated by the following quotation.

"*In Germany, there is this divide in people's heads. We believe that good science cannot possibly be driven by considerations of commerce.*" (Senior manager, male)

The language that interviewees used was a manifestation of this perceived divide. To engage in commercialization activities, a scientist would have "to take the plunge," "to jump into the deep end," "to go down a rough road," "to be ready to suffer," and "to be a real bulldog". These choices of words suggest that the managers believed that engaging in commercialization activities would require much courage, endurance, and assertiveness. To summarize, most interviewed senior transfer managers believed that academic employment and entrepreneurship differed substantially on many levels and that engaging in commercialization activities entailed a range of challenges, as illustrated by the following quotation.

"*Starting a business is just a huge life change.*" (Senior manager, female)

Most interviewed postdoctoral students mentioned differences between academic employment and entrepreneurship similar to those mentioned by interviewed senior transfer managers. Most spoke of the risks and downsides of academic entrepreneurship and few spoke of the upsides and opportunities that it provided. Both those who could imagine starting a business at some point and those who could not associated entrepreneurship with a range of challenges, primarily those related to financing and planning, as illustrated by the following quotation.

"*Well, that would be extremely risky and require a huge investment. That's why it probably wouldn't work.*" (Postdoc, male)

Simultaneously, more than one-fourth of the interviewed postdoctoral students found entrepreneurship appealing and considered it a valid career option. These students included men and women in approximately equal proportions. Among those whose organizations provided spin-off support, as compared to those whose organizations did not, a greater proportion either already had some entrepreneurial experience or intended to start a business in the immediate future, as illustrated by the following quotation.

"*This program [provided by the institute] is actually quite generous. [...] They funded four full-time positions for a start-up. We also have quite a mix of backgrounds in our team, in a good way, everything a company needs, right at the start and later, after it takes off.*" (Postdoc, male)

Many interviewed postdoctoral students found that good, marketable ideas were essential for a successful start-up. Many believed that the specifics of one's academic field determined how much opportunity one had to develop such ideas and that applied research, as compared to basic research, provided better opportunities. Many believed, sometimes with regret, that it would be nearly impossible to commercialize most findings in certain basic research fields, as illustrated by the following quotation.

"To start a business, one needs to have ideas that have that kind of potential. We often have interesting ideas here, but being outside of our field… they're just ideas. And then we say, yeah, that would be useful, it would be great to do it. But you can't, not with this group." (Postdoc, male)

Many interviewed postdoctoral students believed that to attempt entrepreneurship, one needed to have certain personality traits such as high risk tolerance and to possess certain skills, such as business administration. Most believed that they lacked both and found that entrepreneurship would require too much time and effort, as illustrated by the following quotation.

"I don't think I'm cut out for that. There would be just too much uncertainty." (Postdoc, female)

To conclude, most interviewed postdoctoral students believed that academic entrepreneurship was an option only for those scientists who were more risk tolerant, were interested in practical application, had the necessary knowhow and skills, and were willing to invest a great deal of time and effort. Although many found entrepreneurship potentially appealing, they believed that they lacked the necessary skills, had "the wrong personality," and were generally unfit for entrepreneurship.

When looking at possible causes for the outlined perceptual differences of academic employment and entrepreneurship two main factors can be identified: First, scientists and entrepreneurs lack the opportunity to identify themselves within the other group. It requires opportunities for reflection and change of perspective to find out about the working conditions and tasks in science and entrepreneurship respectively.

"The fact, that scientists have long been employed in their field, makes entrepreneurship seem really strange and far away. So they are just not interested in it and don't see potential overlaps." (Senior manager, female)

University-industry cooperation could be a promising way to overcome these perceptions, as pointed out by a senior KTT manager:

"*Cooperation between research institutions and businesses are certainly a good way to simply have a change of perspective and also to see how companies work, what markets need, and what research can and cannot do."* (Senior manager, male)

Secondly, academic entrepreneurship as part of KTT-activities is still a young topic and not yet well established in research institutions. The findings indicate that–apart from a small number of exceptions–entrepreneurship and academic spin-off formation is neither part of university curricula nor is it well communicated in the research institutions.

"A huge barrier is that the issue of technology transfer and spin-offs is just not on the agenda of [the research organization] and the directors of the institutions." (Senior manager, male)

Additionally, there is a lack of incentives and appreciation for transfer activities and spin-off formation within research organizations as research and teaching are still perceived as being of greater value.

"There are many ways to incentivize spin-off activities. An award or financial benefits could be a good idea. […] but that just does not fit to the strategy of [the research organization]. Here it's mainly projects with industry that count." (Senior manager, male)

The results are in line with the findings of Grave et al. (2014) that more than half of the scientific staff at German universities do not know that KTT-support programs exist at their research institutions and less than 25% of German universities provide incentives or reward structures to foster spin-off formation (Grave et al., 2014). In order to increase the engagement of scientists in entrepreneurship activities, supporting structures for spin-off formation must be adequately and frequently communicated (Kolb & Wagner, 2015). Universities, that provide established policies and procedures for the management of technology transfer and articulate entrepreneurship as a fundamental element of their mission, perform significantly better with regard to the number of spin-offs created (Caldera & Debande, 2010a; Huyghe & Knockaert, 2015b).

The above-described opinions and observations of both interviewed senior transfer managers and postdoctoral students match the widely-shared assumptions that academic employment and entrepreneurship are fundamentally different and that engaging in the latter would be an enormous career change and not worth the effort. In the following chapter, we explore to what degree this assumption is grounded in reality.

8.4.2 Similarities between academic employment and entrepreneurship

The postdoctoral students were interviewed about their perceptions of German academia, its existing practices and infrastructures, their own place in it, and the specifics of their work. By analyzing their responses, we concluded that academic employment and entrepreneurship share a range of similarities. Drawing on Kristof-Brown et al. (2005), we associated each similarity with one of the three dimensions described in chapter 2.2–person-job, person-structure, and person-group.

The responses of interviewed postdoctoral students suggest that their decisions to work in academia were primarily determined by considerations that can be referred to person-job fit. Most interviewed postdoctoral students stated that their major drivers were their assignments, research subjects, and the opportunity to research by itself. An occupation in science helped them explore their interests and provided variety of assignments, personal autonomy, and creative freedom. Many found their work to be rich and exciting. Many were motivated by the given autonomy to determine when, where, and how they will work. Many felt that their work was meaningful and its results useful to others. The following quotation illustrates.

"*I was always driven by the substance, by its role. And when a project spoke to me, when I thought that it mattered, that was always a factor. That it was about some important issues, not just producing knowledge. And that it could be implemented and resolve these issues.*" (Postdoc, male)

Many studies indicate that the most appealing aspects of entrepreneurship are very similar. Most entrepreneurs are driven by the opportunities to realize their own ideas (Hünnies-Stemann, Rulle, Seel, & Terberl, 2010), to take responsibility, and work autonomously (Egeln, Gottschalk, Rammer, & Spielkamp, 2002; Kulicke & Schleinkofer, 2008; Roberts, 1989; Shane, 2004).

When asked about their responsibilities, interviewed postdoctoral students mentioned research and project management, including team management, fundraising, and time management. Applying for grants, in particular, has long been a major part of researcher's job, as illustrated by the following quotation.

"*My responsibilities include project supervision and my own research. I mentor graduate and PhD students, network with both researches and business people, and manage my own projects. So, applying for and managing money grants."* (Postdoc, female)

Entrepreneurial activities are very similar to those described above–entrepreneurs raise money, supervise other people, and manage time and finances. Lack of skills necessary for performing these activities can hinder a start-up (Hünnies-Stemann et al., 2010). Some interviewed postdoctoral students commented on these similarities between entrepreneurship and a job in academia, as illustrated by the following quotation.

"*Because I have to find the money by myself… it's like in business. I find the funds for everything here [at the institute]. That's what the overhead is for, so to say, for my co-workers. And if this money stops, I'll be unemployed. It's not that different from entrepreneurship."* (Postdoc, male)

With regard to the person-structure relationship, most postdoctoral students spoke of the shortcomings of existing practices in academia and very few spoke of their benefits. Many mentioned that the system provided limited opportunity for long-term career development planning, and wished that their organizations would more actively communicate with them about their professional prospects and potential career steps, as illustrated by the following quotation.

And then there's career planning, which is a really big issue in academia. I would like to have more certainty with that sometime soon. Not that I necessarily need an unlimited-term contract, but it would be great if we could discuss what I can achieve here and how exactly I can achieve that. (Postdoc, male)

Simultaneously, only few postdoctoral students associated entrepreneurship with similar uncertainties and commented on these similarities between the two worlds, as illustrated by the following quotations.

"*Because academia doesn't do unlimited-term contracts as much anymore, all you can be sure of is one year or two. And then there's the 12-years regulation. I simply see no point for myself [in staying in academia], especially if I want to start a family.*" (Postdoc, female)

"In business as in academia–there're no guaranties that a project will succeed." (Postdoc, female)

In entrepreneurship, such uncertainties are balanced by a large degree of personal autonomy (Hünnies-Stemann et al., 2010; Sass, 2011; Shane, 2004). Similarly in academia, many organizations give their employees the autonomy to determine when, where, and how they will work. This flexibility, however, continues to erase the boundaries between professional and private, and actual workloads exceeding contractual workloads has long been standard practice throughout academia. All postdoctoral students often worked and were available to their co-workers and superiors outside of regular working hours, as illustrated by the quotation below. While the students accepted this investment of time as natural and acceptable within the research context, they considered similar demands of an entrepreneurial lifestyle overwhelming.

"I read my mails. I am available on weekends for emergencies. I respond to mails after work. If you count all this, I start at 7 a.m. and finish around 10 or 11 p.m." (Postdoc, male)

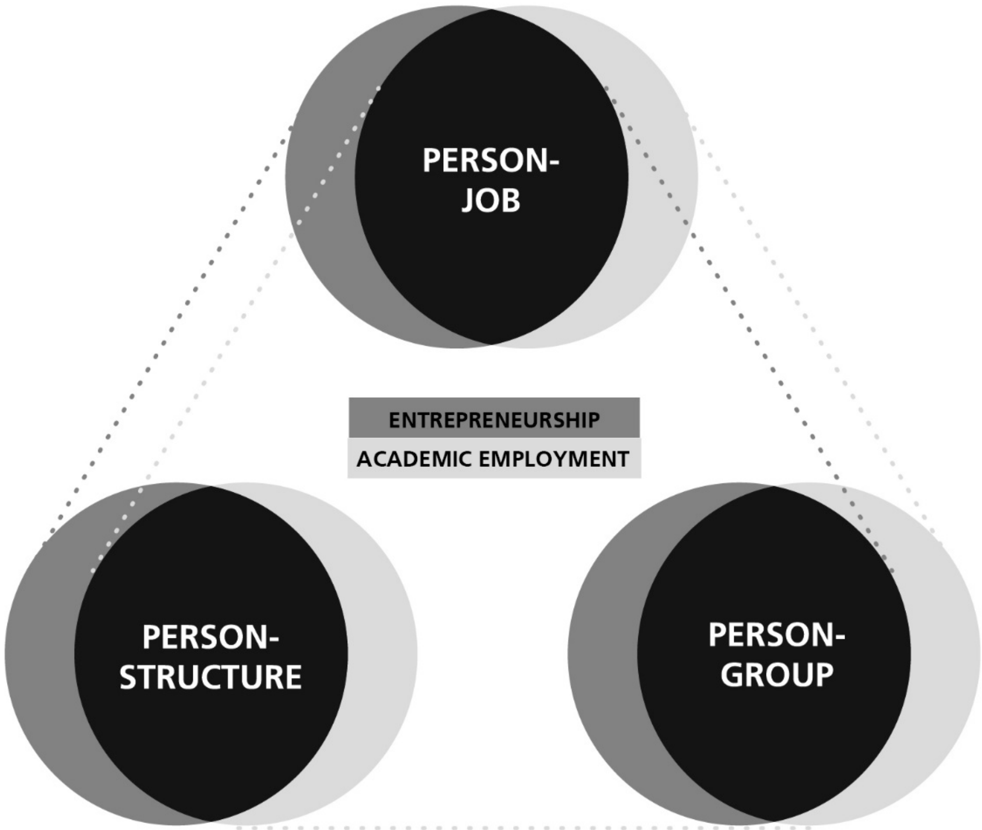
The students were to a large degree driven by intrinsic motivations–they were passionate about their work, felt that it gave them the opportunity to satisfy their curiosity, and associated it with feelings of excitement, enjoyment, and freedom, as illustrated by the quotation below. Most described the given opportunity to fulfil themselves through their work as one of their major drivers. In a similar manner, actual and potential business owners are often driven by intrinsic motivations (Sass, 2011), including the opportunity to fulfil themselves (Autio & Kauranen, 1994; Hünnies-Stemann et al., 2010).

"*As a scientist, I feel […] free. I am more free to choose, what I want to research […]. What motivates me most, is my own curiosity… and then the discoveries, the wonders, and figuring things out.*" (Postdoc, female)

With regard to the person-group relationships, most postdoctoral students found the atmosphere in their workplace to be very encouraging and described it as open, friendly, cooperative, and supportive. In particular, many found discussions with their co-workers to be interesting and motivating. Some even chose to accept their current positions because of their co-workers and atmosphere in the workplace. In a similar manner, actual and potential business owners are often motivated by relationships with their employees and partners (Sass, 2011). Egalitarian relationships are characteristic of academia and its hierarchies are often loosely defined. Almost all postdoctoral students supervised projects and mentored PhD students. Simultaneously, their leadership was not institutionalized and they did not have any sanction power, which often allowed for loose interpretations of their own position in the hierarchy. Some wished for a stricter definition of hierarchies and clearer instruction from their superiors, and others did not question the existing order and appreciated the large degree of personal autonomy it provides. In this regard, some recognized the similarities between their current position and self-employment, as illustrated by the following quotation.

"*That you are, I'd say, your own boss. I mean, you have autonomy, you are not restricted and nobody tells you that you can't do this or that. Working here, at this institute, is really not that different from being self-employed.*" (Postdoc, male)

Figure 6 shows the established similarities between entrepreneurship and academic employment.



PERSON-JOB	PERSON-STRUCTURE	PERSON-GROUP
a. Meaningful work and large personal autonomy b. Useful ideas and potential for practical application c. Project management d. Fundraising	a. Uncertainties b. Limited opportunities to long-term plan career development c. Freedom and flexibilities d. Autonomy to determine, when, where, and how to work	a. Intrinsic motivations b. Encouraging working atmosphere c. Opportunities to fulfill oneself d. Egalitarian relationships

Figure 6. *Similarities between entrepreneurship and academic employment—the three-dimensional construct (drawing on Kristof-Brown et al., 2005).*

Entrepreneurship and academic employment appear to share precisely those traits that a majority of interviewed postdoctoral students found most appealing in their occupation, such as opportunities for stimulating and meaningful work and a large degree of personal autonomy. Similarly, while most postdoctoral students considered entrepreneurship to be a risky and serious undertaking because it provides only limited opportunities for long-term planning, they already faced such challenges in their jobs as researchers. In view of these similarities, the perceptions expressed by both postdoctoral students and senior transfer managers regarding the greater challenges entailed by entrepreneurship and the un-fitness of most researchers for that task appear to be largely unjustified.

8.5 Conclusions

The worlds of science and entrepreneurship have each developed their own different norms and practices. Simultaneously, our findings challenge the widely-shared perceptions of the gap between these two worlds and suggest that academic and entrepreneurial careers might be more alike than different.

A majority of interviewed postdoctoral students were largely driven by the idea that the results of their work could be useful and have a variety of applications. At the same time, many were neither interested in nor considered themselves fit for realizing such applications. In other words, they desired to provide the foundation for potential innovations but not to participate in their commercialization. In view of the many uncertainties that researchers in Germany currently face, on the one hand, and the large number of patents granted to German researchers every year, our findings can be useful to both researchers and transfer managers. By challenging the perception of entrepreneurship as "a completely different occupation," our findings can help researchers–both men and women–recognize it as a valid career option and themselves as already possessing the necessary skills, especially if they are willing to re-evaluate how averse they really are to risk. Transfer managers, on the other hand, might want to utilize our findings to adjust both their ideas of researchers' capabilities and their business supporting strategies.

In view of established similarities between academic and entrepreneurial careers, it would be interesting to explore what can motivate scientists "to take the plunge" into entrepreneurship and what could be the real barriers to such a plunge, as opposed to it remaining merely illusory. To tackle the identified misperceptions and to outline that both roles in entrepreneurial and academic employment share similar characteristics, university-business cooperation could be a promising solution. Joint research projects or internships at entrepreneurial businesses are possible cooperation formats to foster collaboration among scientists and entrepreneurs and may help to overcome the perceptual differences of academic employment and entrepreneurship. Also, entrepreneurial education in university curricula could make entrepreneurship more tangible for scientists and encourage entrepreneurial ideas. By bringing researchers and transfer managers together, accommodating their perspectives, and helping them develop joint strategies, we can foster technology transfer and tap into a vast potential for innovation.

9 Paper II: The gender dimension in knowledge and technology transfer—the German case[27]

9.1 Introduction

For any industrialized nation to secure its economic growth and position in the face of global competition, it must foster knowledge and technology transfer (KTT) (OECD, 2013; Teece, 1977). In global comparison, Germany's capacity for innovation is estimated as very high (Federal Ministry of Education and Research, 2010; Frietsch et al., 2012; Poirson, 2013). At the same time, substantially fewer women than men participate in research and development (Frietsch et al., 2012), which has been found to be a "large waste of potential" (Blickenstaff, 2005; Busolt & Kugele, 2009; Etzkowitz, Fuchs, Gupta, Kemelgor, & Ranga, 2007; Etzkowitz, Ranga, Conway, & Dixon, 2008) and to impair the capacity for innovation Butler. In a similar manner, women's potential remains largely untapped in many other industrial countries (Etzkowitz et al., 2008; European Commission, 2009). Academic entrepreneurship is one particular outcome of KTT, which leads to economic growth and wealth creation (Shane, 2004). We define academic entrepreneurship as activities directed towards the commercialization of scientific findings and technological products, including founding spin-offs, patenting, licensing, and conducting contracted research (Klofsten & Jones-Evans, 2000). Traditionally, German universities

[27] The paper is the post print version and can be cited as: Best, Kathinka; Sinell, Anna; Heidingsfelder, Marie Lena; Schraudner, Martina (2016): The gender dimension in knowledge and technology transfer - the German case. In: *European Journal of Innovation Management* 19 (1), p. 2-25. DOI: 10.1108/EJIM-07-2015-0052. Available at: https://doi.org/10.1108/EJIM-07-2015-0052

followed Humboldt's model of combining research and teaching, but did not engage in commercialization activities. Recently, national funding agencies have increasingly promoted such activities (Federal Ministry of Education and Research, 2010). Between 2012 and 2013 alone, government funding of academic entrepreneurship increased by 28 per cent and reached 65 million euros (Grave et al., 2014). Due to its being one of the world's major economies, Germany greatly contributes to Europe's scientific output (Wright et al., 2007). In comparison to other European countries, however, fewer women typically participate in KTT and in academic entrepreneurship. Their numbers remain extremely low (Best, Sanwald, Ihsen, & Ittel, 2013; Haeussler & Colyvas, 2011), even though an increased amount of effort has been put in promoting gender equality (Commission of Experts for Research and Innovation, 2014a). Until now, little research has been done on the gender dimension in KTT, both in and outside of Germany, and no comprehensive studies have been conducted. Because KTT is not a single event but an ongoing process (Szulanski, 2000), we sought to fill existing research gaps (Bercovitz & Feldman, 2006; Haeussler & Colyvas, 2011) and to rigorously analyze the gender dimension in German KTT. We built upon existing models (Carlsson et al., 2002; Lundvall, 2010) and developed an analytical framework for such an analysis. Following an abductive approach, we simultaneously built hypotheses and collected data (Suddaby, 2006). We considered different levels on which KTT occurs and which can influence its trajectories and individual choices of its participants (Pleschak, 2003). We combined a comprehensive literature review with 22 key informant interviews. Because academic entrepreneurship connects research and business (Klofsten & Jones-Evans, 2000), our sample contained interviewees who had extensive experience with one or both of these areas. Finally, we extracted and organized all relevant information from the selected publications and interview records.

Research on gender in entrepreneurship has increasingly focused on how gender makes a difference rather than whether it does (Carter & Shaw, 2006). Building on this nascent literature, we were particularly attentive to common practices and widely shared attitudes. Our framework and findings can help evaluate the situations both within and across individual countries and develop new, unified approaches.

9.2 Empirical and theoretical background

Occurring between the scientific and the business communities, knowledge, and technology transfer, KTT, can help transform theoretical results and findings into highly marketable products. KTT is defined here as complex exchanges of ideas, scientific findings, and methods of production among research institutions, industry, and the public, with the purposes of accommodating public preferences and of making innovations more accessible, useful, and appealing (Bercovitz & Feldman, 2006; Szulanski, 2000). We recognize that to achieve these goals, we need to accommodate both men and women–in the entire variety of their needs, preferences, and perspectives, both gender specific and otherwise (European Commission, 2013a). By fully integrating the gender dimension, we can foster quality of research and help produce globally marketable transfer products (Bührer & Schraudner, 2010; European Commission, 2011, European Commission, 2013b; Ranga & Etzkowitz, 2010).

This chapter presents the theoretical and empirical findings on both gender and KTT that undergirded our research.

9.2.1 Gender and innovation

Industry has increasingly recognized economic benefits, which can be achieved by realizing the potential for creativity and innovation of mixed-gender teams (Gratton, Voigt, & Erickson, 2007; Thomas & Ely, 1996). Østergaard, Timmermans, and Kristinsson (2011), for instance, established that the likelihood of introducing an innovation was 68 per cent higher in groups with about 60-70 per cent of the same gender than in groups that were dominated by one gender. Ashcraft and Breitzman (2007) found that between 1980 and 2005, mixed-gender teams produced the most frequently cited among all US invented information technology patents–with citation rates that were between 26 and 42 per cent higher than on average. Some studies indicate that mixed-gender research teams, as compared to more homogenous teams, communicate and interact more constructively (Jackson, Joshi, & Erhardt, 2003; Kochan et al., 2003; Schone, Bruno, Kugele, & Busolt, 2010) and boast both a higher capacity for innovation (Schiebinger, 2013) and higher analytical effectiveness (Woolley, Chabris, Pentland, Hashmi, & Malone, 2010).

Following Butler; Butler (1993), we define gender as a socially constructed expression of interpersonal, social, and cultural negotiation processes that can vary in different contexts and change over time. Recently, the European Commission has focused on the "gender dimension in research and innovation content" and the promotion of gender equality (European Commission, 2011, European Commission, 2013b), and the scientific community has increasingly recognized this promotion as one of its key responsibilities to the public. National standard-setting institutions such as the German Research Foundation (2008) and the National Science Foundation (2009) in the USA recognize the gender dimension, or gender, as an important component of quality research. Scientific case studies of gendered innovations, a state-of-the-art European-American project, support this view.

In KTT in particular, adhering to the gender dimension can foster a range of new products, services, and methods of production that accommodate public preferences and expand the realm of the technologically and commercially possible (European Commission, 2013a).

The full utilization of gender potential, however, cannot be achieved by increasing the proportions of women alone (Horwitz & Horwitz, 2007; Jackson et al., 2003; van Knippenberg & Schippers, 2007; Williams & O'Reilly, 1998) but by fully integrating the gender dimension into KTT culture (Schiebinger, 2013).

9.2.2 Deconstructing the gender dimension

For the purposes of our analysis and in order to make the construct of the gender dimension accessible, we distinguish between its quantitative and qualitative components and between two levels of KTT, on which it occurs. The gender dimension is considered fully integrated in KTT when each of its components is (Moser, 2007), or, in other words, if: first, in any particular group of participants, either men or women comprise at least 30 per cent and thus can "affect the culture" of this group (Kanter, 1977); and second, both men and women are accommodated in the entire variety of their needs, preferences, and perspectives, both gender specific and otherwise (Acker, 1990; Connell, 2005). While the quantitative integration can be measured and statistically analyzed, the qualitative integration can be assessed through individual perceptions of decision makers and specialists involved in KTT. One crucial factor for a high qualitative integration is the respective organizational culture (Acker, 1990; Schein, 1990).

Organizational cultures manifest themselves through artefacts, processes, behaviors, and perceptions, which affect individual employees, teams, and the entire organization (Schein, 1990). In entrepreneurship, women often constitute a minority and typical management styles lead to their disadvantage (Redien-Collot, 2009). In order to avoid gender blindness and gender discrimination, we need to incorporate the gender dimension into every aspect of organizational culture.

9.2.3 German KTT—and the gender dimension

Germany is a suitable research subject for a number of reasons. One of the major world economies and producers of new scientific knowledge, it has also traditionally been a country with a lack of commercial activity on the part of research institutes (Shane, 2004). Individual researchers and organizations have not typically engaged in academic entrepreneurship, and the first incubators were created in the early 2000s (Wright et al., 2007). Recently, however, attitudes have slowly begun to change (Haeussler & Colyvas, 2011), and the entrepreneurial activities of German universities nearly doubled between 2011 and 2013 (Grave et al., 2014). Such activities, however, remain low, particularly in comparison to many other European countries. Only approximately 1 per cent of all new businesses in Germany are initiated by researchers and/or research organizations (Braun-Thürmann et al., 2010), and both venture capital investments and revenues from licensing and patenting have remained extremely low (European Commission, 2014b). Seeking to foster academic entrepreneurship, many universities and research institutes attempt to motivate more women to initiate start-ups (Commission of Experts for Research and Innovation, 2014a).

On the participation of women in KTT in Germany and particularly academic entrepreneurship, no comprehensive statistics are currently available. All of the few existing studies, however, indicate that the proportions of women are low and tend to decrease with each successive stage of the KTT process. Between 2006 and 2009, fewer than 30.0 per cent of researchers were women (Frietsch et al., 2012), and there were usually less than 8.0 per cent women among patent applicants and in technological start-ups (Achatz et al., 2009; Busolt, Kugele, & Tinsel, 2009). Potential explanations for such low participation of women in the utilization of transfer products can be found in a range of disciplines and particularly in sociological literature. For non-academic startups in Germany, gender differences in success rates (Sternberg et al., 2013), funding (Metzger et al., 2008), motivation (Furdas & Kohn, 2010), and tasks (Baron, Hannan, Hsu, & Kocak, 2007) have been found. (Achatz et al., 2009, 2010) were the first to establish that existing organizational practices in German KTT limit women's capacity to innovate. All of the few existing studies on women's participation in KTT in other industrial countries reach similar conclusions (Etzkowitz et al., 2008; Ranga & Etzkowitz, 2010; Vehviläinen, Vuolanto, & Ylijoki, 2010). Even though individual European countries appear to prioritize particular aspects of KTT, across Europe, its processes typically follow similar patterns (European Commission, 2014b). In order to increase its capacity for innovation and to secure position in the face of global competition, Germany needs and wants to more effectively utilize women's potential in KTT and particularly in academic entrepreneurship (Commission of Experts for Research and Innovation, 2014a; Frietsch et al., 2012). While based on the case of Germany, our general framework is easily adaptable to the specifics of other countries, and can help achieve these goals.

9.3 Method

As mentioned above, no comprehensive studies on the gender dimension in KTT have been conducted. Seeking to fill this gap, we rigorously analyzed the gender dimension in German KTT. Following an abductive approach, we simultaneously collected data and built hypotheses (Suddaby, 2006). In order to gather knowledge of prior research, we conducted a comprehensive literature review. Rather than prove hypotheses, we utilized existing findings to synthesize a variety of sources into one unified framework by building upon existing models (Carlsson et al., 2002; Lundvall, 2010).

In order to gain further insight in social constructs and "reproduction mechanisms" in German KTT (Lamnek, 2008), we conducted 22 key informant interviews. Our goal was not only to collect raw data but to extract and organize relevant information and to enhance our framework. We make no claim that this framework is exhaustive. Its major purpose is to make the construct of the gender dimension accessible and explain the process by which it can be fully integrated in KTT. Our method helped us explore the subject comprehensively and across time–assess both past and current developments and anticipate future ones (Lamnek, 2008)

9.3.1 Analytical framework

KTT can be considered in four different, interwoven contexts, national, structural, organizational, and individual. The first two of these contexts can be attributed to the meta level, and the last two can be associated with the level of operation (Carlsson et al., 2002; Lundvall, 2010).

Table I provides definitions and measures for the gender dimension, both for each component and on each level. Individual context refers to a combination of factors, which affect individual career choice (Notz, 2008). Because it is interwoven with the national, structural, and organizational contexts (Acker, 1990, 2006; Schein, 1990, 2010), it was not considered in our research. On each of these levels, trajectories, and outcomes of KTT are shaped by a complex range of national specifics (Carlsson et al., 2002; Lundvall, 2010).

9.3.2 Literature review

By utilizing methods of Hart (1998) and Isaac, Lee, and Carnes (2009), we selected 120 publications on the gender dimension in KTT including female academic entrepreneurship. We also selected 30 recent publications on national and European political resolutions and initiatives concerning KTT and gender statistics. With the help of CITAVI, each publication was assigned either to the meta-level or the level of operation category. On the meta-level, we distinguished between the (1a) national and (1b) structural categories. Within (1a), each publication was assigned to one of the following subcategories: cross-national studies, national data, national agenda, legislation, and public discourse. Within (1b), such subcategories comprised government, non-governmental organizations, funding stakeholders, cooperating organizations, and other. The (2) level of operation category contained the following subcategories: scientific organizations, transfer organizations, exploring options, development of ideas, research subjects, and academic entrepreneurship. This last subcategory contained its own subcategories, which were spin-offs, patents, and licenses, cooperation between science and industry, and other. Based on our literature analysis, we developed guidelines for key informant interviews (Kumar, Stern, & Anderson, 1993). The analytical frame (Table 10) was the base for the analysis of the key informant interviews.

Table 10. The gender dimension–definitions and measures on each level

LEVEL	THE GENDER DIMENSION – DEFINITIONS AND MEASURES OF
The meta-level—national and structural contexts	**National context** refers to a combination of factors that influence KTT trajectories and outcomes throughout the entire country. In this context, *quantitative* integration can be measured, for example, by countrywide proportions of women who study or work in particular fields such as STEM fields. *The qualitative component* addresses potential gender in national laws and regulations, the socio-political discourse, and countrywide practices and career choice patterns.
	Structural context refers to a combination of factors, which are largely influenced by stakeholders (Freeman, 1984) such as national and European research funds, the scientific community, large-scale investors, incubators, and, in a broad sense, the public. Because such stakeholder provide much of the funding (Egeln et al., 2002; Metzger et al., 2008), they can substantially influence KTT trajectories and outcomes. In this context, *quantitative* integration can be measured, for example, by the proportions of women among decision-makers within the government, the scientific community, and funding agencies. The *qualitative component* addresses the ways in which individual decision-makers, KTT practices, and funding policies are sensitized to gender.
The level of operation—organizational and individual contexts	**Organizational context** refers to the specific settings in which KTT occurs, such as (1) scientific organizations, (2) transfer organizations, TOs, and (3) academic spin-offs. Individual organizational practices (Schein, 1990; Martins and Terblanche 2003) can substantially foster the development of highly marketable transfer products (Faix et al., 2012) and the cooperation between the scientific community and industry. In this context, *quantitative integration* can be measured, for example, by the proportions of women working in TOs or in transfer divisions of scientific organizations and/or involved in the decision-making process, particularly with regard to new research trajectories, research, and commercialization activities. The *qualitative component* addresses the ways in which women's careers develop, positions women occupy, and tasks they perform.

9.3.3 Key informant interviews

We selected interviewees in such a way that they formed a representative sample, which helped us collect sufficient data for testing our framework. These interviewees were former and current employees of either one of the four major German research institutes or of one of the nine leading German universities of technology jointly known as the TU9 alliance.

We invited 32 of these employees to participate in the interviews, and 22, or 68.75 per cent, chose to do so. Among them, eight were senior KTT managers, eight were KTT specialists, and six were owners of KTT-related businesses. The interviewed managers occupied senior positions such as a director of a transfer-oriented institute, a senior government worker, or a head of a business support center. These managers had extensive experience in KTT, and, due to their seniority, their views and agendas carried substantial weight within their organizations (Sharp, Franzway, Mills, & Gill, 2012). Participating specialists had extensive experience in academic entrepreneurship, such as having evaluated business ideas, participated in the grant process, and supported start-ups (Kumar et al., 1993). The six business owners were regarded specialists in the development and utilization of transfer products (Rogers, Takegami, & Yin, 2001). To avoid potential gender biases (Acker, 1990) we included both men and women in approximately equal proportions. Interviewees were on average 46 years of age. The youngest was 35 years and a business owner, and the oldest was 61 and a KTT manager. Each interview lasted approximately 90 minutes. Interviewees were encouraged to speak freely and in much detail, and the above-mentioned guidelines provided a framework for such speaking (Lamnek, 2008). The questions focused on the gender dimension and on KTT in Germany. A number of questions addressed the specifics of interviewees' teams and organizations including objectives, strategies, and practices. The final questions addressed the gender dimension in other countries and comparisons with the situation in Germany. The interview records were transcribed and qualitatively analyzed with the help of MaxQDA software, which supports data processing and is similar to Atlas.ti. By utilizing the original method of Eisenhardt and Graebner (2007) for deriving theories from case studies and building upon our literature review, we extracted and organized relevant information from the collected data and simultaneously inductively expanded and restructured the above-described categories. We continued doing so until each single relevant interview statement was categorized and assigned an explanatory code. For the meta-level category, these additional codes were national mind-set and gender stereotypes. For the level of operation category, they were organizational culture, networks and collaborations, career paths, emotional attachment, behavioral patterns, available resources, and gender biases. In this manner, we could gather different perspectives on the same phenomena and thereby uncover new aspects of the gender dimension in KTT and compare our findings with those of other studies. Theoretical saturation occurred.

9.4 Findings

We were the first to synthesize a variety of sources into a unified framework and to rigorously analyze the gender dimension in German KTT. Our findings indicate that the gender dimension is barely integrated, both quantitatively and qualitatively, and are described in the following chapters. Available statistics suggest that proportions of women in KTT in Germany are low, particularly in comparison to other European countries, decrease with each next stage of the KTT process, and are particularly low in key positions (Busolt & Kugele, 2009; European Commission, 2008; Eurostat, 2014a, Eurostat, 2014b, Eurostat, 2014c; Metzger et al., 2008). Interviews indicate that also qualitatively, the gender dimension is barely integrated. Most interviewees neither attend to the gender dimension in their daily professionally activities nor contemplate its potential benefits. In the following sections, we refer to some of the reviewed publications and provide interview quotations in order to illustrate our findings. In accordance with the main principle of qualitative research, these quotations are intended to support the argumentation rather than provide a representative sample of opinions (Haas & Scheibelhofer, 1998; Parker, 1992) and were selected by their typicality alone. For reasons of confidentiality, only the sexes and positions of quoted interviewees are revealed. These positions are roughly categorized as KTT manager, KTT specialist, or entrepreneur.

9.4.1 The meta level—national and structural contexts

Because domestic stakeholders such as the government, industry, and financial institutions provide much of the funding, they substantially influence KTT trajectories and outcomes including cooperation between science and industry (Egeln et al., 2002; Federal Ministry of Education and Research, 2010; Metzger et al., 2008). On this meta level, we investigated the integration of the gender dimension in both national and structural contexts.

9.4.1.1 The gender dimension in national context

National standard-setting institutions such as the German Research Foundation (2008) recognize the gender dimension, or gender, also sometimes referred to as "gender aspects", as an important component of quality research. The German Council of Science and Humanities, considers women's potential as "indispensable for securing and improving the performance and capacity for innovation in research and science" (The German Council of Science and Humanities, 2012, p. 5). At present, however, gender is included neither in national KTT guidelines nor in academic entrepreneurship support (Federal Ministry of Education and Research, 2010). According to many interviewees, national political resolutions such as quotas and official claims of policy makers have very little impact on KTT practices, including academic entrepreneurship. Continuously reinforced by media, political organizations, and role models (Blickenstaff, 2005), gender stereotypes have a great effect on career choice patterns (European Commission, 2009). Noticeably more men than women initially consider studying a STEM subject and eventually choose to pursue a career in a STEM field (BMBF, 2009) or in KTT. Over the past 15 years, German government made a number of attempts to foster women's participation in research and science, particularly in STEM fields. *"One would expect an increase in women's participation in KTT. But I don't think it's happening, at least not for high-achieving [KTT] researchers*", as one female KTT manager expressed it. Many current family policies and a lack of childcare facilities still impede women's participation in the workforce (Bach, Geyer, Haan, & Wrohlich, 2011) and particularly in KTT. German culture pressures women to conform to traditional gender roles such as that of a caring stay-home mom (European Institute for Gender Equality [EIGE], 2013; Keller & Haustein, 2013).

KTT statistics consistently reflect these socio-political tendencies. Women of childbearing age and men of the same age in KTT often make very different career choices (Haller et al., 2007). The following quotation demonstrates how motherhood can mean career limitations, both in general and in KTT:

That's what we are facing right now, too! The position of Business Field Manager, could we leave it open for a year? Right! We had to fill it. Our prior manager has just had her first kid. She will only be able to work halftime anyway when she comes back, That is, if she comes back. She will probably want to have another kid right away. […] And it was clear to her, too. She wouldn't want to handle the same workload anymore. Yeah […] what were we to do? (KTT manager, female)

This quotation also illustrates how decision makers in KTT can reinforce the disembodied worker model (Acker, 1990; Benschop & Doorewaard, 1998), which relies on permanent availability of employees. This statement was typical for a high-achieving female KTT manager. Even though she was able to reconcile her own career and family responsibilities, she still expected her female co-workers to exhibit a typical "female" behavior by staying on a "mommy track" and resigning to administrative tasks (Benschop & Doorewaard, 1998). Many interviewees agreed that "[…] *KTT careers [are] still only possible for those who do not have 'real' family responsibilities*" (KTT manager, female). Outside of Europe, many interviewees encountered very different professional choice patterns, as the following quotation illustrates:

During KTT conferences in the Middle East and in Asia, we get to meet all these women. Many more of them are managers and much fewer are assistants. And they act differently […], so confident (KTT manager, male).

According to most interviewees, however, younger researchers are less likely to adhere to typical gender behaviors.

9.4.1.2 The gender dimension in structural context

According to the few available statistics, very few among decision makers in German research and science are women. In Europe in 2010, for example, proportions of women in major research funding agencies and committees constituted approximately 36 per cent on average. In German scientific community in 2010, women among stakeholders comprised roughly 21 per cent (European Commission, 2013c). According to interviewed stakeholders, proportions of women are even lower in committees that allocate funding for KTT-related projects. According to two male interviewees, women were often included into such committees merely for “the sake of fairness”. With regard to academic entrepreneurship, there are very few to no women, or representatives of ethnical minorities, among KTT stakeholders such as investors, both in Germany (approximately 5 per cent according to Brettel, 2003; Stedler & Peters, 2003) and in Europe (European Commission, 2002). Interview findings matched all of the few available official statistics. Interviewees have only ever encountered very few individual women among investors or in R&D divisions. At the same time, they observed that such women were “at least as good as the other boys” (transfer manager, male).

In roughly the past decade, the Federal Ministry of Education and Research, the German Research Foundation, and many other organizations invested considerable funds in a wide range of initiatives in order to promote gender equality in the scientific community (see Best et al., 2013 for an overview). Nonetheless, little to no change can be observed with regard to relative participation of women in academic entrepreneurship, as illustrated by the following quotation:

We did everything we could. We changed our advertising. We included mixed-gender teams. We particularly addressed [aspiring] female entrepreneurs […]. We promoted our programs in non-technical fields. We worked with role models. All this effort led to nothing, we could not increase participation of women in academic entrepreneurship [at our university] (KTT manager, female).

Although the quoted manager is not aware of any comparative increase in women’s participation–the overall figures of academic entrepreneurship almost doubled within a few years. Interviewees stated that the relative share of women among them was stable so that undertaken efforts have apparently contributed to an increased overall attractiveness of academic entrepreneurship. This indirect effect has not been reflected by most key informants.

Due to their stakeholder positions, some interviewees were directly involved in agenda-setting and were able to provide some insight. According to them, very few among decision makers are aware of the benefits that can be achieved by qualitative integration of gender as well. As one male KTT manager expressed it, "*Why would they need to pay special attention to women? One has to be really careful with things like that.*"

9.4.2 The level of operation—gender in organizational context

On the level of operation, KTT activities rely upon the complex dynamics of interaction between its diverse participants (Barjak, 2011; Bessant & Rush, 1995; Bozeman, 2000; Kline & Rosenberg, 1986) and are largely affected by organizational practices. Even though male and female researchers show similar potential for innovation early in their professional lives, substantially fewer women than men engage in academic entrepreneurship (Schone et al., 2010). In order to find differences and similarities in KTT practices on the level of operation, we took a closer look at scientific organizations, TTOs; and academic spin-offs.

9.4.2.1 Scientific organizations and TTOs—the development of transferable ideas

In 2010, the proportions of women working in research constituted 30 and 32 per cent in Germany and Europe, respectively, and the proportions of women working in R&D constituted 37 and 39 per cent in Germany and Europe, respectively (Eurostat, 2014a, Eurostat, 2014b). These percentages can provide approximations for proportions of women in the production of transferable findings.

In Germany, the field of KTT is relatively new and appears to be open to flexible working schedules and non-trivial career paths (Achatz et al., 2009). Nevertheless, a pronounced vertical segregation can be observed. In 2012, between 83 and 89 per cent of all leadership positions in research and "nexus" organizations in Germany were occupied by men (Joint Science Conference [GWK], 2013). In view of these proportions, our qualitative findings are perhaps unsurprising. The following quotation indicates what kind of challenges "token women" (Zimmer, 1988) often have to face in predominantly male KTT environments:

It is hard for a woman to find her niche, I believe. […]. [T]here are these 200 researchers around you, almost all of them men. [In this environment] it is hard for a woman to assert herself (KTT manager, female).

Career choice. Even though flexible career options in KTT are available, organizational cultures continue to favor "typically male", "linear" career paths. Women among interviewees considered working in KTT as their second choice after an academic career, which matched the findings of Etzkowitz et al., 2008 in the USA. Many interviewees observed that organizations involved in KTT often employed women part-time and often in marketing or financing, as opposed to purely scientific work (similar observation by Achatz et al., 2009). Seemingly positive flexible schedules in practice often meant career pitfalls because they came with smaller pay checks, less autonomy, and authority, and limited opportunities for entrepreneurial activity. Many interviewees agreed with the conclusions of (Achatz et al., 2010) that women are often perceived as "social", "sensitive", and "communicative", while men are often expected to have a strong "entrepreneurial interest". Women, simultaneously, do tend to conform to prevailing social and professional expectations (e.g. Achatz et al., 2009), as illustrated by the following quotation:

Our head of marketing is a woman, of course. […] to me, one of...one of the secrets to success is this healthy, balanced mix of "male" and "female" mindsets, approaches, and communication styles […] (KTT manager, male).

While men among interviewees perceived conventional career paths as "normal" rather than "typically male", women often expressed their frustration with the fact that the system continued to favor such paths and viewed this phenomenon as the major reason for the existing vertical segregation. Furthermore, those women who occupied senior positions in KTT or were engaged in academic entrepreneurship, admitted having rarely complied with conventional gender roles and other social expectations.

Cultures and networks. Most women among interviewees found that predominantly male working environments "make it difficult for women to fit in" (KTT entrepreneur, female). According to studies conducted both in Germany (Achatz et al., 2010; Achatz & Hinz, 2001; Jaksztat, Schindler, & Briedis, 2010) and across Europe (Blickenstaff, 2005; European Commission, 2008), such environments contribute to high career drop-out rates of women in KTT and STEM fields. Most interviewees pointed out that by being predominantly male, primary decision makers in German KTT build a homogenous and rather exclusive group. Within this "old boys' club" (Connell, 2005), important business decisions including HR decisions are often made through informal arrangements. As one female KTT manager expressed it, "*It is still very hard for women [to network] sometimes, and to assert themselves, among all these 'fellow networkers'*".

Overall, the interviewees' responses indicate that organizations involved in or related to KTT reinforce typically "male" work and communication styles, particularly with regard to senior management positions (Acker, 1990; Faulkner, 2006; Matthies, 2001). At the same time, younger employees appear to be less driven by the values of the competitive high-performance culture (Wimbauer, 1999), to which the vast majority of scientific organizations continue to adhere. According to studies conducted on performance drivers of female researchers both inside (Bührer, Hufnagl, & Schraudner, 2009; Schone et al., 2010) and outside of Germany (Corley & Gaughan, 2005), women more often consider certain aspects of team culture as crucial for both their personal and professional well-being. Women can be particularly motivated by environments in which they feel that they belong, receive recognition, can constructively interact with their superiors and co-workers, and can identify with their projects. Among interviewees, KTT managers–male and female–dissociated themselves from these positions. Not only many younger women but, interestingly, younger men shared these attitudes.

Potential benefits. All of the very few existing related studies indicate that the gender dimension is barely integrated into research projects (Bührer et al., 2009; Ranga & Etzkowitz, 2010; Schiebinger, 2000). Women have considerably less opportunity to contribute to decision making, particularly co-determine new research trajectories (Bührer & Schraudner, 2006; Pollitzer, 2013), and such decision making is barely sensitized to gender. Most interviewed decision makers neither recognized potential commercial benefits of attending to the gender dimension nor considered such attending as their direct responsibility, as illustrated by the following quotation:

I do, in fact, think more about markets as such, and products, like, for example, cars or all that biomass stuff, and way less about how some people are eventually going to consume all that. And I am still not *sure, should it be my responsibility? Shouldn't the manufacturer take care of that? It is, really […] let me phrase it as a question: should it be part of KTT, or part of industrial marketing, or part of manufacturing?* (KTT manager, male).

At the same time, these decision makers were open to the idea of approaching daily situations in a more gender-aware manner. As one male KTT manager expressed it, "Gives one a change of perspective!". A very small number of interviewees were not aware of any gender biases, as the source of the following quotation:

I am very passionate about KTT, I really found myself there. And it's almost charity work, what I do. But this gender thing […] I have never really concerned myself with that […] possibly because, to name one reason, I already live in a gender-balanced world (KTT manager, male).

Many interviewees believed that a dearth of HR managers often prevented organizations from exploring new approaches, particularly with regard to the gender dimension. Furthermore, they did not believe that organizations recognized the benefits that can be achieved by increasing women's contribution. Many interviewees observed that KTT managers were often skeptical about women's ideas and reluctant to support these or to change existing practices, as illustrated by the following quotation:

[…] but we also can't really begin investing into, let's put it this way, less promising business ideas, in order to just have more women in our portfolio. We have to be careful here (KTT manager, male).

9.4.2.2 The utilisation of KTT products—academic entrepreneurship

In Germany, cooperation between scientific and industrial organizations constitutes the most common form of academic entrepreneurship, respectively, KTT products (Faix, Gerhards, Köller, & Volkmann, 2012). Other forms include patenting, licensing, academic spin-offs, publications, and human interaction such as consulting activities and conference talks (Rogers et al., 2001).

As compared to many other European countries, women in Germany submit fewer scientific articles and patent applications (Haller et al., 2007; Naldi et al., 2005) and a very small number of them can be found in highly technological start-ups. While 90 per cent of such start-ups in 2009 were founded by all-male teams, only 8 and 2 per cent were founded by mixed-gender and all-female teams respectively (Metzger et al., 2008; confirmed by Sternberg et al., 2013). Interviewees' observations matched these findings. In the following two sections, we further identify potential causes.

Resources and stereotypes. Throughout of the European Union, female researchers, as compared to male researchers, appear to have: first, less time for research, ideation, and quality discussions; second, worse access to resources such as money, lab time, training, and manpower (Busolt & Kugele, 2009); and third, less opportunity to network within the scientific community (Ding & Choi, 2011; Schubert & Engelage, 2011). Family obligations are the major reason why women engage in academic entrepreneurship less often than men according to a study by Busolt and Kugele (2009). Most men among interviewees were not aware of any specific barriers that women need to face on their way to academic entrepreneurship. At the same time, many interviewees observed that women with children often preferred to have longer- or unlimited-term employment contracts. No interviewees mentioned a man expressing such preferences, which can be viewed as a gender-based attribution (Butler, 1997). Statistics show—for Germany and Europe—that male scientists do have longer- and unlimited-term contracts more frequently than female scientists (GWK, 2013).

On the other hand, many interviewees believed that men, as compared to women, more readily assumed "patent leadership", or, in other words, initiated patenting and licensing processes and assembled the necessary teams. Most men among interviewees did not see the connection between these narratives and the facts that: first, women are typically associated with motherhood and typically have to carry a greater load of family responsibilities; and second, that established cultures typically favor male-gendered approaches. The following quotation provides examples of such an unconscious gender bias and of a common attribution on "routine accomplishment" (West & Zimmermann, 1987):

Women often have so many concerns. Men can just focus on something completely and forget about everything else. That's our way of looking at things. Women's [way] appears to be more complicated. They see it all, risks, potential challenges, and such, and they have to consider them all, and all of them seem to matter equally (KTT specialist, male).

This quotation also illustrates how the KTT system favors typically male approaches. Many interviewees observed that it was more difficult for women to convince selection panels of their ideas because they were more aware of potential risks. And many interviewees spoke of other typically female traits that can be a disadvantage:

Women are naturally disadvantaged when they present their business ideas because they have higher-pitched voices. Men's voices sound "full", perhaps humming. When women are nervous, they sometimes have these shrill voices. Surely, that cannot be for their advantage (KTT specialist, male).

In this environment, [reserved behavior] is a disadvantage because no one can see you. Such behavior and what it can lead to is what distinguishes women from men (Entrepreneur, female).

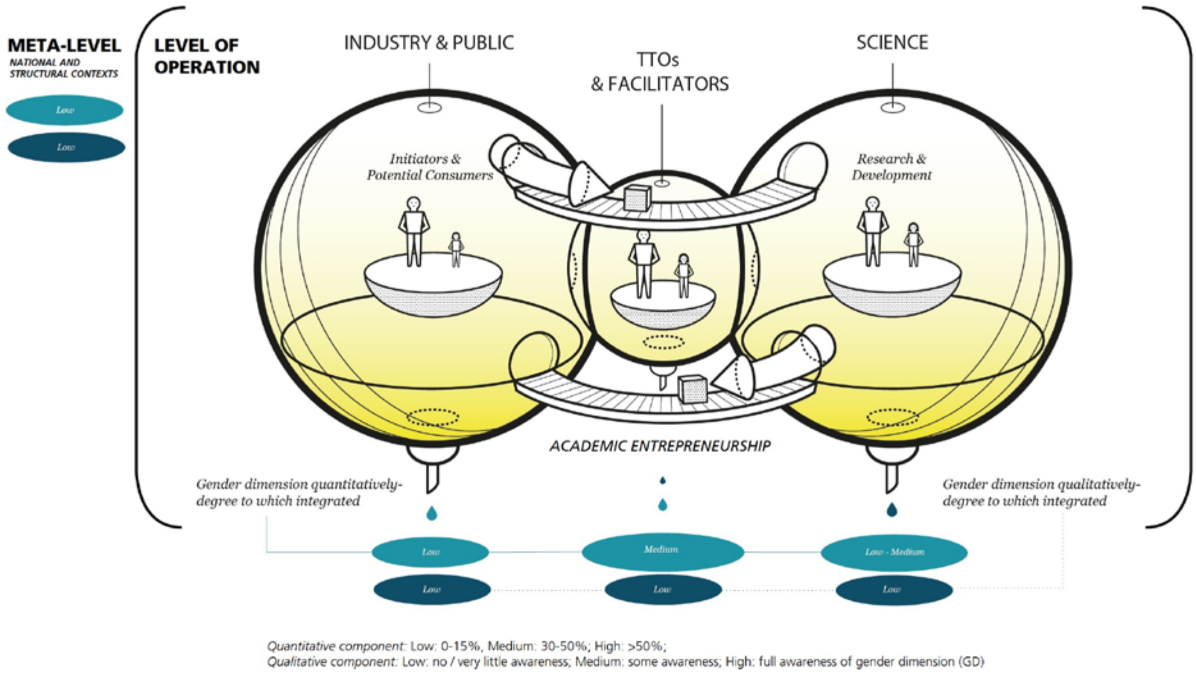
Entrepreneurial cultures. In general, our findings matched those of many studies on the disadvantages that women experience in KTT and particularly academic entrepreneurship (Redien-Collot, 2009). Many interviewees involved in academic entrepreneurship observed that women more often aspired to stable, long-term growth of their businesses, which matched the findings of Lauxen-Ulbrich and Leicht (2005) and Metzger, Heger, Höwer, and Licht (2010) on non-academic start-ups. The findings of Metzger (2015) suggest that women tend to engage in entrepreneurship later in their lives and after they have reached higher levels of education. Common business support practices, however, continue to support younger entrepreneurs and to cultivate male-gendered norms and values (Benschop & Doorewaard, 1998), which can be seen from the following quotation:

[Current and aspiring] female entrepreneurs often tell me about the difficulties they experience with our "traditionally-minded" consultants. And if we ask ourselves, why, and take a closer look, we'll see that most male entrepreneurs have very strong ideas of how businesses should be […]. This is so typical. The one and only goal is to maximise the profit (KTT specialist, female).

The fact that the system favors male-gendered approaches appears to have yet another interesting effect. In many technological start-ups known to them, many interviewees were able to observe two CEOs. The "official" CEO, a man, had one single responsibility of representing the business to the "outside world", while the so-called "hidden CEO", a woman, carried the rest of responsibilities that CEO positions usually entail. These observations indicate that in academic entrepreneurship, women still tend to avoid to or are hindered to take senior-authority positions even when they possess the necessary skills. All gender-biased attitudes and practices described above have been observed not only in academic entrepreneurship but, in mostly the same ways, in every other KTT stage.

9.4.3 Summary

Our study was the first to explore both the qualitative and quantitative components of the gender dimension across all stages and levels of German KTT, including academic entrepreneurship, and resulted in the development of an analytical framework. With the help of this framework, we first, explored in what ways and in to what degree the gender dimension was integrated; and second, identified starting points for increasing such integration. Most findings on the qualitative component, including potential explanations for observed phenomena, stem from interviews. Our framework and major findings are shown in Figure 7.



Notes: Quantitative component: low: 0-15 per cent, medium: 30-50 per cent, high: >50 per cent; qualitative component: low: no/very little awareness, medium: some awareness, high: full awareness of gender dimension (GD)

Figure 7. *Stages and participants of knowledge and technology transfer and the degree of integration of the gender dimension.*

Our findings indicate that the gender dimension is barely integrated on both the meta level and the level of operation, which manifests itself both first, quantitatively, through the fact that proportions of women are low and often decrease with each successive step of the KTT process, and second, qualitatively, through the facts that the gender dimension is barely integrated into research projects and entrepreneurial activities and that women have substantially less opportunity to contribute to decision making and the development and utilization of KTT products, such as spin-offs, patents, licenses, commercial products, and occurrences of HR transfer. This difference in contribution to academic entrepreneurship can be largely attributed to the fact that the most common employment models require full-time commitment and high conformism with the male-gendered culture.

9.5 Conclusions and outlook

By following an abductive approach and building upon existing models (Carlsson et al., 2002; Klofsten & Jones-Evans, 2000; Lundvall, 2010; Moser, 2007), we conducted a comprehensive literature review and 22 key informant interviews. We were the first to synthesize a variety of sources into one unified framework and to rigorously analyze the gender dimension in German KTT with a focus on academic entrepreneurship. Our analytical framework and major findings are shown in Table 10 and Figure 7.

Our findings indicate that both the quantitative and the qualitative components of the gender dimension are barely integrated on both the meta level and the level of operation. Law and regulations, funding policies, and (cultural) gender stereotypes, the overrepresentation of men among stakeholders and decision makers in KTT, and fairly inflexible "men-oriented" organizational practices (Benschop & Doorewaard, 1998) limit the opportunity for women to contribute. They continue to reinforce fairly inflexible gender norms (Redien-Collot, 2009) and notions of masculinity (Connell, 2005).

Interviewees were unanimous that in order to fully integrate the gender dimension in KTT, we will need to develop new approaches. By accommodating both men and women in the entire variety of their needs, preferences, and perspectives, both gender specific and otherwise, we can help them be successful and thus secure competitive advantage (Bührer & Schraudner, 2010; European Commission, 2011, European Commission, 2013a; Schiebinger, 2013). By elucidating key components and complex dynamics of the KTT process, our framework can help achieve these goals.

For KTT stakeholders, findings of (Marom et al., 2016) are of particular interest.

The authors found a significant positive correlation between the proportions of women among investors and in start-ups that they invest in. Furthermore, women have been found to pursue different business goals and to target different markets than men. In view of these findings, an increase in the number of female investors should lead to both a greater number and a greater variety of new business ideas. For KTT organizations, our findings indicate a rather controversial situation. Proportions of women among transfer managers, for example, appear to be relatively large, and many interviewees were aware of potential benefits, which could be achieved by integrating the gender dimension, particularly qualitatively. At the same time, common organizational practices continue to prevent women from contributing, and many decision makers are reluctant to change their habitual attitudes. In order to be fully integrated, the gender dimension must be incorporated into every aspect of organizational culture (Schein, 1990). By re-envisioning their practices, organizations can encourage more women to engage in academic entrepreneurship and increase the commercial impact of KTT (Rosa & Dawson, 2006; Rossi, 2010). An especially effective way to attract more women could be expanding performance measures to include more than publication productivity and introducing broader, quantity and quality based, more gender-sensitized reward systems (Kolb & Wagner, 2015; Renault, 2006). Another way for organizations to motivate more scientists to consider commercialization activities in general is deliberately promoting academic entrepreneurship to their employees (Gottschalk & Niefert, 2011; Kolb & Wagner, 2015).

Our framework and findings can help decision makers in academic entrepreneurship, both in- and outside of Germany, develop new management strategies, set new political agendas and, ultimately, foster knowledge production and distribution (Tippmann & Mangematin, Vincent, and Scott, Pamela S., 2013). Research on national and regional specifics in entrepreneurial behavior (Kalantaridis & Bika, 2011) and cultures allows for valuable insight into how the KTT process can be adjusted on a larger scale. By more closely looking at those entrepreneurial teams in which proportions of women are unusually high, we can elucidate further starting points. Cross-national studies on such teams, both in- and outside of the European Union, can help identify the most effective approaches, particularly with regard to the level of operation.

Due to our research design, our findings address the situation in Germany. By looking at available statistics, however, we expect to observe similar situations in many other industrial countries (Corley & Gaughan, 2005; Ding & Choi, 2011; Klofsten & Jones-Evans, 2000; Marlow & Patton, 2005; Rosa & Dawson, 2006; Thursby & Thursby, 2005). By integrating the gender dimension, particularly its qualitative component, into national funding policies and KTT practices; we can substantially increase women's contribution and thereby foster KTT. Therefore, we join the European Commission (2011) in its appeal to "fix not only the numbers, or the knowledge, but, most importantly, fix the organizations".

10 Paper III: Uncovering transfer—a cross-national comparative analysis[28]

10.1 Introduction

"*Technology is like sugar, you cannot just ship it all over the world, you have to package it, and these packages are called companies.*" (KTT manager, male)

Strong knowledge and technology transfer (KTT) is necessary for driving economic growth and increasing the capacity for innovation. While science, industry, and policy continue to hybridize, state funding agencies are increasingly evaluating proposed projects with regard to their estimated capacity to benefit the public. These communities are therefore increasingly recognizing the value of public input and the need to respond to public needs within the innovation process (The German Council of Science and Humanities, 2016). These developments necessitate that new ways and more effective methods for cross-sector interaction be developed (Etzkowitz et al., 1998; Etzkowitz

[28] The findings were presented at the "Academic Entrepreneurship, and Knowledge and Technology Transfer" conference in Kassel in April in 2016. More advanced findings were presented at "Knowledge, Innovation and Technology Across Boarders: Setting Research Agendas (KITAB)" conference in Tallinn in June 2016 and at "University-Industry Interaction Conference" in Dublin in June 2017.
The paper is the post print version and can be cited as: Sinell, Anna; Iffländer, Vivien; Muschner, Antonia (2017). Uncovering transfer - a cross-national comparative analysis. In: *European Journal of Innovation Management 27* (80). DOI: 10.1108/EJIM-01-2017-0006. Available at: https://doi.org/10.1108/EJIM-01-2017-0006

& Leydesdorff, 2000; Ranga & Etzkowitz, 2013b). In this regard, knowledge and technology transfer (KTT) is becoming increasingly important for all four major stakeholders of the innovation system–science, industry, policy, and society (Carayannis & Campbell, 2009).

However, much effort on the part of various stakeholders across Europe has thus far achieved rather little result, which particularly applies to Germany. While it enjoys international recognition for its economic advancement and capacity for innovation, its publicly funded academic institutions are often reluctant to embrace their "third mission"–in addition to conducting research and providing education, to transfer findings and inventions (The German Council of Science and Humanities, 2016, p. 6). Consequently, academic institutions rarely set specific goals with regard to transfer, let alone develop systematic plans for their achievement (The German Council of Science and Humanities, 2016, p. 8): within the academic community, the number of publications remains the most common measure of academic performance (The German Council of Science and Humanities, 2016) and therefore practically the only method of transfer.

In Europe in general, according to the European Commission, "technology transfer today shows similarities with an emerging industry: many valuable product ideas, a highly fragmented landscape, a lack of critical mass, and wide disparities in terms of performances and developing practices" (European Commission, 2016a). The European Commission, however, expects "profound changes in the KTT landscape within the next decade" (European Commission, 2016a) because of the increasing numbers of national and transnational incentive initiatives.

Major policy actors seek to support academia in their efforts and thus promote the multidirectional transfer process. In its HORIZON 2020 funding program, the European

Commission has stated that a major funding criterion will be the proposed projects' capacity for societal impact (European Commission, 2016b). The purpose is to more closely align research activities with the needs of the public, industry, and the government, thereby producing more socially relevant research findings. In addition, its Union Flagship initiative (European Commission, 2010) is intended to support the formation and operation of knowledge transfer offices in publicly funded research institutions, particularly through transnational collaboration. The European Commission has also founded the European Institute of Innovation and Technology (EIT), intended to help such institutions more actively engage in transfer activities, and specifically to produce academic spin-offs (European Commission, 2014b).

Regarding transfer as necessary for increasing the national capacity for innovation, industry actors likewise increasingly recognize the value of collaborating with academia. As the national innovation systems continue to evolve, so do the ranges of responsibilities of corporate R&D departments, thus increasing their need for acquiring cross-sector knowledge (Dolata, 2015; Schasse, Belitz, Kladroba, & Stenke, 2014). At the same time, a dramatic decrease in research project funded by industry, measurable in Germany over the past several years, clearly indicates the necessity of improving transfer (Schasse et al., 2014).

Finally, actors in academia itself recognize that they need to more actively play their multi-faceted role in transferring academic knowledge and theoretical insights to industry and the public (Bishop et al., 2011; Grimaldi et al., 2011; Lester, 2005; Wright et al., 2008). In this context, technology transfer offices (TTO) are becoming indispensable in their capacity as intermediary agencies between science, industry, and policy. These offices were first institutionalized at research institutions pursuant of the Bayh-Dole Act, adopted in the USA in 1980, which was intended to help commercialize these research institutions' intellectual property (IP) (Grimaldi et al., 2011). Siegel and Wright (2015b, p. 2) define transfer offices as "intermediaries between suppliers of innovations (university scientists) and those who can potentially (help to) commercialize these innovations (i.e., firms, entrepreneurs, and venture capitalists)." Building on this definition, we regard these offices as the key intermediary agencies between the four major elements of the innovations system: academia, industry, policy, and society, and also as major managers of transfer. In this capacity, they serve as the subject of this study.

As the actors in transfer processes become extremely diverse, so do the forms that transfer takes. While some of these forms, such as patents, licenses, and academic spin-offs are quantifiable, others, such as contract research, consulting, and academic collaboration across institutional and national borders and have impacts that can be difficult to assess (Etzkowitz & Leydesdorff, 2000; Grimaldi et al., 2011; Perkmann & Walsh, 2008; The German Council of Science and Humanities, 2016). Because of this complexity, individual transfer offices might have very different, and often diverse, responsibilities. Because spin-off formation can be particularly complex and thus require non-trivial approaches, this study takes a closer look at how transfer offices implement academic entrepreneurship.

Even though the value of transfer offices for their national innovation systems is being increasingly recognized, no comparative cross-national studies on their practices have been conducted until now (Clarysse et al., 2007; Fini et al., 2017). While ways of supporting transfer offices have enjoyed a vast amount of scholarship (see for reviews Perkmann et al., 2013; Siegel & Wright, 2015b), researchers from different disciplines have observed the necessity of more closely examining the interplay between goals, actors, and modes of operation (Siegel & Wright, 2015a). Rasmussen and Wright (2015) state that "some universities are successfully involved in creating and developing new high-growth technology businesses while others struggle to do so" (Rasmussen & Wright, 2015, p. 782) and argue that "if spin-off creation [as one form of KTT] is to be a successful endeavor at more than a few universities, more knowledge is needed on how this activity could become integrated and mutually beneficial to the activities at all levels within the university" (Rasmussen & Wright, 2015, p. 795). Likewise, the European Commission stresses the necessity to develop "mechanisms to further strengthen knowledge transfer offices in public research institutions, in particular through transnational collaboration" (European Commission, 2010).

In view of these developments, the purpose of this study was to examine the transfer offices of leading, (internationally) recognized research institutions in five different countries (Germany, Sweden, Switzerland, Italy, and Israel). The goal was not to uncover the universal secret for other organizations to learn–as we later found, the degree of variation within the sample would have made such a task extremely challenging (Grimaldi et al., 2011; Lautenschläger et al., 2014; Rasmussen & Wright, 2015). Instead, we addressed the following research questions: *Which individual characteristics of the offices under study, such as their goals and practices, account for their high levels of transfer activity? Are there consistent relationships between these characteristics and, if so, are these relationships part of the explanation?* The data analysis resulted in the development of a TTO typology, which can support inter-organizational and international transfer collaboration.

This paper first presents the theoretical framework and empirical findings that supported our re-search (section 10.2), followed by our methodology (section 10.3) and empirical findings (section 10.4), and concludes with a discussion of the results (section 10.5) and implications for future research (section 10.6).

10.2 Theoretical background

KTT and methods for its promotion have enjoyed an increase in scholarly interest and study within a variety of disciplines over the past 30 years , often with a focus on technology transfer offices (TTOs) as a subject of research. Reviews of existing literature (Perkmann et al., 2013; Rothaermel et al., 2007; Siegel & Wright, 2015b) have suggested that merely establishing technology transfer offices does not appear to automatically improve KTT in the long term, a position borne out by several recent studies (Baldini et al., 2015).

Following Meißner and Sultanian (2007), we regard knowledge and technology transfer as a "structured, typically multidirectional exchange of scientific findings and results, including those that are intermediary, between diverse actors within the innovation system, which seeks to produce highly welcome innovations by responding to public needs" (Meißner & Sultanian, 2007, p. 6) and which can take many different forms as described above.

Traditionally, number of publications has served as the major performance measure in the scientific community. Therefore, researchers have always been motivated to publish and scientific publications have constituted the most common method of transfer. Because our goal was to explore other, less developed methods, publications as such a method lie outside the scope of this paper.

Academic spin-offs, on the other hand, are currently considered to play the primary role in KTT because they have a broad range of long-term advantages. For example, they help transfer scientific innovations directly to the public, create jobs, and promote national competitiveness and business growth (Auer & Walter, 2009; Bijedić et al., 2014; Lautenschläger et al., 2014). Because of their tremendous capacity for innovation, they can produce profound economic impacts that will span multiple markets (Dickel, 2009).

According to Lundvall (2010), innovations always originate within a national innovation system, the boundaries of which are coextensive with national borders. This system consists of different elements, such as policy, industry, and science. A dynamic interaction of these elements leads to the constant production and exchange of new knowledge (Lundvall, 2010). This framework thus supplements a previous model of the innovation system, one that viewed it as a "static," unidirectional transfer from science to industry (Leontief, 1941), by recognizing the contributions of multiple actors, such as scientific, industrial and political organizations, and their influence on the R&D process within the entire nation.

In a time of global markets, innovation processes can be highly complex and difficult to man-age, particularly with regard to the exchange of tacit knowledge. When actors come from the same national environment and thus have similar social and cultural values, it is more likely that KTT and the innovation process will be successful (Lundvall, 2010). The successful integration of policies and programs from another innovation system, however, requires a deep understanding of how the foreign system works.

The model of the innovation system can be expanded to that of an ecosystem in which multiple organizations collaborate beyond the industry borders (Autio & Thomas, 2014). Such ecosystems include not only production participants, as do clusters and innovation networks, but also use-side participants (Autio & Thomas, 2014). Thinking in terms of ecosystems draws the attention to the connections between their multiple actors and ultimately enables new forms of shared reflection through co-creation und co-evolution (Adner & Kapoor, 2010). TTOs constitute a relevant part of such ecosystems and are influenced by other institutional actors, logics, and governance structures. In their capacity as intermediaries between science, industry, and society, TTOs can greatly enhance their collaboration and ultimately the innovation ecosystem.

Building upon Lundvall (2010) and Best, Sinell, Heidingsfelder, and Schraudner (2016), we distinguish between two different levels of influence on KTT, the meta-level and the level of operation. The former can further be divided into national and structural sublevels and the latter into organizational and individual.

The national sublevel refers to the influences on KTT trajectories and the interaction between different KTT actors throughout the entire country. These influences include national laws, policies, and regulations. In Germany, for example, administrative procedures necessary for starting a business typically require a large investment of time and financial resources (Commission of Experts for Research and Innovation, 2014a). Other such influences are established cultural norms and values, such as attitudes toward entrepreneurship or gender stereotypes, which in turn affect individual career behavior. Dautzenberg et al. (2013) found that in Germany, an entrepreneur is typically expected to be male, which might be one major reason for a small proportion of women among entrepreneurs.

The structural sublevel refers to the influences by different stakeholders, such as national and European research funds, the scientific community, large- and smaller scale investors including venture capitalists, incubators, and, in a broad sense, the public. Because such stakeholders typically provide much of the funding, they can substantially influence KTT trajectories and outcomes. Kulicke and Leimbach (2012) found that in Germany, if a start-up receives financial support (in the form of government funding or venture capital) around the time it was created, its chances of success increase. Gender also constitutes a structural factor, for example, because higher proportions of women among investors have been found to lead to higher proportions of women in stat-ups (Brooks et al., 2014; Brush, Green, Balachandra, & Davis, 2014; Marom et al., 2016; Metzger, 2015).

On the level of operation, the organizational sublevel refers to the influences on work processes within individual scientific organizations and their TTOs. These influences include organizational strategies (vision, mission statement), practices (HR policies, standard procedures), and culture (established values, basic assumptions) (Martins & Terblanche, 2003; Schein, 1990).

These influences can be more direct than and thus override the influences on the national sublevel. In relatively entrepreneurship-unfriendly countries, for example, services provided within individual research institutions can increase academic spin-off formation (Grimaldi et al., 2011). Such services that have been found to be particularly successful include the integration of entrepreneurship in the mission statement (Huyghe & Knockaert, 2015a), start-up support, and the existence of transfer offices with experienced and interdisciplinary staff (Caldera & Debande, 2010b; Lautenschläger et al., 2014; van der Sijde et al., 2014). Rasmussen et al. (2014) found that support provided at the department level was more crucial for academic spin-off formation than support at the university level.

Within the increasing amount of scholarship in the field of KTT, the organizational sublevel has received the most attention (see for reviews Grimaldi et al., 2011; Perkmann et al., 2013; Siegel & Wright, 2015b) probably because research institutions increasingly regard KTT as their third mission. While TTOs have typically focused on achieving financial returns from patenting, licensing, and academic entrepreneurship, their focus is shifting towards building entrepreneurial ecosystems, promoted by state policies and intended to benefit the public (Siegel & Wright, 2015a). These ecosystems primarily comprise incubators, the number of which continues to increase, entrepreneurship education, the involvement of surrogate entrepreneurs, and alumni support.

These developments influence which services TTOs provide and to whom. While their clientele have typically been researchers, they increasingly include students, alumni, industry, and surrogate entrepreneurs. In keeping with these developments, Siegel and Wright (2015a) propose attending to the questions of why, what, who, and how in the analysis of transfer practices, which we build upon to identify the characteristics of transfer offices both within and across the five countries:

Why

Thus far, little research has been done on the reasons of strategic KTT decisions, such as that to prioritize a specific method of transfer in a specific field. Another promising area for future study may be the measures of TTO performance.

What

TTO services are becoming increasingly diverse and currently include incubators and entrepreneurship education. One of the major questions currently facing TTOs is that of the new types of start-ups and of the needs of prospective founders. Students, for example, increasingly often choose social entrepreneurship. Start-ups in this area require different forms of support than those that are more business-oriented, which needs to be taken into account in entrepreneurial training.

Who

While actors in academic entrepreneurship are becoming increasingly diverse, scientific organizations continue to search for new ways to encourage researchers to engage in entrepreneurship, for example, through tenure or remuneration. Other major questions concern TTOs: Whom do they need to address with their services? What backgrounds might be most suitable for TTO staff? How can competent, diverse candidates be found?

How

Typically, they are a university's highest authorities who provide TTO funding and determine their primary objectives. What is the most advantageous way for universities to govern their transfer activities and which factors (e.g., research strength, location) can foster a university's entrepreneurship ecosystem?

Finally, the individual sublevel refers to influences on individual career choices and is interwoven with the national, structural, and organizational sublevels. Bercovitz and Feldman (2008), for example, found in their study that the reasons why 1,780 faculty members engaged in transfer activities depended not only on these members' individual characteristics, but also the characteristics of their work environments. Moog et al. (2015) have shown that researchers with more diverse skills and experience were more likely to initiate start-ups, which reflected the findings of other studies (Abel-Koch, 2015; Bijedić et al., 2014; D'Este, Mahdi, & Neely, 2010; Shane, 2000). Because engaging in transfer activities would require individual researchers to modify their role identities, scientific organizations can help their employees to overcome this barrier by promoting hybrid role identities (Jain et al., 2009).

Mixed-gender teams have been shown to boast higher analytical effectiveness (Bear & Woolley, 2011) and women's participation in the innovation process has been shown to increase the range of business ideas, particularly those responding to specific individual or market needs (Lauxen-Ulbrich & Leicht, 2005). Women-owned businesses have been shown to develop steadily and to remain stable in times of crisis, which can help promote longer-term job security (Dautzenberg, 2010; Reichborn-Kjennerud & Svare, 2014). However, very little research has been done on the factors that can encourage women to participate in KTT. Assuming that an increase in this participation can help foster the national capacity for innovation and open new markets (Best et al., 2016; Bührer et al., 2009; Bührer & Schraudner, 2010), our study also addresses the question of gender and diversity in KTT.

10.3 Methodology

The goal was to examine the transfer practices in a number of leading, internationally recognized research institutions, which was accomplished using analytical framework described in the previous section. Five countries were chosen for the study. Germany, Sweden, and Switzerland were selected be-cause their start-up cultures are similar. Start-up culture is defined here as the "entirety of all economic, political, and social factors that influence the frequency and quality of start-ups" (Koch, 2000) and also as a national system of shared values in a country that recognizes and supports entrepreneurship (Ireland, Tihanyi, & Webb, 2008). Even though Israel differs from the other countries in this regard, we included it because of its well-recognized achievements in academic entrepreneurship. Finally, we identified Northern Italy as a Europe-wide innovation hotspot, which, primarily with the help of EU funding and of the European Institute of Innovation and Technology, has recently developed a strong innovation ecosystem. Because these five countries had similar levels of economic, social, and technological development, the approaches of their transfer offices could be easily compared.

The study concerned the overall research questions (see section 10.1), particularly the following and similar matters: Is there a commonly understood meaning of the expression "knowledge and technology transfer" within each of the five countries and, if so, how do these meanings compare to one another? What goals do TTOs in these organizations pursue, what practices do they follow, and how do these goals and practices compare to others within their own country and the other four countries in the sample? Assuming that a diversity of perspectives enhances the innovation process, what role do gender and disciplinary diversity play in these countries' transfer practices?

Across these five countries, we chose 25 research institutions, between four and eight in each country, that enjoy (international) recognition for their high levels of transfer and commercialization activities. In these organizations, we conducted 32 qualitative interviews with 35 senior KTT managers (mostly CEOs and CCOs) about the above questions. These interviews were distributed between countries as shown in Table 11.

Table 11. The number of organizations and individuals interviewed in each country

	GERMANY	SWEDEN	SWITZERLAND	ITALY	ISRAEL	TOTAL
Organizations	8	4	3	4	6	25
Individuals	12	4	5	6	8	35

Each interview lasted approximately 90 minutes. Being "part of the field of study under examination" (Meuser & Nagel, 1991), interviewees acted in the capacity of transfer experts. Furthermore, due to their seniority and/or social standing, they had comprehensive knowledge about their organization's goals, internal arrangements, and decision-making processes. Contrary to other types of qualitative interviews, which regard the interviewees and the full range of their observations and opinions as the subject of research, our method allows us to encourage interviewees to speak freely on a given subject and then to extract relevant information. The framework for this speaking was provided by interview guidelines, which we developed by building upon a literature review.

The analysis of the collected protocols was threefold. First, we gathered descriptive statistics on the transfer practices in each country by extracting and organizing these practices' key characteristics (e.g., what was the commonly understood meaning of "KTT" within a particular office and whether the transfer process was consequently considered to be uni- or multidirectional). This phase was conducted by utilizing Mayring's method of open-end, qualitative content analysis to rigorously "make conclusions about the interaction specifics" (Mayring, 2010). In the second phase, we enhanced the statistics by building on the above-described framework of Siegel and Wright (2015a) and assigning the identified attributes to four different categories.

Finally, we developed a TTO typology by compounding the identified attributes. In social research, such typologies help better organize acquired information and thus make complex phenomena more assessable (Bohnsack, 1989, 1991; Dietz, Matt, Schumann, & Seus, 1997; Gerhardt, 1986; Honer, 1993; Ludwig, 1996; Nagel, 1997). The procedure used was built on the concept of attribute space and included the typological operation of reduction (Barton, 1955; Lazarsfeld, 1937; Lazarsfeld & Barton, 1951). Applying this empirically sound procedure (Kluge, 1999), we identified multiple TTO types, to a large degree reflecting the transfer offices in the sample.

Increasing the level of abstraction, we condensed these multiple types into two compound "ideal" types, the purpose of which was to highlight those characteristics of the examined organizations that can help explain their high levels of transfer activities and to illustrate the relationships between these characteristics. The goal was to maximize both the within-type homogeneity and between-type heterogeneity of the assigned attributes (Bailey, 1994; Friedrichs, 1983; Haupert, 1991; Kluge, 1999; Sodeur, 1974). These types were thus "fictional" mental constructs, not existing in the material world (Weber, 1995), and did not represent any of actual transfer offices known to us, which typically combine characteristics of both types.

In the following section, we present our findings, including the descriptions of these two types (see Table 3 below), the characteristics of examined transfer offices, and a selection of quotations. This selection is not intended to provide a representative sample of opinions, but to best illustrate the identified characteristics (Haas & Scheibelhofer, 1998). The quotations were therefore chosen in accordance with the main principle of generalization in qualitative social research. For reasons of confidentiality, only the positions and sexes of quoted interviewees are revealed.

10.4 Findings

10.4.1 The meta-level

This section describes major meta-level influences on the innovation process in the five countries and thus KTT actors' decisions on the level of operation. These influences include laws and regulations, funding programs, and national alliances and are shown in Table 1.

Laws and regulations

In Germany, Switzerland (Schilling, 2014, p. 78), Italy (Organisation for Economic Co-operation and Development [OECD], 2011, p. 81), and Israel (Rubin, Bukofzer, & Helms, 2003, p. 81) research institutions have the intellectual property rights to the inventions of their employees. Sweden is the only country among the five that continues to recognize the professor's privilege in which intellectual property rights always belong to the inventor (OECD, 2013). The transfer offices, which exist at most national universities, still support the commercialization of academic inventions.

Funding programs

In all five countries, start-ups can apply for grants through the KMU part of the European Union's HORIZON 2020 (European Commission, 2016b). Germany, Israel, and Sweden also support academic spin-offs through a range of national funding programs. The EXIST program, provided by the German Federal Ministry for Economic Affairs and Energy (BMWi), helps research groups and individual students or researchers start a business or bring their inventions to the point at which their market potential can be assessed. In Israel, the Office of the Chief Scientist in the Ministry of Economy and Industry administers different services for current and aspiring academic entrepreneurs. Its Technological Incubators Program, established in 1991, holds a competition for the best new incubator idea and provides the winner with advice, including that on necessary administrative procedures, and access to external finance (Office of the Chief Scientist n.d.; Getz & Segal, 2008).

In Sweden, the Vinnova innovation agency supports academic start-ups in a variety of ways, for example, by providing an incubator or helping research teams develop an idea for a potential international business (Vinnova n.d.). In addition, the state supports spin-off formation through its own investment firms and foundations. In Switzerland, there is a dynamic support system, participants of which come from the state and regional governments, industry, and science (Schilling, 2014). The Commission for Technology and Innovation (KTI) of the national Department for Economic affairs, Education, and Research played the primary role in establishing this system (econcept AG & Austrian Institute of Technology GmbH, 2015).

Alliances

TTO alliances exist in all five countries, but vary widely in terms of capacity and significance. The Network per la Valorizzazione della Ricerca Universitaria (NETVAL) alliance in Italy, which has 60 member organizations, is the largest such alliance across the five countries. The influence of TechnologieAllianz in Germany, on the other hand, is relatively insignificant, particularly considering the number and variety of national research organizations.

Table 12. The meta-level influences on KTT, by country

	GERMANY	SWEDEN	SWITZERLAND	ITALY	ISRAEL
Laws and regulations	IPR belong to employer (professors' privilege abolished in 2002), only students can claim IPR	IPR belong to inventor(s) (employee(s) or graduate student(s))	IPR belong to employer, only students can claim IPR	IPR belong to employer, research institutions are largely independent (Lissoni et al., 2012); administrative procedures for start-ups simplified in 2012	IPR belong to employer
Funding programs	EXIST (start-up grants); High-Tech funds for founders; Go-Bio; Comparion	Vinnova; ALMI; Tillväxtverket; Industrifonden; Norrlandsfonden; Inlandsinnovation; Fouriertransform	A large variety of national, regional, and private funding programs	Italian Venture Fund I; State guarantee funds	Technological Incubators Program; Tnufa; Heznek Fonds; State guarantee funds
Alliances	Technology-Allianz	Swedish Network for Innovation and Technology Transfer Support (SNITTS)	Swiss Technology Transfer Association (swiTT)	Network for the utilization of university research (Network per la Valorizzazione della Ricerca Universitaria, NETVAL)	Israel Technology Transfer Network (ITTN)

10.4.2 The level of operation: the descriptive statistics on the transfer practices

Following Siegel and Wright (2015a), we placed the findings for this level in four different categories: why (the strategies), what (the meaning), who (the actors), and how (the modes) (see chapter 10.2). The major findings for each category are shown in Table 13. The actors category includes all identified factors that can influence individual choices of different KTT participants.

Why–the strategies

To identify the main strategies employed by the selected organizations and compare these strategies to one another, we examined what goals these organizations and their TTOs pursued, which positions these offices occupied within organizational structures, and how these offices were funded.

Within Germany, examined organizations vary in their understanding of what “KTT” and “promoting KTT” mean and how the latter can be achieved. Most TTOs in Germany are part of a publicly funded research institution and thus also publicly funded. Most of these publicly funded offices regard giving back to their country as their obvious responsibility and therefore seek to promote transfer: *“And it is not like an investment into entrepreneurial activities, or a capital return tax, or something like that. Rather, it is really a question of [benefiting the society and] making our country [even more] successful in the future. It is a question of attitude [and] orientation, with which we go out there and look at problems.”* (KTT manager, female)

Other TTOs in Germany focus on entrepreneurial education and the third group regards management of intellectual property rights as their primary responsibility. While most of the staff is employed through and for the duration of particular projects, only a few had unlimited-term contracts.

In Israel, the primary purpose of transfer is to produce economic impact: *“[The primary goal is] creating an impact, an economic impact and so on. And this motivates us also and guides us when we do the licensing deal, but basically, we are a for-profit organization, so our main target is to make more money for the university."* (KTT manager, female)

While these offices are also typically associated with a research institution, they are independent for-profit business entities. In this capacity, their major goal is to protect and commercialize the intellectual property, while this property typically belongs to the organization.

The primary goal of TTOs in Italy is to benefit regional ecosystems (of innovation) by supporting spin-offs, collaborating with industry, licensing, and so forth and thereby to demonstrate to the public that they conduct "*responsible research in the role of the university*". (KTT manager, female) In this manner, transfer activities aim rather at social benefits than at financial returns: *"It is the impact you have… it's a matter of impact, it's not just money."* (KTT manager, male) TTOs are typically part of a research institution, and answer directly to its highest authorities. They are thus often non-profit and publicly funded.

In Switzerland, relationships between scientific and commercial organizations are typically very strong. While national TTOs vary widely across cantons with regard to their practices, they often pursue the same goal of improving cross-organizational and particularly science-industry collaboration: *"We collaborate with industry to create added value, which does not end with publishing, but expands be-yond it."* (Transfer manager male)

Their other major purposes are to create opportunities for researchers to cooperate with or work in industry and to promote the benefits of knowledge, rather than to "merely" spread this knowledge through teaching and transferring. Some TTOs are part of an organization and thus publicly funded, answer directly to the highest authority, and receive substantial recognition within their organizations. Others are independent and fund their own projects through commissions or over-heads. These TTOs appreciate the necessity of acting entrepreneurially and believe that it helps them be more efficient.

In Sweden, each interviewee described a wide range of transfer goals within his or her organization. One such goal is strengthening the regional economy and helping create jobs through spin-off sup-port. When allocating grants for research projects, national funding organizations prefer projects that are intended to promote transfer. Transfer offices therefore focus on encouraging researchers within their associated organization to more readily engage in transfer activities. They also provide a wide range of entrepreneurial education programs, which suggests that such education is a core part of their strategy: *"[Our universities] do a lot of entrepreneurial education anyways, if you will, I expect more today than yesterday, but we have a very precise offering. It's interdisciplinary maybe, […what] you have in the classroom, you have the business student next to the tech student, next to the doctor, next to the designer, next to the law student already in the classroom, and it's applied. So you come in, you get your hand steady."* (Transfer manager, male)

The positions of these offices within organizational structures vary. Some were initiated by and thus serve multiple organizations. TTOs are typically funded by the state and less often by private foundations.

What–the meaning

In Germany, we identified not one but two dominant understandings of KTT. One portion of the TTOs considered KTT to be a unidirectional process in which knowledge, produced by a research institution, is transferred to the public. Another, by contrast, regarded KTT as a multidirectional exchange be-tween science, industry, and the public and stressed the variety of contributions by KTT actors. The latter group considered KTT to be a particularly important process that should be conducted parallel to every research project and, ideally, respond to public needs. Similarly, the TTOs in Sweden varied in their understanding of what KTT means and typically focused on the commercialization of research findings or collaboration with industry.

In Switzerland and Italy, all TTOs regarded KTT as multidirectional. In Switzerland, emphasis was placed on the continuous exchange of knowledge and technology, particularly between science and industry, and on the impact on the public: "*KTT, it always sounds like a one-way street. But it is not, not at all. KTT … [does not just go] from [point] A to [point] B, but actually also from [point] B to [point] A. Interaction with the people out there, that is to say, industry, research centers, but also inside the university environment, that is extremely important."* (Transfer manager, male) Interviewees from Italy described KTT as a process of interaction and coordination between different actors rather than as a collection of specific products: *"You have to face the real world, it's not just about theories. You have to put together people, different institutions and enterprises, with different goals, from process goals normally."* (KTT manager, male)

Offices in Israel regarded transfer as a unidirectional process, in which knowledge is produced by a research institution and then transferred to industry and thus indirectly to the public. Such transfer products that can be relatively easily commercialized and promote economic growth were considered to particularly benefit the public. *"If there is knowledge that can be translated, or transferred, translated into a product or services that can benefit the public on [the] one hand, or, on the other hand, if we are able to create a new job and affect the economy development of Israel, then it is our responsibility to do so.*" (Transfer manager, female)

All of the TTOs within Israel and Italy managed the entire range of their associated organization's transfer activities. Within Sweden, Switzerland, and particularly Germany, many of the TTOs were often responsible for only a part of such activities, while one or more other offices within the organization, not associated with transfer, were responsible for the rest.

Who–the actors

Important KTT actors include TTO employees and clientele. We examined these actors' most relevant characteristics and compared them across the five countries. With regard to TTO staff, we focused on their skills, educational backgrounds, experiences, and motivations as explained by interviewees.

While choosing their employees, TTOs pay particular attention to their networking skills because according to the interviewed managers, transfer can only work if all actors from different sectors see the benefits for themselves or their organizations. The interviewed KTT managers thus typically regard them-selves as intermediary agents and "translators" between science and industry: *"You need to know how to pack this nice story of your researcher into something that the industry would like to see."* (KTT manager, male)

Particularly in Sweden, Switzerland, and Israel the transfer offices seek people with experience in industry, often preferably in combination with academic background. In Israel furthermore, where the primary goal is to maximally realize an invention's commercial potential, the TTOs most often regard facilitating transdisciplinary connections as their primary responsibility: "*We try to bring people from the outside, not from the university, with experience in industry because we understand that we have to sort of speak the language of the industry in order to be able to bridge […] academia and […] industry. And working within […] academia, we get very close[ly] attached […to] everything that is happening here. You need to understand fully the incentives and the agenda of […] industry. So yes, we try to bring people with industry experience.*" (Transfer manager, female) In Germany, transfer offices particularly value managers with both entrepreneurial and academic experience. Because these managers should also ideally be highly-skilled, finding suitable candidates poses a particular challenge.

The TTO positions in all countries except Israel are typically funded by the state. Consequently, TTO managers in these countries, particularly as compared to managers in more business-oriented organizations, are less motivated by monetary rewards. In Switzerland, for example, interviewees mentioned intrinsic motivations and the opportunity to organize their own work. TTO managers in Germany reported being primarily motivated by the opportunity to be on the cutting edge of technology and by their own passion for entrepreneurship: "*Well, for starters, I find being at the intersection of science and industry very exciting. One gets to meet so many cool people, passionate, with so much knowhow, enthusiastic […]. One is actually..., when it comes to technological trends, one is ahead of the curve.*" (Transfer manager, male)

TTOs in Italy regard themselves as creators of an entrepreneurial ecosystem who are thus working for the greater good. In Israel, the self-funded, entrepreneurial, team-spirited staff is motivated by the idea of having an economic impact and opportunities to "close the deal: "*We are enjoying our work. We want to be productive...We want to close deals. I think that the... you can look at the board behind you [… where there] are […] names of the people and their deals listed. So, this is what I think motivates everyone including my department."* (KTT manager, female)

Other important actors are the clientele of transfer offices, those who produce knowledge and need help transferring it. While the TTOs in Sweden reach out to both researchers and students, the services in Switzerland, Italy, and Israel primarily address researchers. In Germany, on the other hand, transfer offices focus on encouraging students to engage in academic entrepreneurship. Their clientele, who may also include researchers, may come not only from within, but, to some degree, from outside of their associated organization. A majority of the start-ups assisted by participating TTOs were initiated by teams, rather than individuals.

All interviewees regarded diversity of perspectives, whether among their staff or clientele, as important. Transfer offices in Italy value interdisciplinarity within their teams and attend to other types of diversity such as gender. In Sweden, TTOs deliberately try to gender-balance their teams. In Germany, gender is included in hiring policies in some offices. These findings suggest that while within each country, the transfer offices focused on different aspects of diversity, all of them recognized its value: *"So, while establishing something, any other college or university should rely on diversity rather than on structures, but on people, focus on them, those who will later be actually doing the work."* (KTT manager, male)

At the same time, all interviewees shared the opinion that a diversity of personal and professional skills matters more than gender: "*Building a team [of entrepreneurs] is, in fact, most challenging. […] It has less to do with the gender than, as a matter of fact, with the educational background… or with a certain type [of specialist] whom I need to be able to successfully finalize a start-up… a motivator or an engineer, for example."* (KTT manager, female)

How–the modes

The services offered by the examined TTOs are extremely diverse, while the volume of pro-grams and initiatives indicates the importance of KTT to their associated organizations. In Germany, Switzerland, and Sweden, many offices support academic spin-off formation by connecting KTT participants and providing entrepreneurial education: "[Our responsibilities include] the evaluation of business ideas, advice to aspiring entrepreneurs, long-term coaching, help with the grant applications to EXIST, or other things." (Transfer manager, female) All of the interviewed organizations in these countries have start-up incubators on campus, which provide office spaces, access to labs or prototyping studios, and often training and mentoring programs: "*We [... own our] office, […] we have three floors […with a size of about] 1500 [square] meters, and […] on these three […*

floors,] we have the laboratory, the incubator, and then offices for consultancy services." (Transfer manager, female)

The ways in which these incubators help start-ups vary in depth and duration, and sometimes an accelerator provides an ongoing support after an incubator.

In Israel, the transfer offices recognize that researchers can sometimes be uncomfortable with an idea of playing an entrepreneurial role and prefer staying in their research fields. These offices there-fore match a research team with one or more entrepreneurs. Researchers provide the technology or invention, while the entrepreneurs build the business, which they can later pass to the associated organization: "*So, our challenge [...while] commercializing the entities is to find entrepreneurs from outside [of] the university [...who] will be able to work together with our inventor in order to work on the technology transfer. So, that's a real challenge because you need to [...take] a few steps in order for that to happen.*" (Transfer manager, female)

The offices in Northern Italy focus on connecting diverse participants and coordinating their collaboration, particularly on providing access to external finance to aspiring entrepreneurs. Both there and in Israel, transfer managers have formed working alliances that help them to connect and exchange experience with each other (see section 10.4.1) and to advice individuals and organizations from science and industry. Participation in some of these alliances requires member dues.

In all five countries, many interviewees stressed that while their offices' services appear to be standardized, they are always tailored to the needs of particular individuals or teams in practice: "*What somebody needs for his or her idea to turn into a business is largely individual. I don't think that standard procedures would work here. It's just... we need a landscape, an ecosystem,* *in which any start-up can get what it needs to get to the next level. And that can be very diverse."* (Transfer manager, male)

Also in all five countries, entrepreneurship education is often not a TTO service, but part of the curriculum, typically provided by the associated organization through a series of practice-related seminars.

All interviewees strongly believed that a top-down commitment to transfer by their organization's highest authorities was absolutely necessary to promote transfer, particularly to encourage re-searchers to more readily participate. Such a commitment can manifest itself through particular activities of the senior management, the articulation of KTT as a fundamental element of the university's mission, and particular structural arrangements, such as the transfer office answering directly to the highest authorities. The vast majority of interviewees reported that their organizations expressed this commitment.

Organizations in three of the five countries also often provide monetary incentives for researchers engaged in transfer activities. In Israel, a researcher typically receives a 40% of the revenues from his or her invention. Some TTOs in Switzerland and Sweden provide inventors with intellectual property rights or salary benefits. While none of the TTOs provide career benefits such as promotions, interviewees believed that rewards would encourage researchers to more readily participate in transfer.

Table 13. TTO characteristics, by country

	GERMANY	SWEDEN	SWITZERLAND	ITALY	ISRAEL
Why – the strategy - Goals - Position within the organization - Funding	Vary: societal impact; entrepreneurial education; IPR management Separate department Public, typically through projects	Vary: regional impact; societal impact; to comply with policy Some co-established by multiple organizations Typically public; sometimes by private foundations	Primarily to improve cooperation with other organizations (business firms) Vary: typically answer to the highest authorities Vary: typically public or by private foundations	Typically to strengthen regional ecosystem Part of research institute; non-profit organization Typically public	To protect and commercialize IP; economic impact Independent for-profit entity, typically part of research institution; Entrepreneurial activities
What – KTT meaning - Process - Method	Both uni- and multidirectional Different teams responsible for different types of transfer with the organization	No commonly understood meaning Primarily collaborations with industry; start-ups, entrepreneurial education	Multidirectional Primarily collaborations with industry, particularly licensing	Coordinating between different actors One TTO manages all transfer activities	Unidirectional One TTO manages all transfer activities
Who – the actors - TTO personnel - Clientele - Diversity	Highly competent staff: ideally experienced in both science and entrepreneurship, which is rare; well-networked and/or good networking skills; rarely driven by passion for KTT; gender is part of hiring practices (to some degree) Primarily students; most start-ups are initiated by teams; Personal and professional skills more important than gender	Ideally experience in both science and industry; well-networked and/or networking skills; financers prioritize gender balance Students and researchers; typically teams	Highly competent staff; ideally experienced in both science and industry; well-networked and/or good networking skills; intrinsic motivation; opportunity to organize own work; diversity of perspectives regarded crucial for success Researchers Personal and professional skills more important than gender	Regard good networking skills as very important; regard themselves as ecosystem creators; value diversity of backgrounds Researchers; typically teams Personal and professional skills more important than gender	Typically experienced in business; well-networked and/or good networking skills; transdisciplinary work; rapid and suited commercialization prioritized; motivation to maximize profit; value diversity of backgrounds Researchers Personal and professional skills more important than gender
How – the modes - Rewards - Services - Senior management's commitment	No career benefits, no monetary rewards Incubators, alumni networks, entrepreneurial education institutionalised Top-down commitment expressed, regarded as necessary	- IPR, Incubators, Accelerators, Entrepreneurial education, Consulting Top-down commitment expressed, favored by the state	- Incubators, IP consulting, Entrepreneurial education, consulting Top-down commitment expressed, regarded as necessary	Few monetary rewards: variable salary, revenue shares Networks, consulting Top-down commitment expressed, regarded as necessary	Monetary rewards through revenue shares (typically 40% to inventor); no career benefits Incubators, networks, consulting, "borrowed" entrepreneurs Top-down commitment expressed

10.4.3 The cross-national qualitative typology

As described above (see section 10.3), we assigned the gathered data to two different types of ideal transfer offices: common good and entrepreneurial. These two abstractions were constructed based on the ways in which the individual characteristics of transfer offices typically cluster. While the characteristics of both types can be found in different countries in the sample and each office can, to a greater or lesser degree, be assigned to one or the other type, none of these offices precisely embodies either of the two types. The types are described below, and their key characteristics are shown in Table 14.

A **common good transfer office** is a non-profit entity that seeks to create dissemination opportunities and to maximize the benefits of research findings and (technological) inventions to the public rather than their commercial success: "*We are as happy to work with that, the utilization of research for the [… public] utility but not commercial utility. […] This is the mission for society. So our mission is actually to bring more utilization of knowledge to society.*" (Transfer manager, male)

It is typically integrated into the structures of an academic or research institution. Thus it is either wholly subsidized by the host organization or partially subsidized with the balance made up through the acquisition of third-party, typically state, funds. In its capacity as an integrated office, it is responsible for protecting the interests of the university or research institute and its affiliates: "*The goal is not to earn money. We don't have a goal to make profit of our research. The first goal is to protect the IP and to help. The researchers should be aware of […their] rights.*" (Transfer manager, female)

Primarily, such an office would offer opportunities for training and professional development by means of consulting for those interested in licensing their inventions or starting their own business, and generally contribute to creating a strong entrepreneurial culture: "*We offer free office spaces here at the Founder's Centre. Yes… then workshops, you already mentioned them. That's pretty much it. Oh yeah, and events, as I said earlier. Particularly match… we call those matchmaking initiatives. [...] And that leads to connections, and those to finance–they [for sure] have a couple of times.*" (Professor, male)

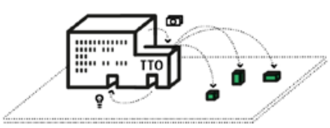
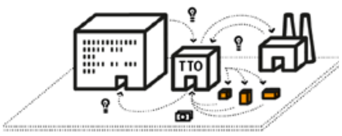
Thus it also acts as mediator between prospective founders and national incentive programs, helping candidates gain access to and apply for inclusion in these programs: "*It is mostly consulting. This is an important part, one of the most important parts, of the founder's services here. We have different staff, who consult for start-ups and, yes, give pointers, also with regard to applying for EXIST [grants], and help figure it out.*" (Transfer manager, female)

Because such an office generates no income of its own, it also cannot invest in start-up shares: "*We surely don't make any money on start-ups. It's more [...that] we invest [our time and effort]. But that will never lead to big returns. It's just [technically] impossible. […] Well, [...we] support the local economy, for sure.*" (Professor, male)

Such an office would also manage industry cooperation, where such cooperation has the goal of transferring and valorizing knowledge gained from research. By networking with other regional academic and research institutions and industry partners, it strengthens the local ecosystem. In addition, it engages in international cooperation and partnerships with the goal of creating further transfer opportunities for academic and research staff: *"… because the researchers can more easily get [to working] abroad through this collaboration and then see for themselves, what the market there looks like, what opportunities they might have there. They can maybe co-share office space there for free. Or, and yes, also… we work with a pitch coach from Silicon*

Valley, she is just so familiar with the investor scene, she always gives such good pointers." (Transfer manager, female)

Table 14. Two ideal types of transfer office

TYPE	POSITION AND FUNDING	GOALS AND PRACTICES
Common good 	▪ integrated ▪ non-profit; ▪ subsidies from host organization; ▪ third-party (state) funds	▪ benefits to host organization and society ▪ (optimal) knowledge transfer ▪ dissemination opportunities ▪ IP protection ▪ support to inventors upon request ▪ mediation between inventors and (state) funding programs ▪ opportunities for training and professional development ▪ (international) collaboration with academia and industry ▪ strengthening local ecosystem
Entrepreneurial 	▪ own income; ▪ state grants; ▪ earmarked foundation grants; ▪ start-up revenues	▪ economic impact ▪ (optimal) commercialisation of findings and inventions ▪ business opportunities ▪ start-up investment ▪ idea scouting ▪ mediation between inventors and industry ▪ staff with industry background ▪ collaboration with industry ▪ strengthening local economy and job market

An **entrepreneurial transfer office** is a for-profit entity that seeks to create business opportunities and to maximize the commercial success of research findings and (technological) inventions: "*We need to generate our own resources… I think this is actually a huge cultural difference… Once you start preaching entrepreneurship, you have to act entrepreneurially as well. There is actually a huge difference, if someone is really responsible for something in the capacity of an entrepreneur or just [works] … for a public organization, where most of the money comes from state 'pots.' The attitude will have to be very different.*" (KTT manager, male)

The hallmark of an entrepreneurial transfer office is its active scouting for promising ideas, which it does by providing a variety of services, addressed either to the inventions themselves or the people involved: "*We try to do a scouting activity, let's say. We try to go to the researchers, trying to understand what they are doing in that particular moment. We also have different automatic channels by which they can raise questions or propose ideas or something like that. But we are proactive in doing this kind of scouting.*" (Transfer manager, male)

Such commercialization also benefits both the inventor and the organization because, as is rarely possible for a common good transfer office, generated revenues may be invested in further shares or used for self-financing. "*The philosophy is, like, you eat what you pick […], in the sense that you have to generate income from the inventions. You cannot just [invent] for the sake of [in-venting].*" (Transfer manager, male)

It is typically associated with, but not integrated into specific academic or research institutions. Such an office may be financed through income generated by its own transfer activities or through state or earmarked foundation grants. This independence not only necessitates that such an office's mode of operation be oriented toward entrepreneurship, but creates business opportunities: "*We work hands-on with business developers, we are not business coaches or advisers, we do it and we don't just give advice. And we also have money. […] And that we offer always full service to handle the company, administration as well, and that we have the name […], we're owned by the university, and the researchers, they can trust us. We are not a commercial body outside [of] the university. We are inside the university, but a company.*" (Transfer manager, male)

To achieve this goal, such an office would mainly employ personnel with industry background: "*But what is really important, the people need to have been in industry before, they need to be* *familiar with 'the other side.' And they also typically have another degree, in intellectual property rights, meaning patent procedures and such, or an MBA.*" (Transfer manager, male)

The clientele of such an office, academic researchers and/or potential founders, may come either from within or outside of the associated organization(s). The goal is the optimal commercial transfer of the invention(s) in question, and the precise transfer methods are of secondary importance: "*A start-up is not the goal, but [...commercialization]. [... Commercialization] matters more than a specific method or conditions. [...] So, you see, when it comes to the method, we can be very practical.*" (Transfer manager, male)

Ultimately, the efforts of such an office produce economic impact and strengthen the local job market. "*And our goal is also to create new jobs and new companies here in this region.*" (Transfer manager, male)

An entrepreneurial transfer office thus functions as mediator between the academic sector and industry: "*You have a huge gap between the basic research at the academic institutions and the needs of the industry. So the technology transfer purpose is actually bridging the gap. [...] It [... is necessary] to support the inventions at an early stage to get [... them] to [... the point] where [... industry can be interested in them]. [...] You have the cultural gap between [...] academic [...] and industry perspective[s]. [...] And they are conflicting: there's the freedom to publish and the freedom to research, and [issues of] anti-competition [...] and confidentiality, and things that are, on [the] one hand, the basic principles of researchers at academic institution[s]. But, on the other hand, [...there] are issues that are very important to [...] industry, when they are [... investing] money in it and would like to protect it, and [...] their commercial interests.*" (Transfer manager, female)

10.5 Discussion

One goal of this study was to identify and compare those specifics of the given offices that can be attributed to meta-level influences, particularly national. We found that interviewed organizations varied by country, and to some degree within each country, with regard to their understandings of what "KTT" means, what goals it should pursue, and what practices it should follow. Interviewees in Israel regard transfer as a unidirectional process, originating in an academic or research institution, in which a solution is transferred to a recipient through "technology push" (Di Stefano, Gambardella, & Verona, 2012). In other countries, most often in Switzerland and Italy, interviewees described transfer as a bidirectional exchange between science and industry. This latter understanding aligns more closely with the theoretical Quadruple Helix model of the innovation system (Carayannis & Campbell, 2009) and thus provides empirical evidence for this model. However, it does so only partially because the Quadruple Helix model comprises four major elements, science, industry, policy, and the public, each bi-directionally interacting with all of the others.

The found variance in goals and strategies is in line with recent studies suggesting that the methods and volume of transfer depend on a variety of factors, such as the specifics of the given research field, the organization's size or standing within the academic community, and influences at the department level (Belenzon & Schankerman, 2009; Kulicke, 2006; Rasmussen et al., 2014). While this variance made comparisons rather difficult, we observed certain general tendencies within the countries. For example, in Israel, the primary purpose of transfer is to maximally realize an invention's commercial potential. Rather than being committed to any particular method such as licensing, patenting, or spin-off formation, the TTOs will employ whatever method they consider most likely to help achieve this goal. Similarly, in Switzerland, the examined organizations and their TTOs seek to bring about economic impacts, while cooperation with industry constitutes the most common form of transfer. Many TTOs in Sweden and Italy and some in Germany are particularly motivated by the opportunity to foster a region-al ecosystem and to have societal impacts. The latter is a major criterion on which the European Commission's Horizon 2020 funding program (European Commission, 2016b) evaluates proposed projects. There are, however, very few studies examining "spill-over" effects from such approaches on local economies. One such study, conducted by the Technical University of Berlin, established that academic spin-offs originating in Berlin created over 10,000 jobs in the metropolitan Berlin area (Kirchner & Matuschka, 2011).

Interviewees also stated that the transferability of findings having become such a major criterion for receiving public funding increasingly encourages research organizations to prioritize transfer, which reflects the findings of other recent studies (Siegel & Wright, 2015b). Transfer, particularly academic entrepreneurship, is growing increasingly complex (Siegel & Wright, 2015a), and the forms of KTT employed by the examined TTOs are extremely diverse, including on-campus incubators, open lectures, networking events, individual consulting, and entrepreneurial scouting. Franklin et al. (2001) found that especially transfer-oriented universities often match inventor teams with "surrogate entrepreneurs" who help initiate academic spin-offs. Some offices within our sample, particularly those in Israel, used this method. Also in Israel, TTOs much more often provide monetary rewards to incentivize researchers to engage in transfer activities.

The variance found within individual countries suggests that meta-level influences have a limited impact on a transfer office's strategies. The three-phase data analysis (see Section 10.3), con-ducted with an eye toward possible relationships between the individual characteristics within and across the offices under study, identified the ways in which these characteristics typically cluster. This analysis thus resulted in two ideal types of transfer office, distinguishable in terms of their goals, practices, sources of income, and positions within their associated organizations. These abstractions reveal the otherwise obscured causal relationships between these characteristics. While the state-funded common good office would create dissemination opportunities by providing training and advising potential founders upon request, the self-financed entrepreneurial office would pursue business opportunities by seeking out promising inventions and investing in their commercialization. Likewise, each of these two goals determines other individual characteristics of each type (see Table 14). While no office in the sample embodies either of the two types precisely, each provides some mix of both types and can, to a greater or lesser degree, be assigned to one or the other.

The exploratory nature of this study, however, made establishing deeper causal relationships extremely challenging. This inquiry provides a promising area of future research. Because the individual characteristics of both types are found within actual, highly productive offices across different countries in the sample, these types indicate potential best practices.

Different innovation ecosystems are driven by different actors, comply with different regulations regarding research, and have different attitudes toward academic entrepreneurship. Therefore, they will be producing different types of transfer offices. The availability of certain types of funding in a country, public or private, also plays role in determining which types will predominate.

Studies have shown that a clearly expressed commitment to transfer by an organization's highest authorities and the articulation of transfer as a fundamental element of the organization's mission encourages the participation of its employees (Huyghe, Knockaert, Piva et al., 2016; Moog et al., 2015). These findings are reflected in the fact that all interviewees strongly believed such a commitment to be absolutely necessary for high levels of transfer productivity.

Lautenschläger et al. (2014) found that a certain amount of interdisciplinarity within a transfer office's staff is more important for the effective promotion of transfer than the size of the office. Interviewees expressed particular appreciation for teams, comprised of members who were highly skilled in two or more areas, such as academia and entrepreneurship, and often expressed a desire for increased transdisciplinarity. Some interviewees, however, stated that finding suitable candidates for the TTOs can pose a particular challenge. These opinions reflect the findings of Siegel and Wright (2015a) who established that the issues of how best to position a transfer office and to find the best personnel are growing increasingly important both in theory and practice. In general, if transfer offices were to more actively network within the innovation ecosystem, they could increase their collaboration opportunities and access to resources such as funds, knowhow, and labs.

Our study, however, has its limitations. While we gathered a rich data set, we were able to examine only a relatively small number of transfer offices in each country, and numbers per country varied greatly. A disproportionate number of interviewees were based in Germany, and the greater diversity of these interviewees could account for the wider variations in their assessments. The smallest number of interviewees was based in Sweden, in which case the number was potentially too small to identify a common denominator. In most of the examined TTOs, only one person was interviewed and his or her opinions may not have represented the organization as a whole. It was also impossible for a single study this size to identify and examine all meta-level influences on transfer. The factors described above, such as national regulations and funding programs, were identified as the ones exerting the greatest influence on the individual choices of transfer actors at the level of operation.

10.6 Conclusions and implications

Within dynamically evolving innovation ecosystems, actors in knowledge and technology transfer are becoming increasingly diverse, as are the ways in which they interact. The transfer process can no longer be understood simply in terms of unidirectional "pulls" and "pushes." Because of these developments, transfer offices are growing indispensable in their capacity as ecosystem mediators.

This study examined the strategies employed by particularly productive transfer offices in order to account for their high levels of activity. Furthermore, the study analyzed their specific contributions to their local innovation ecosystems. Analysis of the collected data suggested two ideal types of transfer office, distinguishable in terms of their characteristics such as their positions within their associated organizations, practices, and staff's backgrounds. While the primarily state-funded common good type would seek social benefits, the self-financed entrepreneurial type would pursue commercial success. The former would therefore create opportunities for training and strengthening the local innovation ecosystem, while the latter would scout for promising ideas and cultivate relationships with industry.

The fact that the individual characteristics of both types can be found in different countries in the sample suggests that meta-level influences have a limited impact on a transfer office's approaches. Other factors appear to be more determinative: the particular goals of the given office and the specifics of the given field as well as influences at the level of operation and of the local innovation ecosystem. The types expose the causal relationships between these factors, which help explain the exceptional transfer productivity of the offices in the sample.

We found that different organizations prioritize different transfer activities. Transfer managers with an interest in creating synergies should evaluate which of the two types better characterize their own office and those with which they collaborate. This evaluation can help them more effectively interact not only with those who share these priorities, but with those who do not. By being aware of and systematically communicating their strategies beyond their institutional or even national borders, transfer offices can help their associated organizations establish promising new connections and improve the existing ones. Organizations pursuing similar goals can more easily discover one another and combine their efforts. On a larger scale, this approach can advance the European Commission's goals, such as the promotion of collaborative processes, the provision of training programs, and the development of Europe-wide standards for the professionalization of technology transfer (European Commission, 2016a).

The goal of knowledge and technology transfer is to promote scientific findings and inventions outside of academia. Thus far, transfer offices have focused on supporting commercialization, while providing informational materials and hosting open lectures and participatory events have been regarded as part of public relations, unrelated to transfer. Such activities, however, bring findings and inventions nearer to the public, suggesting the need for closer collaboration and possibly even a merger between PR and transfer offices.

As innovation ecosystems continue to evolve, interdisciplinary co-creation processes continue to spread. Future research can establish which particular transfer activities and combinations thereof may support such processes best. In this regard, more systematic collaboration between different transfer teams within individual organizations can create substantial synergies. A single, central transfer office may be most effective in gathering comprehensive information about transfer activities and their impact as well as in communicating this information both inside and outside of the organization. Our findings, however, suggest that employing transfer managers in individual departments has its benefits as well: the more direct the relationship between a manager and a researcher, the more inclined the researcher is to engage in transfer.

Future cross-national studies can identify the benefits and shortcomings of national initiatives and regulations, while national cross-organizational studies can determine transfer methods typical for individual countries, particularly those at the department level that best promote spin-offs. Also, it would be interesting to examine which types of office individual innovation ecosystems are more likely to produce, which could be achieved by addressing the following and similar questions: What role, if any, do national funding initiatives play in the increasing prevalence of certain types of transfer office? How important are the attitudes held within the academic community, such as those toward entrepreneurship? How significant a factor is the level of economic development or the amount of investment in R&D?

The proposed typology can be enhanced through empirical research on the following and similar matters: What are the measurable differences between spin-offs originating with the help of different types of offices and within different types of ecosystems, for example, with regard to sales, turnover, and staff? What are the differences in goals such as social entrepreneurship or desirable profit and development speed? Do different office types develop different types of networks and collaboration styles? Is there a causal relationship between these collaboration styles and the most common types of spin-offs?

11 Paper IV: Academic Entrepreneurship and Design: The Role of Design in Spin-off Processes[29]

11.1 Introduction

Decision-makers from scientific, business and political communities have long recognized the key role and varied potential of academic spin-offs in knowledge and technology transfer (KTT). Academic spin-offs are particularly effective at fostering innovation and technological development, and at creating jobs and promoting economic growth—all of which help in addressing global challenges (Auer & Walter, 2009; Dickel, 2009; Lautenschläger et al., 2014; Rasmussen & Wright, 2015). Despite these benefits, the frequency of academic spin-off formation from research institutions remains unsatisfactorily low. The European Commission likens European technology transfer today to an emerging industry with "many valuable product ideas; a highly fragmented landscape; a lack of critical mass; wide disparities in terms of performances and developing practices" (European Commission, 2016a).

Scholars from various disciplines have analyzed the wide discrepancy in performance of academic entrepreneurship of different research institutions (Grimaldi et al., 2011; Perkmann et al., 2013; Siegel & Wright, 2015b). However, with the exception of the tendency

[29] The paper was presented at 12th European Design Academy Conference in Rome in April 2017. This is the authors accepted manuscript of an article published as the version of record in The Design Journal on 6TH September 2017. http://www.tandfonline.com/. The paper can be cited as: Sinell, Anna; Brodack, Franziska; Denef, Sebastian (2017). Academic Entrepreneurship and Design: The Role of Design in Spin-off Processes. The Design Journal 20(1). S457-S468. DOI: 10.1080/14606925.2017.1352984. Available at: https://doi.org/10.1080/14606925.2017.1352984.

Scholars from various disciplines have analyzed the wide discrepancy in performance of academic entrepreneurship of different research institutions (Grimaldi et al., 2011; Perkmann et al., 2013; Siegel & Wright, 2015b). However, with the exception of the tendency of success in academic entrepreneurship to be preceded by prior success, no successful organizational practices and structures have thus far been identified (Rasmussen & Wright, 2015). Team characteristics of academic spin-offs have not been studied extensively either (Visintin & Pittino, 2014). Academic spin-offs have been criticized for their homogeneity in terms of technical and educational backgrounds (Ensley & Hmieleski, 2005; Franklin et al., 2001), and scholars argue that teams need to comprise academic as well as non-academic profiles and different fields of expertise (Knockaert et al., 2011; Rasmussen & Wright, 2015; Visintin & Pittino, 2014). While the importance of entrepreneurial know-how and business skills for successful technology start-ups is well known (Meyer, 2003; Mosey & Wright, 2007; Samsom & Gurdon, 1993), little work has been carried out to explore the role of design competencies (Driver et al., 2011). Designers, however, can help commercialize new technologies, if they are involved from an earlier stage in the research process (Black & Baker, 1987; Gemser & Leenders, 2001; Hertenstein, Platt, & Brown, 2001). Building upon the findings of existing research into innovation and academic entrepreneurship, we analyzed the role of design in academic founding teams. In particular, we attempted to answer the following question: How does design contribute to the development of three entrepreneurial competencies, namely opportunity development, championing and resource acquisition (Rasmussen, Mosey, & Wright, 2011; Rasmussen & Wright, 2015) in academic founding teams?

Adopting a competency-based perspective, we combined expertise from design, natural science and business management in founding teams so as to enable them to develop marketable, technology-based business ideas. Our findings are not merely theoretical, but will also contribute to the approaches research organizations develop to promote academic spin-off formation.

11.2 Related Work

Following Auer and Walter (2009), we define academic spin-offs as autonomous organizations that are formed by or with the help of employees of publicly funded research institutions, in order to commercialize scientific findings and technological products originating in these institutions.

In order to successfully initiate an academic spin-off, academic founding teams must develop a specific set of entrepreneurial competencies. Aiming to analyze how design contributes to the evolution of such competencies, we build upon the entrepreneurial competency framework of Rasmussen et al. (2011). Through longitudinal observation of the initial formation and development of four university-based start-ups, Rasmussen et al. (2011) identified three basic competencies that academic spin-offs must develop in order to reach a certain credibility threshold for their ventures: (1) opportunity development competency, which refers to the need to identify a viable business idea; (2) championing competency, which refers to the need for team members who provide energy and meaning to the start-up process; and (3) resource acquisition competency, which describes the ability to gain access to necessary resources.

In the context of spin-offs, design has the potential to transcend purely verbal expression and foster insights into technological developments (Krippendorff, 2005). Designers apply an iterative process that continually questions underlying assumptions and solutions

(Leavy, 2010). With their ability to embody ideas and knowledge in artefacts, designers can stimulate others to develop and evaluate new ideas (Rust, 2004). Following Denef (2012), we understand design as the process of creating form, and thus following Alexander (1964), creating form is the task of the designer. Form, in its most general sense, is the result of actions taken by the designer. Here, 'form' does not only include the physical shape of things, but also refers to all the characteristics of the thing that is being created: not only its appearance, but also its structure, inner workings and other features that its designer(s) might impart to it. Every form resides in a context that is composed of a manifold set of properties. These properties lead the designer to find a form that fits the context in question (Alexander, 1964). Learning about the context helps in building an understanding of what actually is or should be achievable for the designer. The object of design is to achieve an optimal fit between form and context, which also means that the form helps the context itself evolve further. Thus, we understand design as all activities that create form and optimize contextual fit (Alexander, 1964; Denef, 2012).

In what follows, we analyze how design contributes to the development of the entrepreneurial competencies outlined above.

11.3 Method

11.3.1 Context and Sample

The start-up teams were analyzed in the context of a six-month incubation program. The program was designed to create and support interdisciplinary technology-based start-up teams. After an ideation and teambuilding phase, participants formed eight interdisciplinary start-up teams (see Table 1), each comprising expertise from design, the natural sciences and business management. During a four-month incubation phase, the teams developed their technology-based business ideas and created business plans. Throughout the program, participants took part in team coaching and expert consulting activities. Finally, an interdisciplinary jury evaluated the teams on the basis of a final presentation. The two winning teams were awarded additional research and development resources to the value of €80.000.

23 founders (10 designers, 7 business managers and 6 natural scientists) participated in the incubation program. The mean age was 30.64 (SD = 5.21), 47.8 % of the participants were male, and 52.2 % were female. Roughly half of the participants were students; the others were permanent employees or freelancers (with an average working experience of 4.67 years, SD = 4.49). Two of the eight teams (5 participants) aborted their projects during the program (see Table 1). Each team followed a different technology-based business idea in the areas of health, healthcare or renewable materials. Each technology emerged from academic research (a university research project, or a master's or PhD thesis).

11.3.2 Data Analysis

In order to analyze how design contributes to the development of entrepreneurial competencies, we followed a case study approach (Eisenhardt, 1989a; Eisenhardt & Graebner, 2007). This approach is inductive in nature and provides a means of analyzing qualitative data in unexplored research areas, with the aim of answering "how" and "why" questions (Yin, 2009). In using this approach, new theoretical concepts can be derived and new propositions formulated.

Table 15. Characteristics of the cases.

CASE	TECHNOLOGY	PRODUCT/ SERVICE	NUMBER OF FOUNDERS	INDUSTRY EXPERIENCE	STATUS
ASO1	Medical device	Product	2	Yes	Ongoing
ASO2	Damping panel	Product	4	No	Ongoing
ASO3	Psychological gaming	Service	4	Yes	Ongoing
ASO4	Patient management service	Service	4	Yes	Ongoing
ASO5	Data Mapping	Service	3	No	Ongoing
ASO6	Smart hardware vendor	Service	1	Yes	Ongoing
ASO7	Medical device	Product	3	No	Aborted
ASO8	Healthcare App	Service	2	No	Aborted

Following the multiple-case study principle (Eisenhardt, 1989a; Yin, 2009) this study is comprised of eight cases, which falls within Eisenhardt's recommended range of four to ten (Eisenhardt, 1989a). In order to explore the influential role of design, we conducted two semi-structured interviews with each participant. We conducted the first round of interviews in the middle of the incubation phase (two months after the initial workshop) and the second round at the end of the program, after the final jury pitch. We also interviewed those participants who dropped out of the project, to assess their reasons for leaving. To evaluate the quality and market potential of the start-up ideas and the strength of the respective teams, we also conducted interviews with the three coaches who had been involved for the duration of the program, and with five members of the jury. In total, we conducted 60 qualitative interviews of between 20 and 60 minutes in length throughout the program with 38 persons (30 participants, 5 jury members and 3 coaches; 16 women and 22 men). In the interest of objectivity, the interviews were not analyzed by the same researchers who conducted them. All interviews were transcribed and their content qualitatively analyzed using Mayring's (2010) method.

We ensured that our findings have a high degree of validity by means of data triangulation (Leech & Onwuegbuzie, 2007), in that each unit of analysis was interpreted by four researchers from different fields. Our understanding of the various entrepreneurial competencies are hence based on shared interpretations among multiple research perspectives. To complement the collected qualitative data, we took field notes for each case throughout the entire six-month program, including during consultation hours, pitches, emails and telephone communication. Additionally, we took into account further documents such as the teams' one pagers, business plans and pitch decks. This approach allowed us to include observations from outside the immediate context of the interviews into our research (Ritchie, Lewis, Nicholls, & Ormston, 2013).

11.4 Findings—Development of Propositions

11.4.1 Design and Opportunity Development Competency

A successful start-up always relies on a viable business idea that meets the needs of a particular user group. Academic researchers have often been found to lack the necessary market knowledge or industry experience to spin out a company based on their research activities (Bercovitz & Feldman, 2008; Marion et al., 2015; Sinell et al., 2015). In investigating eight academic founding teams at an early stage of their respective start-up projects, we found that design contributes to the identification and refinement of business opportunities by enhancing user research, facilitating ideation processes and through early testing of ideas.

Enhancing user research. While defining their technologies' specific application scenarios, those team members who had an educational background in design were very determined to understand the context and application scenarios in full. Accordingly, all teams started their projects with user research, and conducted interviews or user journeys. ASO1 additionally held a one-day workshop in order to assess all relevant areas for their technology. By taking into account different perspectives, the teams were able to understand the broader contexts in which their technologies were relevant. One of the founders of ASO8 described the process of better understanding the context for their technology as follows:

"*When we discussed our idea again, we realized that our assumptions about it and understanding of it were too simple, and that we had to break the concept down into its constituent parts in order to identify particular technological challenges. In doing so, we were better able to focus on the users' needs.*" (ASO8)

In the case of ASO1, this in-depth research led the team to change their business idea completely. Remaining in the women's health sector, they switched their initial focus from pregnancy to female intimate care. ASO3, ASO6 and ASO8 were likewise observed to change their initial ideas.

Facilitating ideation processes. Thanks to their user research, the teams had little to no difficulty in identifying additional areas in which their technologies could be applied. One of the founders of ASO1, for example, stated that thanks to their having integrated knowledge from the fields of both design and medicine, "interesting new things automatically emerged very quickly". The design expertise within the teams helped them generate diverse concepts and remain open to further ideas. Sometimes, however, this also led to challenges and dissonance within the teams. In the case of ASO7, the team fell apart because the designer who initially championed the technology wanted to keep the ideation process open and generate more application scenarios for her idea. The other team members, however, wanted to accelerate the business process and stick to the initial application scenario. The following comment by the designer of ASO6 illustrates this openness to new ideas:

"*I am definitely open to completely changing ideas and choosing a different direction–as long as the idea gets better than it was in the first place. In this sense, our project has developed immensely. When I recall what our first idea was, then, OK, I mean, we stuck to the basic idea, but the whole context changed as we considered feedback from different sources. We changed directions quite a few times…*" (ASO6)

Early testing. For an in-depth assessment of the user's opinion of a technology and its functionality, prototypes or minimum viable products are essential. Almost every team (except for ASO5) recognized the vital role of a viable prototype to test their idea at an early stage, as the following quote illustrates:

"[The prototype] doesn't have to be perfect. It just has to work as a first step, so you can test it, and then you keep working on and improving it." (ASO3)

Such a design-oriented approach is helpful in early testing and further development of ideas. ASO3 used a paper-based prototype to test the concept and underlying assumptions of their self-optimization game. All teams that aimed to develop a product (ASO1, ASO2, ASO7) integrated testing phases as key elements in their process, in order to further develop and understand the characteristics of their respective products. While technological development within the teams was strongly theory-based, the application of said technologies in a user-oriented and business context was rather practically driven.

Design methods helped the teams in furthering this process, as stated by one of the founders of ASO5:

"*The doing is what counts. We just start doing and trying things out. Our approach is very much practically driven. And that's why it's really important to test things early on. It's actually like learning by doing… more learning and then again more doing…*" (ASO5)

Based on the observations outlined above, we propose the following:

Proposition 1a: Design helps in understanding the broader contexts in which technologies and users interact, and thereby furthers opportunity development competency.

Proposition 1b: Design facilitates ideation processes and thereby furthers opportunity development competency.

Proposition 1c: Design facilitates testing of ideas and technologies early on in the start-up process and thereby furthers opportunity development competency.

11.4.2 Design and Championing Competency

As outlined by Rasmussen et al. (2011), entrepreneurial teams depend on individuals with championing skills to support and fight for early ideas, and ensure their survival and growth in the challenging start-up context. While this skill is certainly closely related to personal character and the broader social context of any individual, we have found a close correlation between championing and design in our teams. In other words: design is a championing tool.

A core task of championing is joint *vision building*. Internally, team members need to stay focused on a common, but dynamic goal. 'Pivoting', as this strategy is known in the context of start-ups, requires finding a new direction when the previous approach did not produce the expected results. Pivoting also requires constant vision building and making sure that the team stays focused. Externally, investors, customers and other stakeholders need to believe in the start-up's vision. As products often lack features or suffer from initial quality problems, and since business milestones are very often missed, future visions are crucial in spin-offs as a means of fostering and maintaining focus, motivation and support, both internally and externally.

In our research project, idea champions initially pitched their concepts to a wider audience to attract teammates. The ideas that created the largest interest were those that were presented with a focused vision that clearly described both context and form. While the successful presentations varied in structure and style, they all made extensive use of design methods that capture and give shape to ideas. The idea champion of ASO6, for instance, used videos to communicate his idea at a very early stage. In modified real-world images, he made his envisioned technology materialize in public environments. ASO3 showed how their application would help all people in the room improve their social skills. During the process, as ideas were discarded, changed or refined, we witnessed the continuing importance of design as a tool that ensures that both team members and external stakeholders remain committed to a team's vision. The members of ASO1 radically altered their idea, yet they were able efficiently to communicate and demonstrate their contextual and form-related design rationale.

Closely connected to vision building is *experience creation.* Given that they typically create new solutions that are hard to compare to existing products or services, and given their initial lack of resources, academic spin-offs benefit greatly from creating user experiences very early on as a means of testing contextual fit. At the very beginning of the program, ASO7's idea champion used experience prototypes as a tool to gain support for her concept and recruit team members. Although the team later encountered difficulties in effectively championing their idea–with the project in fact faltering as a result–their idea initially showed exceptional promise, thanks to the idea champion's design expertise. The idea champion of the ASO4 team used role-playing of patients' user experience as a key tool in building the empathy needed to understand the problem they sought to address, and as a means of maintaining constant focus on their idea. ASO5 used physical objects metaphorically as a means of explaining, in everyday language, complex new ideas in the fields of data analytics and information technology.

Based on the observations outlined above, we propose the following:

Proposition 2a: Design fosters vision building and thereby furthers championing competency.

Proposition 2b: Design enhances experience creation and empathy and thereby furthers championing competency.

11.4.3 Design and Resource Acquisition Competency

Especially in the early stages of the academic start-up process, access to resources within the university or from external sources is vital. Our case studies illustrate very clearly that design allows founding teams to produce something tangible early on. Design also contributes to the communication of ideas and acquisition of external resources through the use of prototypes and mock-ups that make ideas more tangible and the creation of professional audio-visual aids.

Facilitating the creation of prototypes and mock-ups. The majority of teams in our study used prototypes or mock-ups for the development and communication of their ideas. ASO2, one of the winning teams, continually used prototypes. They used a technical prototype to demonstrate their product's properties, functionality and material construction. Additionally, they developed a design prototype to showcase the future design of the fully developed product. Likewise, the ASO7, team used design prototypes to illustrate how their medical device worked, and so as to be able to discuss it with technicians and physical therapists. To visualize their basic idea, ASO5 created a mock-up. This was important since their proposed software-based service was very complex and there was no technical prototype available at the time. However, the team was able to establish cooperation in research and development with industry partners and potential customers. Using prototyping, the teams were able to make their ideas more tangible and easier to understand. This not only helps start-ups develop their ideas further, but also helps in attracting external support. Almost all teams were able to create an advisory board peopled with supporters from universities and from their target market. The importance of design for this process can be illustrated by the following comment by the designer of ASO8: "*We went very quickly from conception to prototyping and this helped greatly in communicating our idea. And I think this is an advantage of having a designer in the team. When you build a prototype you can talk about it and develop it further.*" (ASO8)

Creating professional audio-visual aids. In order to secure external resources, it is important that audio-visual aids come across as having been professionally crafted. All teams were successful in this respect. They created well-designed pitch decks and business plans. They used graphics and schematic representations to illustrate their concepts, and worked with prototypes and mock-ups when pitching their ideas. With the use of logos and individual color schemes, they were able to create a comprehensive picture of their future products and brands. Team members with design expertise were able to contribute not only know-how but also professional connections with others in the field, thus allowing the teams to keep the costs of creating audio-visual materials relatively low. Only one team (ASO4) stated a lack of design know-how, as illustrated in the following observation by one of their natural scientist:

"*I can work with [Adobe] Illustrator too, but it is not my focus. I would rather concentrate on other tasks. And a professional designer–someone who is creative–would be of great value and take a load off our shoulders.*" (ASO4)

This leads to the following propositions:

Proposition 3a: Through the use of prototypes, design helps make ideas tangible and easier to understand, and thereby furthers resource acquisition competency.

Proposition 3b: Design aids in the creation of professional audio-visual aids, and thereby furthers resource acquisition competency.

11.5 Conclusions

Despite the fact that academic spin-offs are held in high esteem and are recognized for their varied potential, they remain rare in Europe (European Commission, 2016a). Aiming to develop an approach that fosters the development of entrepreneurial competencies at research organizations, we analyzed how design contributes to the development of such skills.

Our study reveals that design supports the start-up process in all three important respects identified by Rasmussen et al. (2011). Firstly, a design approach helps open up the process of opportunity refinement and fosters an understanding of the contexts and application scenarios for the technology or technologies in question. In our study, the teams used design techniques to achieve an optimal fit between technologies and contexts. Design furthermore enhances ideation processes and thereby contributes to the creation of multiple and varied ideas. Secondly, through the creation of visions and experience, design furthers idea championing and helps convincingly convey concepts and visions for the future. In creating a shared vision, even when said vision needs to be revised, design is used to build commitment. Thirdly, design helps in the acquisition of resources with the aid of prototypes and mock-ups that translate intangible ideas into something that others can grasp and are willing to invest in.

Our findings also confirm the value of integrating designers and design competencies at an early stage of the innovation process in order to foster the development of entrepreneurial competencies at research organizations. Design can act as a research catalyst by enabling consideration of the application of technologies early on, placing the focus on customer needs and through the creation of artefacts to aid understanding and stimulate ideas (Bonnafous-Boucher, Cuir, & Partouche, 2011; Kurvinen, 2005).

Our study carries implications for both theory and practice. By outlining how design contributes to the development of entrepreneurial competencies, our findings suggest that research institutions should deliberately set up multidisciplinary research teams in order to identify opportunities for exploiting their findings. As detailed above, design expertise benefits research institutions both internally, through developing entrepreneurial competencies within the institutions themselves, and externally, by furthering vision building and resource acquisition. We built upon Rasmussen's entrepreneurial competency framework (Rasmussen et al., 2011; Rasmussen & Wright, 2015) by adding design-specific competencies as requirement for a successful start-up process. We focused on the early stages of the process; whether design competencies have a positive effect on start-up performance in the long term is a question that merits further investigation. Clearly, our study is not without its limitations. We analyzed start-up teams in the context of an academic research institution and provided them with access to the institution's infrastructure, resources and networks. All of the technologies emerged from research projects. Typically, however, the founders of an academic spin-off would themselves be employees of the academic institution in question. That was not the case in our program, and should therefore form the focus of future research. Furthermore, by including spin-off teams without design expertise as control groups, future studies should be able to develop our conclusions further, and find even stronger evidence for the internal and external effects of design.

12 References

Abel-Koch, J. (2015). Gründungsfreudige Akademiker setzen auf Geschäftsideen aus der Berufspraxis. *Fokus Volkswirtschaft, 27. Januar 2015*(80), 1–4.

Abrams, I., Leung, G., & Stevens, A. J. (2009). How are U.S. Technology Transfer Offices Tasked and Motivated: Is it all about the Money. *Research Management Review, 17*(1), 1–34.

Abreu, M., & Grinevich, V. (2013). The nature of academic entrepreneurship in the UK: Widening the focus on entrepreneurial activities. *Research Policy, 42*(2), 408–422. https://doi.org/10.1016/j.respol.2012.10.005

Abreu, M., & Grinevich, V. (2014). Academic Entrepreneurship in the Creative Arts. *Environment and Planning C: Government and Policy, 32*(3), 451–470.

Abreu, M., & Grinevich, V. (2016). Gender patterns in academic entrepreneurship. *The Journal of Technology Transfer*.

acatech – Deutsche Akademie der Technikwissenschaften. (2010). *Wirtschaftliche Entwicklung von Ausgründungen aus außeruniversitären Forschungseinrichtungen* (acatech Berichtet Und Empfiehlt No. 4). Berlin, Heidelberg.

Achatz, J., Fuchs, S., Kleinert, C., & Roßmann, S. (2009). Arbeitsfeld Technologietransfer. Management als Chance. *IAB-Forum.* (1), 58–63.

Achatz, J., Fuchs, S., Kleinert, C., & Roßmann, S. (2010). "We are a Motley Crew": Exploring the Careers of Men and Women Working at the University-Industry Interface. *Journal of Technology, Management & Innovation, 5*(1), 75–84.

Achatz, J., & Hinz, T. (2001). Wandel einer Wissenschaftsorganisation und die Integration von Frauen. *Zeitschrift für Soziologie, 30*(5), 323–340.

Acker, J. (1990). Hierarchies, Jobs, Bodies: A Theory of Gendered Organizations. *Gender & Society, 4*(2), 139–158. https://doi.org/10.1177/089124390004002002

Acker, J. (2006). Inequality Regimes: Gender, Class, and Race in Organizations. *Gender & Society, 20*(4), 441–464. https://doi.org/10.1177/0891243206289499

Adner, R., & Kapoor, R. (2010). Value creation in innovation ecosystems: How the structure of technological interdependence affects firm performance in new technology generations. *Strategic Management Journal, 31*(3), 306–333.

Agrawal, A. (2006). Engaging the inventor: Exploring licensing strategies for university inventions and the role of latent knowledge. *Strategic Management Journal, 27*(1), 63–79. https://doi.org/10.1002/smj.508

Aldridge, T. T., & Audretsch, D. (2011). The Bayh-Dole Act and scientist entrepreneurship. *Research Policy, 40*(8), 1058–1067. https://doi.org/10.1016/j.respol.2011.04.006

Alexander, C. (1964). *Notes on the synthesis of form.* Cambridge: Harvard University Press.

Allen, T. J., O'Shea, R. P., Allen, T. J., & O'Shea, R. P. (Eds.). (2014). *Building Technology Transfer within Research Universities*. Cambridge: Cambridge University Press.

Amason, A. C. (1996). Distinguishing the effects of functional and dysfunctional conflict on strategic decision making: Resolving a paradox for top management teams. *Academy of Management Journal*, *39*(1), 123–148. https://doi.org/10.2307/256633

Ambos, T. C., Mäkelä, K., Birkinshaw, J., & D'Este, P. (2008). When Does University Research Get Commercialized? Creating Ambidexterity in Research Institutions. *Journal of Management Studies*, *45*(8), 1424–1447. https://doi.org/10.1111/j.1467-6486.2008.00804.x

Ashcraft, C., & Breitzman, A. (2007). *Who Invents IT? An Analysis of Women's Participation in Information Technology Patenting*. Executive Summary. Boulder, CO.

Association of University Technology Managers (AUTM). (2005). *AUTM U.S. Licensing SurveyTM: FY 2004: Survey summary*. Northbrook, IL.

Astebro, T. B., Braguinsky, S., Braunerhjelm, P., & Brostroem, A. (2016). Academic Entrepreneurship: Bayh-Dole versus the 'Professor's Privilege'. *SSRN Electronic Journal*, 1–48. https://doi.org/10.2139/ssrn.2677283

Audretsch, D. (2000). *Is University Entrepreneurship Different?*, Mimeo, Indiana.

Audretsch, D., & Göktepe-Hulten, D. (2015). University Patenting in Europe: Does Faculty Ownership of Intellectual Property Impede University Technology Transfer? In A. N. Link, D. S. Siegel, & M. Wright (Eds.), *The Chicago handbook of university technology transfer and academic entrepreneurship* (pp. 188–217). Chicago, London: The University of Chicago Press.

Auer, M., & Walter, A. (Eds.). (2009). *Academic Entrepreneurship: Unternehmertum in der Forschung* (1st ed.). Wiesbaden: Gabler.

Autio, E., & Kauranen, I. (1994). Technologist-entrepreneurs versus non-entrepreneurial technologists: analysis of motivational triggering factors. *Entrepreneurship & Regional Development*, *6*(4), 315–328.

Autio, E., & Thomas, L. D. W. (2014). Innovation Ecosystems: Implications for Innovation Management? In M. Dodgson, D. M. Gann, & N. Phillips (Eds.), *Oxford handbooks in business and management. The Oxford handbook of innovation management*. Oxford: Oxford Univ. Press.

Azagra-Caro, J. M. (2007). What type of faculty member interacts with what type of firm? Some reasons for the delocalisation of university–industry interaction. *Technovation*, *27*(11), 704–715. https://doi.org/10.1016/j.technovation.2007.05.003

Azoulay, P., Ding, W., & Stuart, T. (2005). *The Determinants of Faculty Patenting Behavior: Demographics or Opportunities?* Cambridge, MA: National Bureau of Economic Research.

Bach, S., Geyer, J., Haan, P., & Wrohlich, K. (2011). Reform des Ehegattensplittings: Nur eine reine Individualbesteuerung erhöht die Erwerbsanreize deutlich. *DIW Wochenbericht.* (41), 13–19.

Bailey, K. D. (1994). *Typologies and Taxonomies. An Introduction to Classification Techniques.* Thousand Oaks: Sage.

Baldini, N. (2009). Implementing Bayh–Dole-like laws: Faculty problems and their impact on university patenting activity. *Research Policy*, *38*(8), 1217–1224. https://doi.org/10.1016/j.respol.2009.06.013

Baldini, N., Fini, R., & Grimaldi, R. (2015). The Transition toward Entrepreneurial Universities: An Assessment of Academic Entrepreneurship in Italy. In A. N. Link, D. S. Siegel, & M. Wright (Eds.), *The Chicago handbook of university technology transfer and academic entrepreneurship*. Chicago, London: The University of Chicago Press.

Banal-Estanol, A., Jofre-Bonet, M., & Meissner, C. (2010). *The Impact of Industry Collaboration on Research: Evidence from Engineering Academics in the UK.*

Barjak, F. (2011). *Wissens- und Technologietransfer als Interaktion: Theoretische Überlegungen und Fallbeispiele aus der Schweiz.* Bern: Internationaler Verlag der Wissenschaften.

Barney, J. B. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, *17*(1), 99–120.

Baron, J. N., Hannan, M. T., Hsu, G., & Kocak, Ö. (2007). In the Company of Women: Gender Inequality and the Logic of Bureaucracy in Start-Up Firms. *Work and Occupations*, *34*(1), 35–66.

Barr, S., Baker, T., Markham, S., & Kingon, A. (2009). Bridging the Valley of Death: Lessons Learned From 14 Years of Commercialization of Technology Education. *Academy of Management Learning & Education*, *8*(3), 370–388. https://doi.org/10.5465/AMLE.2009.44287937

Barton, A. (1955). The Concept of Property-Space in Social Research. In P. Lazarsfeld & M. Rosenberg (Eds.), *The Language of Social Research. a reader in the methodology of social research* (pp. 40–53). New York: Free Press.

Baum, J. R., & Locke, E. A. (2004). The relationship of entrepreneurial traits, skill, and motivation to subsequent venture growth. *The Journal of applied psychology*, *89*(4), 587–598.

Baxter, P., & Jack, S. (2008). *Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers.* Retrieved from http://nsuworks.nova.edu/cgi/viewcontent.cgi?article=1573&context=tqr

Bear, J. B., & Woolley, A. W. (2011). The Role of Gender in Team Collaboration and Performance. *Interdisciplinary Science Reviews*, *36*(2), 146–153.

Belenzon, S., & Schankerman, M. (2009). University knowledge transfer: Private ownership, incentives, and local development objectives. *The journal of law & economics*, *52*(1), 111–144.

Benschop, Y., & Doorewaard, H. (1998). Covered by Equality: The Gender Subtext of Organizations. *Organization Studies*, *19*(5), 787–805. https://doi.org/10.1177/017084069801900504

Bercovitz, J., & Feldman, M. (2004). *Academic Entrepreneurs: Social Learning and Participation in University Technology Transfer*.

Bercovitz, J., & Feldman, M. (2006). Entreprenerial Universities and Technology Transfer: A Conceptual Framework for Understanding Knowledge-Based Economic Development. *The Journal of Technology Transfer*, *31*(1), 175–188.

Bercovitz, J., & Feldman, M. (2008). Academic Entrepreneurs: Organizational Change at the Individual Level. *ORGANIZATION SCIENCE*, *19*(1), 69–89. https://doi.org/10.1287/orsc.1070.0295

Bessant, J., & Rush, H. (1995). Building bridges for innovation: the role of consultants in technology transfer. *Research Policy*, *24*(1), 97–114. https://doi.org/10.1016/0048-7333(93)00751-E

Best, K. (2016). *Innovation durch Diversität. Vier empirische Studien zur Nutzung von Gender-Diversity als Innovationsressource in naturwissenschaftlich-technischen Organisationen*. Technische Universität Berlin, Berlin.

Best, K., Sanwald, U., Ihsen, S., & Ittel, A. (2013). Gender and STEM in Germany: Policies Enhancing Women's Participation in Academia. *International Journal of Gender, Science and Technology*, *5*(3), 292–304.

Best, K., Sinell, A., Heidingsfelder, M. L., & Schraudner, M. (2016). The gender dimension in knowledge and technology transfer – the German case. *European Journal of Innovation Management*, *19*(1), 2–25. https://doi.org/10.1108/EJIM-07-2015-0052

Bhattacharjee, Y. (2006). U.S. research funding. Industry shrinks academic support. *Science (New York, N.Y.)*, *312*(5774), 671. https://doi.org/10.1126/science.312.5774.671a

Bijedić, T., Maass, F., Schröder, C., & Werner, A. (2014). *Der Einfluss institutioneller Rahmenbedingungen auf die Gründungsneigung von Wissenschaftlern an deutschen Hochschulen.* [Individual and Structural Influences on the Entrepreneurial Activities of Scientists in German Universities] (IfM-Materialien No. 223). Bonn.

Bird, B. J., Hayward, D. J., & Allen, D. N. (1993). Conflicts in the Commercialization of Knowledge: Perspectives from Science and Entrepreneurship. *Entrepreneurship, theory and practice*, *17*(4), 57–77.

Bishop, K., D'Este, P., & Neely, A. (2011). Gaining from interactions with universities: Multiple methods for nurturing absorptive capacity. *Research Policy*, *40*(1), 30–40.

Black, C. D., & Baker, M. J. (1987). Success through design. *Design Studies*, *8*(4), 207–216. https://doi.org/10.1016/0142-694X(87)90017-2

Blaikie, N. W. H. (1991). A critique of the use of triangulation in social research. *Quality and Quantity*, *25*(2), 115–136. https://doi.org/10.1007/BF00145701

Blickenstaff, J. C. (2005). Women and science careers: leaky pipeline or gender filter? *Gender and Education*, *17*(4), 369–386.

Blumenthal, D., Campbell, E. G., Anderson, M. S., Causino, N., & Louis, K. S. (1997). Withholding research results in academic life science. Evidence from a national survey of faculty. *Journal of the American Medical Association*, *277*(15), 1224–1228.

Boardman, P. C. (2008). Beyond the stars: The impact of affiliation with university biotechnology centers on the industrial involvement of university scientists. *Technovation*, *28*(5), 291–297. https://doi.org/10.1016/j.technovation.2007.06.001

Bogner, A., & Menz, W. (2002). Das theoriegenerierende Experteninterview. In A. Bogner, B. Littig, & W. Menz (Eds.), *Das Experteninterview* (pp. 33–70). Wiesbaden: VS Verlag für Sozialwissenschaften. https://doi.org/10.1007/978-3-322-93270-9_2

Bohnsack, R. (1989). *Generation, Milieu und Geschlecht. Ergebnisse aus Gruppendiskussionen mit Jugendlichen*. Opladen: Leske und Budrich.

Bohnsack, R. (1991). *Rekonstruktive Sozialforschung. Einführung in Methodologie und Praxis qualitativer Forschung*. Opladen: Leske und Budrich.

Bok, D. C. (2003). *Universities in the marketplace: The commercialization of higher education*. Princeton, N.J.: Princeton University Press.

Bollinger, L., Hope, K., & Utterback, J. M. (1983). A review of literature and hypotheses on new technology-based firms. *Research Policy*, *12*(1), 1–14.

Bonaccorsi, A., & Piccaluga, A. (1994). A theoretical framework for the evaluation of university-industry relationships. *R&D Management*, *24*(3), 229–247. https://doi.org/10.1111/j.1467-9310.1994.tb00876.x

Bonnafous-Boucher, M., Cuir, R., & Partouche, M. (2011). The new and the challenge of the market or the non-instrumental function of creation. In M. Scherdin & I. Zander (Eds.), *Art Entrepreneurship*. Edward Elgar Publishing. https://doi.org/10.4337/9781849808507.00010

Bornmann, L. (2013). What is societal impact of research and how can it be assessed? A literature survey. *Journal of the American Society for Information Science and Technology*, *64*(2), 217–233.

Bortz, J., & Döring, N. (2006). *Forschungsmethoden und Evaluation: Für Human- und Sozialwissenschaftler*. [Research methods and evaluation: for humanities and social scientists] (4th ed.). *Springer-Lehrbuch*. Heidelberg: Springer.

Bozeman, B. (2000). Technology transfer and public policy: a review of research and theory. *Research Policy*, *29*(4-5), 627–655.

Bozeman, B., Rimes, H., & Youtie, J. (2015). The evolving state-of-the-art in technology transfer research: Revisiting the contingent effectiveness model. *Research Policy*, *44*(1), 34–49. https://doi.org/10.1016/j.respol.2014.06.008

Braunerhjelm, P. (2007). Academic entrepreneurship: social norms, university culture and policies. *Science and Public Policy*, *34*(9), 619–631.

Braunerhjelm, P., & Svensson, R. (2010). The inventor's role: Was Schumpeter right? *Journal of Evolutionary Economics*, *20*(3), 413–444. https://doi.org/10.1007/s00191-009-0157-5

Braun-Thürmann, H., Knie, A., & Simon, D. (2010). *Unternehmen Wissenschaft: Ausgründungen als Grenzüberschreitungen akademischer Forschung*. Bielefeld: Transcript.

Brettel, M. (2003). Business angels in Germany: A research note. *Venture Capital: An International Journal of Entrepreneurial Finance*, *5*(3), 251–268.

Breznitz, S. M., O'Shea, R. P., & Allen, T. J. (2008). University Commercialization Strategies in the Development of Regional Bioclusters *Journal of Product Innovation Management*, *25*(2), 129–142.

Brixy, U., Hundt, C., Sternberg, R., & Stüber, H. (2009). *Unternehmensgründungen im internationalen Vergleich: Deutschland - eine Gründungswüste?* (IAB Kurzbericht No. 15/2009).

Brooks, A. W., Huang, L., Kearney, S. W., & Murray, F. E. (2014). Investors prefer entrepreneurial ventures pitched by attractive men. *Proceedings of the National Academy of Sciences of the United States of America*, *111*(12), 4427–4431. https://doi.org/10.1073/pnas.1321202111

Bruni, A., Poggio, B., & Gherardi, S. (2005). *Gender and entrepreneurship: An ethnographic approach. Management, organizations and society*. London, New York: Routledge. Retrieved from http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10094458

Brush, C., Green, P., Balachandra, L., & Davis, A. E. (2014). *Women Entrepreneurs 2014: Bridging the Gender Gap in Venture Capital: Diana Report*.

Bührer, S., Hufnagl, M., & Schraudner, M. (Eds.). (2009). *Frauen im Innovationssystem - im Team zum Erfolg*. Stuttgart: Fraunhofer.

Bührer, S., & Schraudner, M. (Eds.). (2006). *Gender-Aspekte in der Forschung: Wie können Gender-Aspekte in Forschungsvorhaben erkannt und bewertet werden? DiscoverGender*. Stuttgart: Fraunhofer IRB.

Bührer, S., & Schraudner, M. (2010). Die Dimension Gender bei der Festlegung und Bearbeitung von Forschungsthemen. In M. Schraudner (Ed.), *Diversity im Innovationssystem* (pp. 19–44). Stuttgart: Fraunhofer Verlag.

Bunderson, J. S., & Sutcliffe, K. M. (2002). COMPARING ALTERNATIVE CONCEPTUALIZATIONS OF FUNCTIONAL DIVERSITY IN MANAGEMENT TEAMS: PROCESS AND PERFORMANCE EFFECTS. *Academy of Management Journal*, *45*(5), 875–893. https://doi.org/10.2307/3069319

Busolt, U., & Kugele, K. (2009). The gender innovation and research productivity gap in Europe. *International Journal of Innovation and Sustainable Development*, *4*(2/3), 109–122.

Busolt, U., Kugele, K., & Tinsel, I. (2009). Chancengleichheit im europäischen Innovationsgeschehen? *horizonte.* (33), 13–17.

Butler, J. (1993). *Bodies that matter: On the discursive limits of "sex"*. New York, NY: Routledge.

Butler, J. (1997). *Körper von Gewicht: Die diskursiven Grenzen des Geschlechts. Edition Suhrkamp: Vol. 737*. Frankfurt a.M.: Suhrkamp.

Butler, J. (2004). *Undoing gender*. New York, NY, Abington: Routledge.

Caldera, A., & Debande, O. (2010a). Performance of Spanish universities in technology transfer: An empirical analysis. *Research Policy*, *39*(9), 1160–1173.

Caldera, A., & Debande, O. (2010b). Performance of Spanish universities in technology transfer: An empirical analysis. *Research Policy*, *39*(9), 1160–1173.

Caliendo, M., Fossen, F., & Kritikos, A. (2009). Risk attitudes of nascent entrepreneurs–new evidence from an experimentally validated survey. *Small Business Economics*, *32*(2), 153–167. https://doi.org/10.1007/s11187-007-9078-6

Caliendo, M., Fossen, F. M., & Kritikos, A. S. (2011). *Personality Characteristics and the Decision to Become and Stay Self-Employed* (IZA Discussion Paper No. 5566). Bonn.

Camerer, C., & Lovallo, D. (1999). Overconfidence and Excess Entry: An Experimental Approach. *American Economic Review*, *89*(1), 306–318.

Campbell, E. G., Clarridge, B. R., Gokhale, M., Birenbaum, L., Hilgartner, S., Holtzman, N. A., & Blumenthal, D. (2002). Data withholding in academic genetics: evidence from a national survey. *Journal of the American Medical Association*, *287*(4), 473–480.

Carayannis, E. G., & Campbell, D. F. J. (2009). 'Mode 3' and 'Quadruple Helix': toward a 21st century fractal innovation ecosystem. *International Journal of Technology Management*, *46*(3/4), 201–234.

Carayannis, E. G., & Campbell, D. F. J. (2011). Mode 3 Knowledge Production in Quadruple Helix Innovation Systems: Twenty-first-Century Democracy, Innovation, and Entrepreneurship for Development. *SpringerBriefs in Business.* (7), 1–63.

Carayol, N. (2007). ACADEMIC INCENTIVES, RESEARCH ORGANIZATION AND PATENTING AT A LARGE FRENCH UNIVERSITY. *Economics of Innovation and New Technology*, *16*(2), 119–138. https://doi.org/10.1080/10438590600982855

Carlsson, B., Jacobsson, S., Holmén, M., & Rickne, A. (2002). Innovation systems: analytical and methodological issues. *Research Policy*, *31*, 233–245.

Carter, S. L., & Shaw, E. (2006). *Women's business ownership : recent research and policy developments*.

Clark, B. R. (1998). *Creating entrepreneurial universities: Organizational pathways of transformation. Issues in higher education.* Bingley: Emerald.

Clarysse, B., Wright, M., Lockett, A., Mustar, P., & Knockaert, M. (2007). Academic spin-offs, formal technology transfer and capital raising. *Industrial and Corporate Change*, *16*(4), 609–640. https://doi.org/10.1093/icc/dtm019

Clarysse, B., Tartari, V., & Salter, A. (2011). The impact of entrepreneurial capacity, experience and organizational support on academic entrepreneurship. *Research Policy*, *40*(8), 1084–1093.

Clarysse, B., Wright, M., Bruneel, J., & Mahajan, A. (2014). Creating value in ecosystems: Crossing the chasm between knowledge and business ecosystems. *Research Policy*, *43*(7), 1164–1176. https://doi.org/10.1016/j.respol.2014.04.014

Clarysse, B., Wright, M., Lockett, A., van de Velde, E., & Vohora, A. (2005). Spinning out new ventures: A typology of incubation strategies from European research institutions. *Journal of Business Venturing*, *20*(2), 183–216. https://doi.org/10.1016/j.jbusvent.2003.12.004

Commission of Experts for Research and Innovation. (2014a). *Gutachten zu Forschung, Innovation und technologischer Leistungsfähigkeit Deutschlands 2014.* Berlin.

Commission of Experts for Research and Innovation. (2014b). Research, Innovation and Technological Performance in Germany - EFI Report 2014. Retrieved from http://www.e-fi.de/fileadmin/Gutachten_2014/EFI_Report_2014.pdf

Commission of Experts for Research and Innovation (EFI). (2017). *Gutachten zu Forschung, Innovation und technologischer Leistungsfähigkeit Deutschlands 2017.* Berlin. Retrieved from EFI website: http://www.e-fi.de/fileadmin/Gutachten_2017/EFI_Gutachten_2017.pdf

Connell, R. W. (2005). *Masculinities* (2nd ed.). Crows Nest, N.S.W.: Allen & Unwin.

Corley, E., & Gaughan, M. (2005). Scientists' participation in University research centers: what are the gender differences? *The Journal of Technology Transfer*, *30*(4), 371–381.

Crespi, G., D'Este, P., Fontana, R., & Geuna, A. (2011). The impact of academic patenting on university research and its transfer. *Research Policy*, *40*(1), 55–68. https://doi.org/10.1016/j.respol.2010.09.010

Czarnitzki, D., Doherr, T., Hussinger, K., Schliessler, P., & Toole, A. A. (2015). Individual Versus Institutional Ownership of University Discovered Inventions. *SSRN Electronic Journal*, 1–41.

D'Este, P., & Patel, P. (2007a). University–industry linkages in the UK: What are the factors underlying the variety of interactions with industry? *Research Policy*, *36*(9), 1295–1313. https://doi.org/10.1016/j.respol.2007.05.002

D'Este, P., & Perkmann, M. (2011). Why do academics engage with industry? The entrepreneurial university and individual motivations. *The Journal of Technology Transfer*, *36*(3), 316–339.

Dalborg, C., Friedrichs, Y. von, & Wincent, J. (2012). Beyond the numbers: qualitative growth in women's businesses. *International Journal of Gender and Entrepreneurship*, *4*(3), 289–315.

Dautzenberg, K. (2010). Frauen gründen Technologieunternehmen - eine Untersuchung im Land Brandenburg: [Women are establishing technology enterprises: a study in the Bundesland of Brandenburg]. *Sozialwissenschaftlicher Fachinformationsdienst (soFid) Frauen- und Geschlechterforschung*. (2/2010), 1–22.

Dautzenberg, K., Steinbrück, A., Brenning, L., & Zinke, G. (2013). *Wachstumspotenziale inhaberinnengeführter Unternehmen – wo steht Deutschland im EU-Vergleich? Studie im Auftrag des Bundesministeriums für Wirtschaft und Technologie*. Endbericht. Berlin.

Debackere, K., & Veugelers, R. (2005). The role of academic technology transfer organizations in improving industry science links. *Research Policy*, *34*(3), 321–342. https://doi.org/10.1016/j.respol.2004.12.003

Degroof, J.-J., & Roberts, E. B. (2004). Overcoming Weak Entrepreneurial Infrastructures for Academic Spin-Off Ventures. *The Journal of Technology Transfer*, *29*(3/4), 327–352. https://doi.org/10.1023/B:JOTT.0000034126.23592.23

Denef, S. (2012). A pattern language of firefighting frontline practice to inform the design of ubiquitous computing. In R. Wichert, K. van Laerhoven, & J. Gelissen (Eds.), *Communications in Computer and Information Science. Constructing Ambient Intelligence* (Vol. 277, pp. 308–312). Berlin, Heidelberg: Springer. https://doi.org/10.1007/978-3-642-31479-7_52

Denzin, N. K. (1970). *The research act in sociology: A theoretical introduction to sociological methods* ([2nd printing]). *Methodological perspectives*. London, Chicago: Butterworths; Aldine.

D'Este, P., Mahdi, S., & Neely, A. (2010). *Academic Entrepreneurship: What are the Factors Shaping the Capacity of Academic Researchers to Identify and Exploit Entrepreneurial Opportunities?* (DRUID working paper No. 10-05).

D'Este, P., & Patel, P. (2007b). University–industry linkages in the UK: What are the factors underlying the variety of interactions with industry? *Research Policy*, *36*, 1295–1313.

Destler, B. (2008). A new relationship. *Nature*, *453*(7197), 853–854. https://doi.org/10.1038/453853a

Di Gregorio, D., & Shane, S. (2003). Why do some universities generate more start-ups than others? *Research Policy*, *32*(2), 209–227. https://doi.org/10.1016/S0048-7333(02)00097-5

Di Stefano, G., Gambardella, A., & Verona, G. (2012). Technology push and demand pull perspectives in innovation studies: Current findings and future research directions. *Research Policy*, *41*(8), 1283–1295.

Dickel, P. (2009). *Marktbezogenes Lernen in Akademischen Spin-offs: Gewinnung und Integration von Marktinformationen in der frühen Phase technologiebasierter Ausgründungen. Betriebswirtschaftslehre für Technologie und Innovation: Vol. 62.* Wiesbaden: Gabler.

Diekmann, A. (2008). *Empirische Sozialforschung: Grundlagen, Methoden, Anwendungen* (19th ed.). *Rororo Rowohlts Enzyklopädie: Vol. 55678.* Reinbek bei Hamburg: Rowohlt-Taschenbuch-Verlag.

Dietz, G.-U., Matt, E., Schumann, K. F., & Seus, L. (1997). *"Lehre tut viel … ": Berufsbildung, Lebensplanung und Delinquenz bei Arbeiterjugendlichen.* Münster: Votum.

Dietz, J. S., & Bozeman, B. (2005). Academic careers, patents, and productivity: Industry experience as scientific and technical human capital. *Research Policy*, *34*(3), 349–367. https://doi.org/10.1016/j.respol.2005.01.008

Ding, W., & Choi, E. (2011). Divergent paths to commercial science: A comparison of scientists' founding and advising activities: Special Section on Heterogeneity and University-Industry Relations. *Research Policy*, *40*(1), 69–80.

Ding, W. W., Murray, F., & Stuart, T. E. (2010). *From Bench to Board: Gender Differences in University Scientists' Participation in Commercial Science* (working paper No. 11-014).

Dolata, U. (2015). Forschung und Entwicklung in der Wirtschaft: Konzentration, Kooperation und Internationalisierung. In D. Simon, A. Knie, S. Hornbostel, & K. Zimmermann (Eds.), *Handbuch Wissenschaftspolitik* (pp. 1–15). Wiesbaden: Springer.

Driver, A., Peralta, C., & Moultrie, J. (2011). Exploring How Industrial Designers Can Contribute to Scientific Research. *International Journal of Design*, *5*(1), 17–28.

econcept AG, & Austrian Institute of Technology GmbH. (2015). *CTI Invest: Evaluation: Schlussbericht mit Stellungnahme von CTI Invest.*

Egeln, J., Gottschalk, S., Rammer, C., & Spielkamp, A. (2002). *Spinoff-Gründungen aus der öffentlichen Forschung in Deutschland: Gutachten für das Bundesministerium für Bildung und Forschung* (Wirtschaftsanalysen). Mannheim.

Eisenhardt, K. M. (1989a). Building theories from case study research. *Academy of Management Review*, *14*(4), 532–550. https://doi.org/10.5465/AMR.1989.4308385

Eisenhardt, K. M. (1989b). Making fast strategic decisions in high-velocity environments. *Academy of Management Journal*, *32*(3), 543–576. https://doi.org/10.2307/256434

Eisenhardt, K. M., & Graebner, M. E. (2007). Theory Building From Cases: Opportunities And Challenges. *Academy of Management Journal*, *50*(1), 25–32. https://doi.org/10.5465/AMJ.2007.24160888

Ekehammar, B. (1974). Interactionism in personality from a historical perspective. *Psychological Bulletin*, *81*(12), 1026–1048.

Ekelund, J., Johansson, E., Järvelin, M.-R., & Lichtermann, D. (2005). Self-employment and risk aversion–evidence from psychological test data. *Labour Economics*, *12*(5), 649–659.

Ensley, M. D., & Hmieleski, K. M. (2005). A comparative study of new venture top management team composition, dynamics and performance between university-based and independent start-ups. *Research Policy*, *34*(7), 1091–1105. https://doi.org/10.1016/j.respol.2005.05.008

Erikson, T., Knockaert, M., & Foo, M. D. (2015). Enterprising scientists: The shaping role of norms, experience and scientific productivity. *Technological Forecasting and Social Change*, *99*, 211–221. https://doi.org/10.1016/j.techfore.2015.06.022

Etzkowitz, H., Fuchs, S., Gupta, N., Kemelgor, C., & Ranga, M. (2007). The Coming Gender Revolution in Science. In E. J. Hackett, O. Amsterdamska, M. Lynch, & J. Wajcman (Eds.), *The new handbook of science and technology studies* (3rd ed., pp. 403–428). Cambridge, MA: MIT.

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and "Mode 2" to a Triple Helix of university–industry–government relations. *Research Policy*, *29*(2), 109–123. https://doi.org/10.1016/S0048-7333(99)00055-4

Etzkowitz, H., Ranga, M., Conway, C., & Dixon, L. (2008). Gender patterns in technology transfer: social innovation in the making. *Research Global*, *8*(2), 4–5.

Etzkowitz, H., Uzzi, B., & Kemelgor, C. (2000). *Athena unbound: The advancement of women in science and technology*. Cambridge: Cambridge University Press. Retrieved from https://doi.org/10.1017/CBO9780511541414

Etzkowitz, H., Webster, A., & Healey, P. (Eds.). (1998). *Capitalizing knowledge: New intersections of industry and academia*. Albany, NY: State University of New York Press.

European Commission. (2008). *Evaluation on Policy: Promotion on Women Innovators and Entrepreneurship*. Brüssel.

European Commission. (2009). *Women in science and technology: Creating sustainable careers*. Brüssel.

European Commission. (2010). *Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions: Europe 2020 Flagship Initiative*. Innovation Union (No. SEC(2010) 1161). Brussels.

European Commission. (2011). *Proposal for a Regulation of the European Parliament and of the council establishing Horizon 2020* (COM(2011) 809 final No. 2011/0401 (COD)). Brüssel.

European Commission. (2013a). *Gendered Innovations: How Gender Analysis Contributes to Research* (Research and Innovation). Brüssel.

European Commission (EC). (2013). *Options for Strengthening Responsible Research and Innovation: Report of the Expert Group on the State of Art in Europe on Responsible Research and Innovation*. Brussels.

European Commission. (2013b). *Responsible Research and Innovation (RRI), Science and Technology: Summary* (Special Eurobarmometer No. 401). Brüssel.

European Commission. (2013c). *She Figures 2012: Gender in Research and Innovation. Statistics and indicators. Research and Innovation.* Luxembourg: Publications Office of the European Union.

European Commission. (2014a). *Horizon 2020 in brief: The EU framework programme for research & innovation.* Luxembourg: Publications Office.

European Commission. (2014b). Innovation Union Scoreboard 2014. Advance online publication. https://doi.org/10.2769/88936

European Commission. (2016a). Connecting the technology transfer offices of major european public research organisations. Retrieved from https://ec.europa.eu/jrc/communities/community/629/about

European Commission. (2016b). *Horizon 2020: Work Programme 2016 - 2017. 16. Science with and for Society* (European Commission Decision No. C(2016)1349 of 9 March 2016).

European Institute for Gender Equality (EIGE). (2013). *A study on collected narratives on gender perceptions in the 27 EU Member States.* Luxemburg.

Eurostat. (2014a). HRST by sub-groups, sex and age.

Eurostat. (2014b). Share of female researchers by sectors of performance.

Eurostat. (2014c). Total R&D personnel by sectors of performance, occupation and sex.

Faix, A., Gerhards, U., Köller, C., & Volkmann, M. (2012). Enabling Innovation: Wissens- und Technologietransfer – Pflicht und Kür für Forschungseinrichtungen. *Wissenschaftsmanagement. Zeitschrift für Innovation*, *19*(2), 32–37.

Faulkner, W. (2006). *Genders in/of Engineering: A Research Report.* Edinburgh.

Federal Ministry of Education and Research (BMBF). (2009). *Chancengerechtigkeit in Bildung und Forschung.* Bonn, Berlin.

Federal Ministry of Education and Research. (2010). *Ideen. Innovation. Wachstum: Hightech-Strategie 2020 für Deutschland.* Bonn, Berlin.

Federal Ministry of Education and Research (BMBF). (2014). *Die neue Hightech-Strategie Innovationen für Deutschland.* Berlin.

Federal Ministry of Education and Research (BMBF). (2016). *Daten und Fakten zum deutschen Forschungs- und Innovationssystem: Bundesbericht Forschung und Innovation 2016. Ergänzungsband 1.*

Federal Ministry of Education and Research (BMBF). (2017). Innovative Hochschule. Retrieved from https://www.bmbf.de/de/innovative-hochschule-2866.html

Fini, R., Fu, K., Mathisen, M. T., Rasmussen, E., & Wright, M. (2017). Institutional determinants of university spin-off quantity and quality: A longitudinal, multilevel, cross-country study. *Small Business Economics*, *48*(2), 361–391. https://doi.org/10.1007/s11187-016-9779-9

Fini, R., Grimaldi, R., Santoni, S., & Sobrero, M. (2011). Complements or substitutes? The role of universities and local context in supporting the creation of academic spin-offs. *Research Policy*, *40*(8), 1113–1127. https://doi.org/10.1016/j.respol.2011.05.013

Fini, R., Lacetera, N., & Shane, S. (2010). Inside or outside the IP system? Business creation in academia. *Research Policy*, *39*(8), 1060–1069. https://doi.org/10.1016/j.respol.2010.05.014

Flick, U. (2007). *Qualitative Sozialforschung: Eine Einführung* (6th ed.). *rowohlts enzyklopädie*. Hamburg: Rowohlt.

Flick, U. (2008). *Triangulation: Eine Einführung* (2. Aufl.). *Qualitative Sozialforschung: Bd. 12*. Wiesbaden: VS Verlag für Sozialwissenschaften.

Flick, U. (2010). Design und Prozess qualitativer Forschung. In U. Flick, E. von Kardorff, & I. Steinke (Eds.), *Qualitative Forschung. Ein Handbuch* (8th ed., pp. 252–264). Reinbek: Rowohlt.

Flick, U. (2011). *An introduction to qualitative research* (4. ed., repr). Los Angeles, Calif.: Sage.

Foltz, J., Barham, B., & Kim, K. (2000). Universities and agricultural biotechnology patent production. *Agribusiness*, *16*(1), 82–95. https://doi.org/10.1002/(SICI)1520-6297(200024)16:1<82::AID-AGR7>3.0.CO;2-V

Foo, M.-D., Knockaert, M., Chan, E. T., & Erikson, T. (2016). The Individual Environment Nexus: Impact of Promotion Focus and the Environment on Academic Scientists' Entrepreneurial Intentions. *IEEE Transactions on Engineering Management*, *63*(2), 213–222. https://doi.org/10.1109/TEM.2016.2535296

Franklin, S. J., Wright, M., & Lockett, A. (2001). Academic and Surrogate Entrepreneurs in University Spin-out Companies. *The Journal of Technology Transfer*, *26*(1-2), 127–141. https://doi.org/10.1023/A:1007896514609

Fraunhofer-Gesellschaft. (2014). *Jahresbericht 2013: Leben in der digitalen Welt*. München.

Friedman, J., & Silberman, J. (2003). University Technology Transfer: Do Incentives, Management, and Location Matter? *The Journal of Technology Transfer*, *28*(1), 17–30.

Friedrichs, J. (1983). *Methoden empirischer Sozialforschung* (11th ed.). Opladen: Westdeutscher Verlag.

Frietsch, R., Rammer, C., Schubert, T., Bührer, S., & Neuhäusler, P. (2012). *Innovationsindikator 2012*. Berlin, Bonn.

Fritsch, M., & Krabel, S. (2012). Ready to leave the ivory tower? Academic scientists' appeal to work in the private sector. *The Journal of Technology Transfer*, *37*(3), 271–296.

Froese, A., & Schraudner, M. (2010). Implementing diversity management: A good practise study on contemporary implementation methods employed by large companies in the German-speaking countries. In A. Spitzley, P. Ohlhausen, & D. Spath (Eds.), *The innovation potential of diversity. Practical examples in innovation management* (pp. 21–46). Stuttgart: Fraunhofer Verlag.

Funken, C., Rogge, J.-C., & Hörlin, S. (2015). *Vertrackte Karrieren: Zum Wandel der Arbeitswelten in Wirtschaft und Wissenschaft* (1st ed.). Frankfurt am Main: Campus Verlag.

Furdas, M., & Kohn, K. (2010). *What's the Difference?! Gender, Personality, and the Propensity to Start a Business* (IZA Discussion Paper No. 4778). Bonn.

Gemser, G. L., & Leenders, M. A. (2001). How integrating industrial design in the product development process impacts on company performance. *Journal of Product Innovation Management*, *18*(1), 28–38. https://doi.org/10.1016/S0737-6782(00)00069-2

Gephart, R. P. (2004). Qualitative Research and the Academy of Management Journal. *Academy of Management Journal*, *47*(4), 454–462. https://doi.org/10.5465/AMJ.2004.14438580

Gerhardt, U. (1986). *Patientenkarrieren. Eine medizinsoziologische Studie*. Frankfurt a. M.: Suhrkamp.

German Research Foundation. (2008). *The DFG's Research-Oriented Standards on Gender Equality*. Bonn.

Getz, D., & Segal, V. (2008). *The Israeli innovation system: An overview of national policy and cultural aspects*. Haifa: Samuel Neaman Institute for Advanced Studies in Science and Technology; Technion, Israel Institute of Technology.

Geuna, A. (2001). The Changing Rationale for European University Research Funding: Are There Negative Unintended Consequences? *Journal of Economic Issues*, *35*(3), 607–632. https://doi.org/10.1080/00213624.2001.11506393

Geuna, A., & Nesta, L. J. (2006). University patenting and its effects on academic research: The emerging European evidence. *Research Policy*, *35*(6), 790–807. https://doi.org/10.1016/j.respol.2006.04.005

Geuna, A., & Rossi, F. (2011). Changes to university IPR regulations in Europe and the impact on academic patenting. *Research Policy*, *40*(8), 1068–1076. https://doi.org/10.1016/j.respol.2011.05.008

Gewin, V. (2005). The technology trap. *Nature*, *437*(7061), 948–949. https://doi.org/10.1038/437948a

Glaser, B. G., & Strauss, A. L. (1967). *The Discovery of Grounded Theory: Strategies for qualitative research*. Chicago: Aldine de Gruyter.

Glaser, B. G., & Strauss, A. L. (2010). *Grounded Theory: Strategien qualitativer Forschung* (3rd ed.). Bern: Huber.

Goethner, M., Obschonka, M., Silbereisen, R. K., & Cantner, U. (2012). Scientists' transition to academic entrepreneurship: Economic and psychological determinants. *Journal of Economic Psychology*, *33*(3), 628–641. https://doi.org/10.1016/j.joep.2011.12.002

Göktepe-Hultén, D. (2008). *Why and how do scientists commercialize their research? Towards a typology of inventors* (Jena economic research papers No. 2008,071).

Gottschalk, S., Fryges, H., Metzger, G., Heger, D., & Licht, G. (2007). *Start-ups zwischen Forschung und Finanzierung: Hightech-Gründungen in Deutschland: Gutachten.* Mannheim.

Gottschalk, S., & Niefert, M. (2011). *Gender Differences in Business Success of German Start-up Firms* (Discussion paper / Wissenschaftszentrum Berlin für Sozialforschung, Forschungsschwerpunkt Gesellschaft und wirtschaftliche Dynamik, Forschungsgruppe Wissenschaftspolitik No. 11-019). Mannheim.

Gratton, L., Voigt, A., & Erickson, T. (2007). Bridging Faultlines in Diverse Teams. *MIT Sloan Management Review*, *48*(4), 22–29.

Grave, B., Hetze, P., & Kanig, A. (2014). *Gründungsradar 2013: Wie Hochschulen Unternehmensgründungen fördern. Analysen.* Essen: Stifterverband für die deutsche Wissenschaft.

Grave, B., Hetze, P., & Kanig, A. (2017). *Gründungsradar 2016: Wie Hochschulen Unternehmensgründungen fördern. Analysen.* Essen: Stifterverband für die deutsche Wissenschaft. Retrieved from https://www.stifterverband.org/medien/gruendungsradar-2016

Grimaldi, R., Kenney, M., Siegel, D. S., & Wright, M. (2011). 30 years after Bayh–Dole: Reassessing academic entrepreneurship. *Research Policy*, *40*(8), 1045–1057.

Gupta, N., Kemelgor, C., Fuchs, S., & Etzkowitz, H. (2005). Triple burden on women in science: A cross-cultural analysis. *Current Science*, *89*(8), 1382–1386.

Haas, B., & Scheibelhofer, E. (1998). *Typenbildung in der qualitativen Sozialforschung: Eine methodologische Analyse anhand ausgewählter Beispiele. Reihe Soziologie: Vol. 34.* Wien: Institut für Höhere Studien.

Haeussler, C., & Colyvas, J. A. (2011). Breaking the Ivory Tower: Academic Entrepreneurship in the Life Sciences in UK and Germany. *Research Policy*, *40*(1), 41–54.

Haller, I., Vrohlings, M., Frietsch, R., & Grupp, H. (2007). *Analyse des technischen und wissenschaftlichen Beitrags von Frauen* (Studien zum deutschen Innovationssystem No. 18-2007). Berlin.

Hart, C. (1998). *Doing a literature review: Releasing the social science research imagination.* London: Sage Publications.

Haupert, B. (1991). Vom narrativen Interview zur biographischen Typenbildung. In D. Garz & K. Kraimer (Eds.), *Qualitativ-empirische Sozialforschung. Konzepte, Methoden, Analysen* (pp. 213–254). Opladen: Westdeutscher Verlag.

Hayter, C. S. (2011). In search of the profit-maximizing actor: Motivations and definitions of success from nascent academic entrepreneurs. *The Journal of Technology Transfer*, *36*(3), 340–352. https://doi.org/10.1007/s10961-010-9196-1

Heidingsfelder, M., Kimpel, K., Best, K., & Schraudner, M. (2015). Shaping Future – Adapting design know-how to reorient innovation towards public preferences. *Technological Forecasting and Social Change.* (101), 291–298.

Helmholtz Association. (2014). *Geschäftsbericht 2014: Der Helmholtz-Gemeinschaft Deutscher Forschungszentren.*

Hemer, J., Schleinkofer, M., & Göthner, M. (2007). *Akademische Spin-offs: Erfolgsbedingungen für Ausgründungen aus Forschungseinrichtungen. Studien des Büros für Technikfolgen-Abschätzung beim Deutschen Bundestag: Vol. 2*. Berlin: Edition sigma.

Hertenstein, J. H., Platt, M. B., & Brown, D. R. (2001). Valuing design: Enhancing corporate performance through design effectiveness. *Design Management Journal (Former Series)*, *12*(3), 10–19. https://doi.org/10.1111/j.1948-7169.2001.tb00548.x

Hoffmann-Riem, C. (1980). Die Sozialforschung einer interpretativen Soziologie: der Datengewinn. *Kölner Zeitschrift für Soziologie und Sozialpsychologie*, *32*, 339–372.

Honer, A. (1993). *Lebensweltliche Ethnographie. Ein explorativ-interpretativer Forschungsansatz am Beispiel von Heimwerker-Wissen.* Wiesbaden: Deutscher Universitäts-Verlag.

Horwitz, S. K., & Horwitz, I. B. (2007). The effects of team diversity on team outcomes: A meta-analytic review of team demography. *Journal of Management*, *33*(6), 987–1015.

Hulten, D. G. (2010). University-industry technology transfer: Who needs TTOs? *International Journal of Technology Transfer and Commercialisation*, *9*(1/2), 40. https://doi.org/10.1504/IJTTC.2010.029424

Hünnies-Stemann, J., Rulle, E., Seel, B., & Terberl, S. (2010). *Frauen gründen in Nano: Gründerinnenpotenzialstudie im Rahmen des BMBF-Projektes „Power für Gründerinnen" Nano4women & Entrepreneurship*.

Huyghe, A., & Knockaert, M. (2015a). The influence of organizational culture and climate on entrepreneurial intentions among research scientists. *The Journal of Technology Transfer*, *40*(1), 138–160.

Huyghe, A., & Knockaert, M. (2015b). The influence of organizational culture and climate on entrepreneurial intentions among research scientists. *The Journal of Technology Transfer*, *40*(1), 138–160.

Huyghe, A., Knockaert, M., & Obschonka, M. (2016). Unraveling the "passion orchestra" in academia. *Journal of Business Venturing*, *31*(3), 344–364. https://doi.org/10.1016/j.jbusvent.2016.03.002

Huyghe, A., Knockaert, M., Piva, E., & Wright, M. (2016). Are researchers deliberately bypassing the technology transfer office? An analysis of TTO awareness. *Small Business Economics*. Advance online publication. https://doi.org/10.1007/s11187-016-9757-2

Hvide, H., & Jones, B. (2016). *University Innovation and the Professor's Privilege*. Cambridge, MA: National Bureau of Economic Research.

Ireland, R. D., Tihanyi, L., & Webb, J. W. (2008). A tale of two politico-economic systems: Implications for entrepreneurship in Central and Eastern Europe. *Entrepreneurship, theory and practice : ET & P*, *32*(1), 107–130.

Isaac, C., Lee, B., & Carnes, M. (2009). Interventions That Affect Gender Bias in Hiring: A Systematic Review. *Academic Medicine*, *84*(10), 1440–1446.

Jackson, S. E., Joshi, A., & Erhardt, N. L. (2003). Recent Research on Team and Organizational Diversity: SWOT Analysis and Implications. *Journal of Management*, *29*(6), 801–830. https://doi.org/10.1016/S0149-2063_03_00080-1

Jain, S., George, G., & Maltarich, M. (2009). Academics or entrepreneurs? Investigating role identity modification of university scientists involved in commercialization activity. *Research Policy*, *38*(6), 922–935.

Jaksztat, S., Schindler, N., & Briedis, K. (2010). *Wissenschaftliche Karrieren: Beschäftigungsbedingungen, berufliche Orientierungen und Kompetenzen des wissenschaftlichen Nachwuchses* (HIS Forum Hochschule No. 14). Hannover.

Janich, N., & Zakharova, E. (2011). Wissensasymmetrien, Interaktionsrollen und die Frage der „gemeinsamen" Sprache in der interdisziplinären Projektkommunikation. *Fachsprache*, *3-4*, 187–204.

Jensen, R., & Thursby, M. (2001). Proofs and Prototypes for Sale: The Licensing of University Inventions. *American Economic Review*, *91*(1), 240–259. https://doi.org/10.1257/aer.91.1.240

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed Methods Research: A Research Paradigm Whose Time Has Come. *Educational Researcher*, *33*(7), 14–26. https://doi.org/10.3102/0013189X033007014

Joint Science Conference (GWK). (2013). *Pakt für Forschung und Innovation: Monitoring Bericht 2013* (Materialien der GWK No. 33). Bonn.

Jong, S. P. de, Wardenaar, T., & Horlings, E. (2016). Exploring the promises of transdisciplinary research: A quantitative study of two climate research programmes. *Research Policy*, *45*(7), 1397–1409. https://doi.org/10.1016/j.respol.2016.04.008

Jørgensen, M. S., Jørgensen, U., & Clausen, C. (2009). The social shaping approach to technology foresight. *Futures*, *41*(2), 80–86.

Kahlert, H. (2012). Was kommt nach der Promotion? Karriereorientierung und -pläne des wissenschaftlichen Nachwuchses im Fächer- und Geschlechtervergleich. In S. Beaufaÿs, A. Engels, & H. Kahlert (Eds.), *Einfach Spitze? Neue Geschlechterperspektiven auf Karrieren in der Wissenschaft*. Frankfurt a.M.: Campus Verlag.

Kahlert, H. (2013). *Riskante Karrieren: Wissenschaftlicher Nachwuchs im Spiegel der Forschung.* [Risky careers: young scientists and research]. Opladen: Barbara Budrich.

Kaiser, S. (2014). Das Personalmanagement als Motor für Vielfalt - Potenziale eines lebensphasenorientierten Ansatzes. In K. Hochfeld, S. Kaiser, & M. Schraudner (Eds.), *Unternehmenskulturen verändern - Vielfalt erreichen* (pp. 42–70). Stuttgart: Fraunhofer Verlag.

Kaiser, S., Hochfeld, K., Gertje, E., & Schraudner, M. (2012). *Unternehmenskulturen verändern – Karrierebrüche vermeiden.* Stuttgart: Fraunhofer Verlag.

Kalantaridis, C., & Bika, Z. (2011). Entrepreneurial origin and the configuration of innovation in rural areas: the case of Cumbria, North West England. *Environment and Planning*, *43*(4), 866–884.

Kanter, R. M. (1977). Some effects of proportions on group life: Skewed sex ratios and responses to token women. *The American Journal of Sociology*, *82*(5), 965–990.

Karlsruher Institute for Technology (KIT). (2010). Eine starke Partnerschaft: KIT Shared Instruments: Innovative Formen der Kooperation zwischen Wissenschaft und Wirtschaft. Retrieved from https://www.kit.edu/downloads/Research_Flyer_Kooperation.pdf

Keller, M., & Haustein, T. (2013). Vereinbarkeit von Familie und Beruf - Ergebnisse des Mikrozensus 2012. *Wirtschaft und Statistik.* (12), 862–882.

Kenney, M., & Patton, D. (2009). Reconsidering the Bayh-Dole Act and the Current University Invention Ownership Model. *Research Policy*, *38*(9), 1407–1422. https://doi.org/10.1016/j.respol.2009.07.007

Kenney, M., & Patton, D. (2011). Does inventor ownership encourage university research-derived entrepreneurship? A six university comparison. *Research Policy*, *40*(8), 1100–1112. https://doi.org/10.1016/j.respol.2011.05.012

Kirchner, U., & Matuschka, A. v. (2011). *Patent verwertet. TU-Gründungsumfrage 2008/09: [Patent commercialisation. Founder Survey of the Technical University of Berlin 2008/09].* Berlin: Technische Universität Berlin: Gründungsservice.

Kleining, G. (1982). Umriss zu einer Methodologie qualitativer Sozialforschung. *Kölner Zeitschrift für Soziologie und Sozialpsychologie*, *34*, 224–253.

Kleining, G. (1995). *Lehrbuch entdeckende Sozialforschung. Von der Hermeneutik zur qualitativen Heuristik: Vol. 1.* Weinheim: Beltz, Psychologie-Verl.-Union.

Kline, S. J., & Rosenberg, N. (1986). An overview of innovation. In R. Landau & N. Rosenberg (Eds.), *The Positive Sum Strategy. Harnessing Technology for Economic Growth* (pp. 275–306). Washington, DC: The National Academic Press.

Klofsten, M., & Jones-Evans, D. (2000). Comparing Academic Entrepreneurship in Europe: The Case of Sweden and Ireland. *Small Business Economics*, *14*(4), 299–309.

Kluge, S. (1999). *Empirisch begründete Typenbildung: Zur Konstruktion von Typen und Typologien in der qualitativen Sozialforschung.* Opladen: Leske und Budrich.

Knight, D., Pearce, C. L., Smith, K. G., Olian, J. D., Sims, H. P., Smith, K. A., & Flood, P. (1999). Top management team diversity, group process, and strategic consensus. *Strategic Management Journal*, *20*(5), 445–465. https://doi.org/10.1002/(SICI)1097-0266(199905)20:5<445::AID-SMJ27>3.0.CO;2-V

Knockaert, M., Ucbasaran, D., Wright, M., & Clarysse, B. (2011). The Relationship Between Knowledge Transfer, Top Management Team Composition, and Performance: The Case of Science-Based Entrepreneurial Firms. *Entrepreneurship Theory and Practice*, *35*(4), 777–803. https://doi.org/10.1111/j.1540-6520.2010.00405.x

Koch, L. T. (2000). *Gründungskultur: Ökonomischer Gehalt und gesellschaftspolitischer Anspruch* (Forschungsberichte des Gründerseminars No. 6).

Kochan, T., Bezrukova, K., Ely, R., Jackson, S., Joshi, A., Jehn, K.,. . . Thomas, D. (2003). The effects of diversity on business performance: Report of the diversity research network. *Human Resource Management*, *42*(1), 3–21.

Kolb, C., & Wagner, M. (2015). Crowding in or crowding out: The link between academic entrepreneurship and entrepreneurial traits. *The Journal of Technology Transfer*, *40*(3), 387–408.

Krabel, S., & Mueller, P. (2009). What drives scientists to start their own company? *Research Policy*, *38*(6), 947–956. https://doi.org/10.1016/j.respol.2009.02.005

Krippendorff, K. (2005). *The semantic turn: A new foundation for design.* Boca Raton: CRC Press.

Kristof-Brown, A. L., Zimmermann, R. D., & Johnson, E. C. (2005). Consequences of individuals' fit at work. A meta analysis of person-job, person-organization, person-group, and person-supervisor fit. *Personnel Psychology*, *58*(2), 281–342.

Kulicke, M. (2006). *EXIST – Existenzgründungen aus Hochschulen: Bericht der wissenschaftlichen Begleitung zum Förderzeitraum 1998 bis 2005.* Kurzfassung.

Kulicke, M., & Leimbach, T. (2012). *Venture Capital und weitere Rahmenbedingungen für eine Gründungskultur: Gutachten für das Sekretariat der Enquete-Kommission "Internet und digitale Gesellschaft" des Deutschen Bundestages.*

Kulicke, M., & Schleinkofer, M. (2008). *Wirkungen von EXIST-SEED aus Sicht von Geförderten: Ergebnisse einer Befragung im Rahmen der wissenschaftlichen Begleitung von EXIST - Existenzgründungen aus der Wissenschaft im Auftrag des Bundesministeriums für Wirtschaft und Technologie (BMWi). ISI-Schriftenreihe Innovationspotenziale.* Stuttgart: Fraunhofer IRB.

Kumar, N., Stern, L. W., & Anderson, J. C. (1993). Conducting Interorganizational Research Using Key Informants. *The Academy of Management Journal*, *36*(6), 1633–1651.

Kurvinen, E. (2005). How industrial design interacts with technology: A case study on design of a stone crusher. *Journal of Engineering Design*, *16*(4), 373–383. https://doi.org/10.1080/09544820500131219

Lach, S., & Schankerman, M. (2008). Incentives and invention in universities. *The RAND Journal of Economics*, *39*(2), 403–433. https://doi.org/10.1111/j.0741-6261.2008.00020.x

Lam, A. (2010). From 'Ivory Tower Traditionalists' to 'Entrepreneurial Scientists'? Academic Scientists in Fuzzy University-Industry Boundaries. *Social Studies of Science*, *40*(2), 307–340. https://doi.org/10.1177/0306312709349963

Lamnek, S. (2008). *Qualitative Sozialforschung: Lehrbuch* (4th ed.). Weinheim: Beltz.

Lamnek, S. (2010). *Qualitative Sozialforschung: Lehrbuch* (5th ed.). Weinheim, Basel: Beltz.

Landry, R., Amara, N., & Rherrad, I. (2006). Why are some university researchers more likely to create spin-offs than others? Evidence from Canadian universities. *Research Policy*, *35*(10), 1599–1615. https://doi.org/10.1016/j.respol.2006.09.020

Lant, T. K., Milliken, F. J., & Batra, B. (1992). The role of managerial learning and interpretation in strategic persistence and reorientation: An empirical exploration. *Strategic Management Journal*, *13*(8), 585–608. https://doi.org/10.1002/smj.4250130803

Larsen, M. T. (2011). The implications of academic enterprise for public science: An overview of the empirical evidence. *Research Policy*, *40*(1), 6–19. https://doi.org/10.1016/j.respol.2010.09.013

Lautenschläger, A., Haase, H., & Kratzer, J. (2014). Contingency factors on university spin-off formation: an empirical study in Germany. *Journal of Entrepreneurship and Public Policy*, *3*(1), 160–176.

Lauxen-Ulbrich, M., & Leicht, R. (2005). *Wie Frauen gründen und was sie unternehmen: Nationaler Report Deutschland: Teilprojekt: Statistiken über Gründerinnen und selbstständige Frauen.* Mannheim.

Lazarsfeld, P. (1937). Some Remarks on the Typological Procedures in Social Research. *Zeitschrift für Sozialforschung*, *6*, 119–204.

Lazarsfeld, P., & Barton, A. (1951). Qualitative Measurement in the Social Sciences: Classification, Typologies, and Indices. In D. Lerner & H. D. Lasswell (Eds.), *The Policy Sciences*. Stanford University Press.

Leavy, B. (2010). Design thinking – a new mental model of value innovation. *Strategy & leadership*, *38*(3), 5–14.

Lee, J. J., & Rhoads, R. A. (2004). Faculty Entrepreneurialism and the Challenge to Undergraduate Education at Research Universities. *Research in Higher Education*, *45*(7), 739–760.

Leech, N. L., & Onwuegbuzie, A. J. (2007). An array of qualitative data analysis tools: A call for data analysis triangulation. *School Psychology Quarterly*, *22*(4), 557–584. https://doi.org/10.1037/1045-3830.22.4.557

Leibniz Association. (2015). Leibniz Gemeinschaft: Transfer / Gründungen.

Leontief, W. (1941). *The structure of American economy, 1919-1929: an empirical application of equilibrium analysis.* Cambridge, MA: Harvard University Press.

Lerner, J. (2004). The University and the Start-Up: Lessons from the Past Two Decades. *The Journal of Technology Transfer*, *30*(1-2), 49–56. https://doi.org/10.1007/s10961-004-4357-8

Lester, R. K. (2005). *Universities, Innovation, and the Competitiveness of Local Economies* (MIT Industrial Performance Center Working Paper No. 05-010).

Lewin, K. (1935). *A dynamic theory of personality: Selected papers*. New York, NY: McGraw-Hill.

Lindholm Dahlstrand, Å., & Politis, D. (2013). Women business ventures in Swedish university incubators. *International Journal of Gender and Entrepreneurship*, *5*(1), 78–96. https://doi.org/10.1108/17566261311305229

Link, A. N., Siegel, D. S., & Bozeman, B. (2007). An empirical analysis of the propensity of academics to engage in informal university technology transfer. *Industrial and Corporate Change*, *16*(4), 641–655. https://doi.org/10.1093/icc/dtm020

Link, A. N., & Scott, J. T. (2015). Research, Science, and Technology Parks: Vehicles for Technology Transfer. In A. N. Link, D. S. Siegel, & M. Wright (Eds.), *The Chicago handbook of university technology transfer and academic entrepreneurship*. Chicago, London: The University of Chicago Press.

Link, A. N., & Siegel, D. S. (2005). University-based technology initiatives: Quantitative and qualitative evidence. *Research Policy*, *34*(3), 253–257. https://doi.org/10.1016/j.respol.2005.01.005

Link, A. N., Siegel, D. S., & Wright, M. (Eds.). (2015). *The Chicago handbook of university technology transfer and academic entrepreneurship*. Chicago, London: The University of Chicago Press.

Link, A. N., & Strong, D. R. (2016). Gender and Entrepreneurship: An Annotated Bibliography. *Foundations and Trends® in Entrepreneurship*, *12*(4-5), 287–441. https://doi.org/10.1561/0300000068

Lissoni, F., Llerena, P., McKelvey, M., & Sanditov, B. (2008). Academic patenting in Europe: New evidence from the KEINS database. *Research Evaluation*, *17*(2), 87–102. https://doi.org/10.3152/095820208X287171

Lissoni, F., Lotz, P., Schovsbo, J., & Treccani, A. (2009). Academic patenting and the professor's privilege: Evidence on Denmark from the KEINS database. *Science and Public Policy*, *36*(8), 595–607. https://doi.org/10.3152/030234209X475443

Lockett, A., & Wright, M. (2005). Resources, capabilities, risk capital and the creation of university spin-out companies. *Research Policy*, *34*(7), 1043–1057. https://doi.org/10.1016/j.respol.2005.05.006

Lockett, A., Wright, M., & Franklin, S. (2003). Technology Transfer and Universities' Spin-Out Strategies. *Small Business Economics*, *20*(2), 185–200. https://doi.org/10.1023/A:1022220216972

Lockett, A., Wright, M., & Wild, A. (2015). The Institutionalization of Third Stream Activities in UK Higher Education: The Role of Discourse and Metrics. *British Journal of Management*, *26*(1), 78–92. https://doi.org/10.1111/1467-8551.12069

Lowe, R. A. (2006). Who Develops a University Invention? The Impact of Tacit Knowledge and Licensing Policies. *The Journal of Technology Transfer*, *31*(4), 415–429. https://doi.org/10.1007/s10961-006-0003-y

Lu, J., & Tao, Z. (2010). Determinants of entrepreneurial activities in China. *Journal of Business Venturing*, *25*(3), 261–273. https://doi.org/10.1016/j.jbusvent.2008.10.005

Ludwig, M. (1996). *Armutskarrieren. Zwischen Abstieg und Aufstieg im Sozialstaat.* Opladen: Westdeutscher Verlag.

Lundvall, B.-Å. (2010). *National systems of innovation: Toward a theory of innovation and interactive learning. The Anthem Other Canon series.* London, New York, NY: Anthem.

Mair, J., Battilana, J., & Cardenas, J. (2012). Organizing for Society: A Typology of Social Entrepreneuring Models. *Journal of Business Ethics*, *111*(3), 353–373. https://doi.org/10.1007/s10551-012-1414-3

Marion, T. J., Dunlap, D., & Friar, J. H. (2015). Northeastern University: A Study of Technology Transfer and the Academic Entrepreneur. In A. N. Link, D. S. Siegel, & M. Wright (Eds.), *The Chicago handbook of university technology transfer and academic entrepreneurship*. Chicago, London: The University of Chicago Press.

Markman, G. D., Siegel, D. S., & Wright, M. (2008). Research and Technology Commercialization. *Journal of Management Studies*, *45*(8), 1401–1423. https://doi.org/10.1111/j.1467-6486.2008.00803.x

Marlow, S., & Patton, D. (2005). All Credit to Men? Entrepreneurship, Finance, and Gender. *Entrepreneurship Theory and Practice (ET&P)*, *29*(6), 717–735.

Marom, D., Robb, A., & Sade, O. (2016). Gender Dynamics in Crowdfunding (Kickstarter): Evidence on Entrepreneurs, Investors, Deals and Taste Based Discrimination. *SSRN Electronic Journal*. Advance online publication. https://doi.org/10.2139/ssrn.2442954

Martin, B. R. (2011). The Research Excellence Framework and the 'impact agenda': Are we creating a Frankenstein monster? *Research Evaluation*, *20*(3), 247–254.

Martins, E., & Terblanche, F. (2003). Building organisational culture that stimulates creativity and innovation. *European Journal of Innovation Management*, *6*(1), 64–74.

Matthies, H. (2001). *Karrieren und Barrieren im Wissenschaftsbetrieb: Geschlechterdifferente Teilhabechancen in außeruniversitären Forschungseinrichtungen.* [Careers and career barriers in the scientific establishment: gender inequality at research institutes]. Berlin: Edition sigma.

Max Planck Society. (2014). *Jahresbericht 2013*. München.

Mayring, P. (2010). *Qualitative Inhaltsanalyse: Grundlagen und Techniken. Beltz Pädagogik.* Weinheim: Beltz.

Meißner, D., & Sultanian, E. (2007). *Wissens- und Technologietransfer: Grundlagen und Diskussion von Studien und Beispielen.* Bern: Zentrum für Wissenschafts- und Technologiestudien (CEST).

Merrill, S. A., & Mazza, A.-M. (2011). *Managing university intellectual property in the public interest.* Washington, D.C.: National Research Council, National Academies Press.

Merton, R. K. (1959). *Social theory and social structure*. Glencoe: Free Press.

Metzger, G. (2015). *KfW-Gründungsmonitor 2015 - Gründungstätigkeit nimmt zu - Freiberufliche Tätigkeitsfelder dominieren* (KFW Reserach).

Metzger, G., Heger, D., Höwer, D., & Licht, G. (2010). *High-Tech-Gründungen in Deutschland: Zum Mythos des jungen High-Tech-Gründers*. Mannheim.

Metzger, G., Niefert, M., & Licht, G. (2008). *High-Tech-Gründungen in Deutschland.: Trends, Strukturen, Potenziale*. Mannheim.

Meuser, M., & Nagel, U. (1991). ExpertInneninterviews - vielfach erprobt, wenig bedacht: Ein Beitrag zur qualitativen Methodendiskussion. In D. Garz & K. Kraimer (Eds.), *Qualitativ-empirische Sozialforschung. Konzepte, Methoden, Analysen* (pp. 441–471). Opladen: Westdeutscher Verlag.

Meyer, M. (2003). Academic entrepreneurs or entrepreneurial academics? Research-based ventures and public support mechanisms. *R and D Management*, *33*(2), 107–115. https://doi.org/10.1111/1467-9310.00286

Meyer-Krahmer, F., & Schmoch, U. (1998). Science-based technologies: University–industry interactions in four fields. *Research Policy*, *27*(8), 835–851. https://doi.org/10.1016/S0048-7333(98)00094-8

Miller, C. C., Burke, L. M., & Glick, W. H. (1998). Cognitive diversity among upper-echelon executives: Implications for strategic decision processes. *Strategic Management Journal*, *19*(1), 39–58. https://doi.org/10.1002/(SICI)1097-0266(199801)19:1<39::AID-SMJ932>3.0.CO;2-A

Miller, K., McAdam, R., Moffett, S., Alexander, A., & Puthusserry, P. (2016). Knowledge transfer in university quadruple helix ecosystems: An absorptive capacity perspective. *R&D Management*, *46*(2), 383–399. https://doi.org/10.1111/radm.12182

Minguillo, D., & Thelwall, M. (2015). Which are the best innovation support infrastructures for universities? Evidence from R&D output and commercial activities. *Scientometrics*, *102*(1), 1057–1081.

Moog, P., Werner, A., Houweling, S., & Backes-Gellner, U. (2015). The impact of skills, working time allocation and peer effects on the entrepreneurial intentions of scientists. *The Journal of Technology Transfer*, *40*(3), 493–511.

Moser, A. (2007). *Gender and indicators: Overview report. Cutting edge pack : topical gender knowledge*. Brighton: Institute of Development Studies, BRIDGE.

Mosey, S., Guerrero, M., & Greenman, A. (2016). Technology entrepreneurship research opportunities: Insights from across Europe. *The Journal of Technology Transfer*, 1–9. https://doi.org/10.1007/s10961-015-9462-3

Mosey, S., & Wright, M. (2007). From Human Capital to Social Capital: A Longitudinal Study of Technology-Based Academic Entrepreneurs. *Entrepreneurship Theory and Practice*, *31*(6), 909–935. https://doi.org/10.1111/j.1540-6520.2007.00203.x

Mowery, D. C., Nelson, R. R., Sampat, B. N., & Ziedonis, A. A. (2004). *Ivory tower and industrial innovation: University-industry technology transfer before and after the Bayh-Dole Act in the United States. Innovation and technology in the world economy.* Stanford, Calif.: Stanford Business Books. Retrieved from http://www.loc.gov/catdir/enhancements/fy0710/2003025632-b.html

Mowery, D. C., & Sampat, B. N. (2004). The Bayh-Dole Act of 1980 and University? Industry Technology Transfer: A Model for Other OECD Governments? *The Journal of Technology Transfer*, *30*(1-2), 115–127. https://doi.org/10.1007/s10961-004-4361-z

Murray, F. (2004). The role of academic inventors in entrepreneurial firms: Sharing the laboratory life. *Research Policy*, *33*(4), 643–659. https://doi.org/10.1016/j.respol.2004.01.013

Murray, F. E., & Kolev, J. (2015). An Entrepreneur's Guide to the University. In A. N. Link, D. S. Siegel, & M. Wright (Eds.), *The Chicago handbook of university technology transfer and academic entrepreneurship* (pp. 97–137). Chicago, London: The University of Chicago Press.

Murray, F., & Graham, L. (2007). Buying science and selling science: gender differences in the market for commercial science. *Industrial and Corporate Change*, *16*(4), 657–689.

Murray, H. A. (1938). *Explorations in personality.* Oxford: Oxford University Press.

Mustar, P., Renault, M., Colombo, M. G., Piva, E., Fontes, M., Lockett, A.,. . . Moray, N. (2006). Conceptualising the heterogeneity of research-based spin-offs: A multi-dimensional taxonomy. *Research Policy*, *35*(2), 289–308. https://doi.org/10.1016/j.respol.2005.11.001

Mustar, P., & Wright, M. (2010). Convergence or path dependency in policies to foster the creation of university spin-off firms? A comparison of France and the United Kingdom. *The Journal of Technology Transfer*, *35*(1), 42–65. https://doi.org/10.1007/s10961-009-9113-7

Nagel, U. (1997). *Engagierte Rollendistanz. Professionalität in biographischer Perspektive.* Opladen: Leske und Budrich.

Naldi, F., Luzi, D., Valente, A., & Vannini Parenti, I. (2005). Scientific and Technological Performance by Gender. In H. F. Moed, W. Glänzel, & U. Schmoch (Eds.), *Handbook of Quantitative Science and Technology Research* (pp. 299–314). Springer Netherlands. https://doi.org/10.1007/1-4020-2755-9_14

National Science Foundation. (2009). *Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers*.

Ndonzuau, F. N., Pirnay, F., & Surlemont, B. (2002). A stage model of academic spin-off creation. *TECHNOVATION*, *22*(5), 281–289.

Nicolaou, N., & Birley, S. (2003). Academic networks in a trichotomous categorisation of university spinouts. *Journal of Business Venturing*, *18*(3), 333–359. https://doi.org/10.1016/S0883-9026(02)00118-0

Notz, G. (2008). Arbeit: Hausarbeit, Ehrenamt, Erwerbsarbeit. In R. Becker & B. Kortendiek (Eds.), *Handbuch Frauen- und Geschlechterforschung* (pp. 472–480). Wiesbaden: VS Verl. für Sozialwiss. https://doi.org/10.1007/978-3-531-91972-0_56

O'Shea, R. P., Chugh, H., & Allen, T. J. (2008). Determinants and consequences of university spinoff activity: a conceptual framework. *The Journal of Technology Transfer*, *33*(6), 653–666. https://doi.org/10.1007/s10961-007-9060-0

Organisation for Economic Cooperation and Development (OECD). (2011). *OECD economic surveys: Italy 2011. OECD economic surveys Italy: 2011/6.* Paris: OECD.

Organization for Economic Cooperation and Development (OECD). (2003). *Turning Science into Business.* Paris: OECD Publishing.

Organization for Economic Cooperation and Development (OECD). (2013). *OECD Reviews of Innovation Policy: Sweden 2012. OECD reviews of innovation policy.* Paris: OECD Publishing.

O'Shea, R. P., Allen, T. J., Chevalier, A., & Roche, F. (2005). Entrepreneurial orientation, technology transfer and spinoff performance of U.S. universities. *Research Policy*, *34*(7), 994–1009. https://doi.org/10.1016/j.respol.2005.05.011

Østergaard, C. R., Timmermans, B., & Kristinsson, K. (2011). Does a different view create something new? The effect of employee diversity on innovation. *Research Policy*, *40*(3), 500–509.

Owen-Smith, J., & Powell, W. W. (2001). To patent or not: Faculty decisions and institutional success at technology transfer. *The Journal of Technology Transfer*, *26*(1/2), 99–114. https://doi.org/10.1023/A:1007892413701

Parker, I. (1992). *Discourse dynamics: Critical analysis for social and individual psychology*. London, New York, NY: Routledge.

Pelled, L. H., Eisenhardt, K. M., & Xin, K. R. (1999). Exploring the Black Box: An Analysis of Work Group Diversity, Conflict, and Performance. *Administrative Science Quarterly*, *44*(1), 1. https://doi.org/10.2307/2667029

Perkmann, M., Fini, R., Ross, J.-M., Salter, A., Silvestri, C., & Tartari, V. (2015). *Accounting for Impact at Imperial College London: A Report on the Activities and Outputs by Imperial Academics Relevant for Economic and Social Impact.* London. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2649561

Perkmann, M., & Salter, A. (2012). How to create productive partnerships with universities. *MIT Sloan Management Review*, *53*(4), 79–88.

Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P.,. . . Sobrero, M. (2013). Academic engagement and commercialisation: A review of the literature on university–industry relations. *Research Policy*, *42*(2), 423–442. https://doi.org/10.1016/j.respol.2012.09.007

Perkmann, M., & Walsh, K. (2008). Engaging the scholar: Three types of academic consulting and their impact on universities and industry. *Research Policy*, *37*(10), 1884–1891. https://doi.org/10.1016/j.respol.2008.07.009

Perkmann, M., & West, J. (2015). Open Science and Open Innovation. In A. N. Link, D. S. Siegel, & M. Wright (Eds.), *The Chicago Handbook of University Technology Transfer and Academic Entrepreneurship* (pp. 41–74). University of Chicago Press. https://doi.org/10.7208/chicago/9780226178486.003.0002

Pleschak, F. (Ed.). (2003). *Technologietransfer - Anforderungen und Entwicklungstendenzen.* Stuttgart: Fraunhofer IRB Verlag.

Poirson, H. (2013). German Productivity Growth: An Industry Perspective. In A. Mody (Ed.), *Germany in an Interconnected World Economy* (pp. 55–77). Washington, DC: International Monetary Fund.

Pollitzer, E. (2013). Cell sex matters. *Nature*, *500*(1), 23–24.

Proff, S. von, Buenstorf, G., & Hummel, M. (2012). University Patenting in Germany before and after 2002: What Role Did the Professors' Privilege Play? *Industry & Innovation*, *19*(1), 23–44. https://doi.org/10.1080/13662716.2012.649060

Ranga, M., & Etzkowitz, H. (2010). Athena in the World of Techne: The Gender Dimension of Technology, Innovation and Entrepreneurship. *Journal of Technology Management & Innovation*, *5*(1), 1–12.

Ranga, M., & Etzkowitz, H. (2013a). Triple Helix Systems: An Analytical Framework for Innovation Policy and Practice in the Knowledge Society. *Industry and Higher Education*, *27*(4), 237–262.

Ranga, M., & Etzkowitz, H. (2013b). Triple Helix Systems: An Analytical Framework for Innovation Policy and Practice in the Knowledge Society. *Industry and Higher Education*, *27*(4), 237–262.

Rasmussen, E., & Borch, O. J. (2010). University capabilities in facilitating entrepreneurship: A longitudinal study of spin-off ventures at mid-range universities. *Research Policy*, *39*(5), 602–612. https://doi.org/10.1016/j.respol.2010.02.002

Rasmussen, E., Mosey, S., & Wright, M. (2011). The Evolution of Entrepreneurial Competencies: A Longitudinal Study of University Spin-Off Venture Emergence. *Journal of Management Studies*, *48*(6), 1314–1345. https://doi.org/10.1111/j.1467-6486.2010.00995.x

Rasmussen, E., Mosey, S., & Wright, M. (2014). The influence of university departments on the evolution of entrepreneurial competencies in spin-off ventures. *Research Policy*, *43*(1), 92–106.

Rasmussen, E., Mosey, S., & Wright, M. (2015). The transformation of network ties to develop entrepreneurial competencies for university spin-offs. *Entrepreneurship & Regional Development*, *27*(7-8), 430–457. https://doi.org/10.1080/08985626.2015.1070536

Rasmussen, E., & Wright, M. (2015). How can universities facilitate academic spin-offs? An entrepreneurial competency perspective. *The Journal of Technology Transfer*, *40*(5), 782–799. https://doi.org/10.1007/s10961-014-9386-3

Redien-Collot, R. (2009). Female Entrepreneurs' authority: Is the creative aspect of authority a masculine fiction in managerial and entrepreneurial paradigms? *Journal of Enterprising Culture*, *17*(4), 419–441.

Reichborn-Kjennerud, K., & Svare, H. (2014). Entrepreneurial growth strategies: the female touch. *International Journal of Gender and Entrepreneurship*, *6*(2), 181–199.

Renault, C. S. (2006). Academic Capitalism and University Incentives for Faculty Entrepreneurship: The Journal of Technology Transfer. *J Technol Transfer*, *31*(2), 227–239.

Research Excellence Framework (REF). (2011). *Assessment framework and guidance on submissions.* Bristol. Retrieved from http://www.ref.ac.uk/pubs/2011-02/

Riesenhuber, F., Walter, A., & Auer, M. E. (2006). Akademische Spin-offs : eine empirische Untersuchung zum Umgang mit technischer Unsicherheit und der Steigerung des Wachstums. *Zeitschrift für Betriebswirtschaftslehre.* (Special Issue), 117–139.

Ritchie, J., Lewis, J., Nicholls, C. M., & Ormston, R. (2013). *Qualitative research practice: A guide for social science students and researchers* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Roberts, E. B. (1989). The personality and motivations of technological entrepreneurs. *Journal of engineering and Technology Management*, *6*(1), 5–23.

Roberts, E. B. (1991). *Entrepreneurs in high technology: Lessons from MIT and beyond.* New York: Oxford Univ. Press. Retrieved from http://www.loc.gov/catdir/enhancements/fy0603/90026256-d.html

Rodeiro Pazos, D., Fernández López, S., Otero González, L., & Rodríguez Sandiás, A. (2012). A resource-based view of university spin-off activity: New evidence from the Spanish case. *Revista Europea de Dirección y Economía de la Empresa*, *21*(3), 255–265. https://doi.org/10.1016/j.redee.2012.05.006

Rogers, E. M., Takegami, S., & Yin, J. (2001). Lessons learned about technology transfer. *TECHNOVATION*, *21*(4), 253–261.

Rogers, E. M., Yin, J., & Hoffmann, J. (2000). Assessing the Effectiveness of Technology Transfer Offices at U.S. Research Universities. *Journal of the Association of University Technology Managers*, *12*(47-80).

Rosa, P., & Dawson, A. (2006). Gender and the Commercialization of University Science: Academic Founders of Spinout Companies. *Entrepreneurship & Regional Development*, *18*(4), 341–366.

Rossi, F. (2010). The governance of university-industry knowledge transfer. *European Journal of Innovation Management*, *13*(2), 155–171.

Rothaermel, F. T., Agung, S. D., & Jiang, L. (2007). University entrepreneurship: A taxonomy of the literature. *Industrial and Corporate Change*, *16*(4), 691–791. https://doi.org/10.1093/icc/dtm023

Rubin, H., Bukofzer, A., & Helms, S. (2003). From Ivory Tower to Wall Street – University Technology Transfer in the US, Britain, China, Japan, Germany, and Israel. *International Journal of Law and Information Technology*, *11*(1), 59–86.

Rust, C. (2004). Design Enquiry: Tacit knowledge and invention in science. *Design Issues*, *20*(4), 76–85. https://doi.org/10.1162/0747936042311959

Samsom, K. J. (1990). *Scientists as Entrepreneurs: Organizational Performance in Scientist-Started New Ventures*. Dordrecht: Springer Netherlands.

Samsom, K. J., & Gurdon, M. A. (1993). University scientists as entrepreneurs: A special case of technology transfer and high-tech venturing. *Technovation*, *13*(2), 63–71. https://doi.org/10.1016/0166-4972(93)90054-Y

Sass, E. (2011). *Der Naturwissenschaftler als Unternehmer: Gründertypen und deren Motivation im universitären Umfeld. Gabler Research. Unternehmerisches Personalmanagement*. Wiesbaden: Gabler.

Schasse, U., Belitz, H., Kladroba, A., & Stenke, G. (2014). *Forschungs- und Entwicklungsaktivitäten der deutschen Wirtschaft* (Studien zum deutschen Innovationssystem No. 2-2014).

Schein, E. H. (1985). *Organizational culture and leadership: A dynamic view*. San Francisco, CA: Jossey-Bass.

Schein, E. H. (1990). Organizational culture. *American Psychologist*, *45*(2), 109–119. https://doi.org/10.1037/0003-066X.45.2.109

Schein, E. H. (2010). *Organizational culture and leadership* (4th ed.). *The Jossey-Bass business & management series*. San Francisco, CA: Jossey-Bass.

Scherer, R. F., Adams, J. S., Carley, S., & Wiebe, F. A. (1989). Role Model Performance Effects on Development of Entrepreneurial Career Preference. *Entrepreneurship Theory and Practice (ET&P)*, *13*(3), 53–71.

Schiebinger, L. (2000). Has Feminism Changed Science? *Signs*, *25*(4, Feminisms at a Millennium), 1171–1175.

Schiebinger, L. L. (2013). *Gendered Innovations: How Gender Analysis contributes to research*. Report of the Expert Group "Innovation through Gender". Brussels.

Schilling, K. (2014). *Forschen - Patentieren - Verwerten: Ein Praxisbuch für Naturwissenschaftler mit Schwerpunkt Life Sciences*. Berlin: Springer Spektrum.

Schone, W., Bruno, P., Kugele, K., & Busolt, U. (2010). Building on diversity to enhance the leverage power of innovation on the German economy. In A. Fogelberg Eriksson (Ed.), *Forums skriftserie: Vol. 5. Equality, Growth & Sustainability - Do they mix? Linköping Electronic Conference Proceedings, No.58* (pp. 73–79). Linköping.

Schubert, F., & Engelage, S. (2011). Wie undicht ist die Pipeline? Wissenschaftskarrieren von promovierten Frauen. *Kölner Zeitschrift für Soziologie und Sozialpsychologie*, *63*(3), 431–457.

Schubert, T., Rammer, C., & Frietsch, R. (2014). *Innovationsindikator 2014.*

Schütz, F., Sinell, A., Trübswetter, A., Kaiser, S., & Schraudner, M. (2016). Der Science-Case attraktiver Karrierewege - Eine gegenstandsbezogene Perspektive auf Karrierebedingungen und -modelle im deutschen Wissenschaftssystem. *Beiträge zur Hochschulforschung*, *38*(1-2), 64–84.

Sellenthin, M. O. (2009). Technology transfer offices and university patenting in Sweden and Germany. *The Journal of Technology Transfer*, *34*(6), 603–620. https://doi.org/10.1007/s10961-009-9108-4

Shane, S. (2000). Prior Knowledge and the Discovery of Entrepreneurial Opportunities. *ORGANIZATION SCIENCE*, *11*(4), 448–469.

Shane, S. (2004). *Academic entrepreneurship: University spinoffs and wealth creation. New horizons in entrepreneurship.* Cheltenham, UK, Northampton, MA: Edward Elgar.

Sharp, R., Franzway, S., Mills, J., & Gill, J. (2012). Flawed Policy, Failed Politics? Challenging the Sexual Politics of Managing Diversity in Engineering Organizations. *Gender, Work & Organization*, *19*(6), 555–572. https://doi.org/10.1111/j.1468-0432.2010.00545.x

Siegel, D. S., Veugelers, R., & Wright, M. (2007). Technology transfer offices and commercialization of university intellectual property: Performance and policy implications. *Oxford Review of Economic Policy*, *23*(4), 640–660. https://doi.org/10.1093/icb/grm036

Siegel, D. S., Waldman, D., & Link, A. (2003). Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: An exploratory study. *Research Policy*, *32*(1), 27–48. https://doi.org/10.1016/S0048-7333(01)00196-2

Siegel, D. S., & Wright, M. (2015a). Academic Entrepreneurship: Time for a Rethink? *British Journal of Management*, *26*(4), 582–595. https://doi.org/10.1111/1467-8551.12116

Siegel, D. S., & Wright, M. (2015b). University Technology Transfer Offices, Licensing, and Start-Ups. In A. N. Link, D. S. Siegel, & M. Wright (Eds.), *The Chicago handbook of university technology transfer and academic entrepreneurship* (pp. 1–40). Chicago, London: The University of Chicago Press.

Sinell, A., Heidingsfelder, M., & Schraudner, M. (2015). Entrepreneurship and Academic Employment – More Alike than You'd Think. *Journal of Technology Management & Innovation*, *10*(3), 1–10. https://doi.org/10.4067/S0718-27242015000300001

Singer, S., Amorós, J. E., & Arreola, D. M. (2014). *Global Entrepreneurship Monitor 2014 Global Report.* London.

Singer, S., Ernesto Amorós, J., & Moska, D. (2015). *GEM 2014 Global Report.*

Sodeur, W. (1974). *Empirische Verfahren zur Klassifikation.* Stuttgart: Teubner.

Spath, D., Winter, J., & Pape, J. (2010). *Wirtschaftliche Entwicklung von Ausgründungen aus ausseruniversitären Forschungseinrichtungen. acatech: Nr. 4.* Berlin, New York, NY: Springer.

Stedler, H. R., & Peters, H. H. (2003). Business angels in Germany: An empirical study. *Venture Capital: An International Journal of Entrepreneurial Finance*, *5*(3), 269–276.

Sternberg, R., Vorderwülbecke, A., & Brixy, U. (2013). *Global Entrepreneurship Monitor: Unternehmensgründungen im weltweiten Vergleich.* Länderbereicht Deutschland 2012. Hannover.

Stevens, A. J. (2004). The Enactment of Bayh–Dole. *The Journal of Technology Transfer*, *29*(1), 93–99. https://doi.org/10.1023/B:JOTT.0000011183.40867.52

Stewart, W. H., Jr., Watson, W. E., Carland, J. C., & Carland, J. W. (1999). A proclivity for entrepreneurship: A comparison of entrepreneurs, small business owners, and corporate managers. *Journal of Business Venturing*, *14*(2), 189–214.

Stifterverband für die Deutsche Wissenschaft. (2017). *Forschung und Entwicklung in der Wirtschaft 2015* (facts – Zahlen und Fakten aus der Wissenschaftsstatistik). Essen.

Stilgoe, J., Lock, S. J., & Wilsdon, J. (2014). Why should we promote public engagement with science? *Public Understanding of Science*, *23*(1), 4–15.

Suddaby, R. (2006). From the Editors: What Grounded Theory is Not. *Academy of Management Journal*, *49*(4), 633–642.

Sullivan, W., Sullivan, R., & Buffton, B. (2001). Aligning individual and organisational values to support change. *Journal of Change Management*, *2*(3), 247–254. https://doi.org/10.1080/738552750

Szulanski, G. (2000). The Process of Knowledge Transfer: A Diachronic Analysis of Stickiness. *Organizational Behavior and Human Decision Processes*, *82*(1), 9–27.

Teece, D. J. (1977). Technology Transfer by Multinational Firms: The Resource Cost of Transferring Technological Know-How. *The Economic Journal*, *81*(346), 242–261.

Tett, R. P., & Guterman, H. A. (2000). Situation Trait Relevance, Trait Expression, and Cross-Situational Consistency: Testing a Principle of Trait Activation. *Journal of Research in Personality*, *34*(4), 397–423. https://doi.org/10.1006/jrpe.2000.2292

The German Council of Science and Humanities. (2012). *The five-year campaign for gender equality in science – the current situation and recommendations: [Fünf Jahre Offensive für Chancengleichheit von Wissenschaftlerinnen und Wissenschaftlern - Bestandsaufnahme und Empfehlungen]* (Drs. No. 2218-12). Bremen.

The German Council of Science and Humanities. (2016). *Wissens- und Technologietransfer als Gegenstand institutioneller Strategien: Positionspapier* (Drs. No. 5665-16). Weimar. Retrieved from http://www.wissenschaftsrat.de/download/archiv/5665-16.pdf

Thomas, D., & Ely, R. (1996). Making differences matter: A new paradigm for managing diversity. *Harvard Business Review*, *74*(5), 1–12.

Thursby, J., & Thursby, M. (2000). *Who is Selling the Ivory Tower? Sources of Growth in University Licensing*. Cambridge, MA: National Bureau of Economic Research.

Thursby, J. G., & Kemp, S. (2002). Growth and productive efficiency of university intellectual property licensing. *Research Policy*, *31*(1), 109–124. https://doi.org/10.1016/S0048-7333(00)00160-8

Thursby, J. G., & Thursby, M. C. (2005). Gender Patterns of Research and Licensing Activity of Science and Engineering Faculty. *Journal of Technology Transfer*, *30*(4), 343–353.

Thursby, J. G., & Thursby, M. C. (2011). Has the Bayh-Dole act compromised basic research? *Research Policy*, *40*(8), 1077–1083. https://doi.org/10.1016/j.respol.2011.05.009

Tippmann, E., & Mangematin, Vincent, and Scott, Pamela S. (2013). The two faces of knowledge search: New solutions and capability development. *Organization Studies*, *34*(12), 1869–1901.

Treanor, L., & Henry, C. (2010). Gender in campus incubation: Evidence from Ireland. *International Journal of Gender and Entrepreneurship*, *2*(2), 130–149. https://doi.org/10.1108/17566261011051008

Trübswetter, A. (2017). *Chancen und Herausforderungen für Frauen in wissenschaftlichen Karriereverläufen. Studien mit Wissenschaftlerinnen an vier verschiedenen Karrierestationen*. Technische Universität Berlin, Berlin.

Trübswetter, A., Sinell, A., Schütz, F., & Schraudner, M. (2015). Attraktivität von Wissenschaftskarrieren – geschlechtsspezifische Motivationsaktoren und Hürden. In M. Klemisch, A. Spitzley, & J. Wilke (Eds.), *Gender- und Diversity-Management in der Forschung. Stuttgart, 7. und 8. Mai 2015, Konferenzband* (pp. 195–210). Stuttgart: Fraunhofer Verlag.

Valentin, F., & Jensen, R. L. (2007). Effects on academia-industry collaboration of extending university property rights. *The Journal of Technology Transfer*, *32*(3), 251–276. https://doi.org/10.1007/s10961-006-9015-x van den Brink, M., & Benschop, Y. (2012). Gender practices in the construction of academic excellence: Sheep with five legs. *Organization*, *19*(4), 507–524. https://doi.org/10.1177/1350508411414293

van der Sijde, P., David, F., Frederik, H., & Redondo Carretero, M. (2014). University-Business Cooperation: A Tale of Two Logics. In T. Kliewe & T. Kesting (Eds.), *Moderne Konzepte des organisationalen Marketing* (pp. 145–160). Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-04680-4_9

van Knippenberg, D., & Schippers, M. C. (2007). Work Group Diversity. *Annual Review of Psychology*, *58*(1), 515–541.

van Looy, B., Callaert, J., & Debackere, K. (2006). Publication and patent behavior of academic researchers: Conflicting, reinforcing or merely co-existing? *Research Policy*, *35*(4), 596–608.

Vehviläinen, M., Vuolanto, P., & Ylijoki, O.-H. (2010). Gender Equality in Interface Organizations between Science, Technology and Innovation. *Journal of Technology Management & Innovation*, *5*(1), 65–74. https://doi.org/10.4067/S0718-27242010000100005

Verspagen, B. (2006). University research, intellectual property rights and european innovation systems. *Journal of Economic Surveys*, *20*(4), 607–632. https://doi.org/10.1111/j.1467-6419.2006.00261.x

Visintin, F., & Pittino, D. (2014). Founding team composition and early performance of university–Based spin-off companies. *Technovation*, *34*(1), 31–43. https://doi.org/10.1016/j.technovation.2013.09.004

Vohora, A., Wright, M., & Lockett, A. (2004). Critical junctures in the development of university high-tech spinout companies. *Research Policy*, *33*(1), 147–175.

von Kortzfleisch, H. F. O., Bertram, M., Zerwas, D., & Arndt, M. (2015). Consideration of Knowledge and Technology Transfer Characteristics for Research Evaluation. In I. M. Welpe, J. Wollersheim, S. Ringelhan, & M. Osterloh (Eds.), *Incentives and Performance* (pp. 449–463). Springer International Publishing. https://doi.org/10.1007/978-3-319-09785-5_27

Wagner, J. (2003). The Impact of Personal Characteristics and the Regional Milieu on the Transition from Unemployment to Self-employment: Empirical Evidence for Germany. *Journal of Economics and Statistics (Jahrbuecher fuer Nationaloekonomie und Statistik)*, *223*(2), 204–222.

Wagner, J. (2007). What a Difference a Y makes-Female and Male Nascent Entrepreneurs in Germany. *Small Business Economics*, *28*(1), 1–21. https://doi.org/10.1007/s11187-005-0259-x

Walter, A., Auer, M., & Ritter, T. (2006). The impact of network capabilities and entrepreneurial orientation on university spin-off performance. *Entrepreneurship and Strategic Alliances*, *21*(4), 541–567.

Walter, S. G., Schmidt, A., & Walter, A. (2016). Patenting rationales of academic entrepreneurs in weak and strong organizational regimes. *Research Policy*, *45*(2), 533–545. https://doi.org/10.1016/j.respol.2015.11.008

Weber, M. Die "Objektivität" sozialwissenschaftlicher und sozialpolitischer Erkenntnis. In *Archiv für Sozialwissenschaft und Sozialpolitik* (pp. 22–87). Retrieved from http://nbn-resolving.de/urn:nbn:de:0168-ssoar-50770-8* (Original work published 1904).

Weber, M. (1904b). Die "Objektivität" sozialwissenschaftlicher und sozialpolitischer Erkenntnis. *Archiv für Sozialwissenschaften und Sozialpolitik*, *1*, 22–87.

Weber, M. (1995). *Die "Objektivität" sozialwissenschaftlicher und sozialpolitischer Erkenntnis.* Schutterwald/Baden: Wiss. Verl.

Weiblen, T., & Chesbrough, H. W. (2015). Engaging with Startups to Enhance Corporate Innovation. *California Management Review*, *57*(2), 66–90.

Welsh, R., Glenna, L., Lacy, W., & Biscotti, D. (2008). Close enough but not too far: Assessing the effects of university–industry research relationships and the rise of academic capitalism. *Research Policy*, *37*(10), 1854–1864. https://doi.org/10.1016/j.respol.2008.07.010

Welter, F., Brush, C., & Bruin, A. de. (2014). *The Gendering Of Entrepreneurship Context* (working paper No. 01/14). Bonn.

Wennberg, K., Wiklund, J., & Wright, M. (2011). The effectiveness of university knowledge spillovers: Performance differences between university spinoffs and corporate spinoffs. *Research Policy*, *40*(8), 1128–1143. https://doi.org/10.1016/j.respol.2011.05.014

West, C., & Zimmermann, D. H. (1987). Doing Gender. *Gender & Society*, *1*(2), 125–151. https://doi.org/10.1177/0891243287001002002

Wiersema, M. F., & Bantel, K. A. (1992). Top Management Demography and Corporate Strategic Change. *Academy of Management Journal*, *35*(1), 91–121. https://doi.org/10.2307/256474

Williams, K. Y., & O'Reilly, C. A. (1998). Demography and Diversity in Organizations: A Review of 40 Years of Research. *Research in Organizational Behavior*, *20*, 77–140.

Wimbauer, C. (1999). *Organisation und Individuum. Zur organisationalen Prägung individueller Karrierewege am Beispiel eines Instituts der Fraunhofer-Gesellschaft* (Diplomarbeit). Ludwig-Maximilians-Universität München, München.

Witzel, A. (2000). The Problem-centered Interview. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, *1*(1).

Witzel, A., Medjedovic, I., & Kretzer, S. (2008). Sekundäranalyse qualitativer Daten: Zum gegenwärtigen Stand einer neuen Forschungsstrategie. *Historical Social Research / Historische Sozialforschung (HSR)*, *33*(3), 10–32.

Woolley, A. W., Chabris, C. F., Pentland, A., Hashmi, N., & Malone, T. W. (2010). Evidence for a Collective Intelligence Factor in the Performance of Human Groups. *Science*, *330*(6004), 686–688.

Wright, M. (2014). Academic entrepreneurship, technology transfer and society: Where next? *The Journal of Technology Transfer*, *39*(3), 322–334. https://doi.org/10.1007/s10961-012-9286-3

Wright, M., Clarysse, B., Lockett, A., & Knockaert, M. (2008). Mid-range universities' linkages with industry: Knowledge types and the role of intermediaries. *Research Policy*, *37*(8), 1205–1223.

Wright, M., Clarysse, B., Mustar, P., & Lockett, A. (2007). *Academic entrepreneurship in Europe*. Cheltenham, UK, Northampton, MA: Edward Elgar.

Wright, M., Piva, E., Mosey, S., & Lockett, A. (2009). Academic entrepreneurship and business schools. *The Journal of Technology Transfer*, *34*(6), 560–587. https://doi.org/10.1007/s10961-009-9128-0

Yin, R. K. (2009). *Case study research: Design and methods* (4th ed.). Thousand Oaks, CA: Sage Publications.

Yin, R. K. (2003). *Case study research: Design and methods* (3rd ed.). *Applied social research methods series: v. 5*. Thousand Oaks, Calif.: Sage Publications.

Zacks, R. (2000). The TR University Research Scorecard 2000. Retrieved from https://www.technologyreview.com/s/400766/the-tr-university-research-scorecard-2000/

Zahra, S. A., & Hayton, J. C. (2008). The effect of international venturing on firm performance: The moderating influence of absorptive capacity. *Journal of Business Venturing*, *23*(2), 195–220. https://doi.org/10.1016/j.jbusvent.2007.01.001

Zhao, H., Seibert, S. E., & Lumpkin, G. T. (2010). The Relationship of Personality to Entrepreneurial Intentions and Performance: A Meta-Analytic Review. *Journal of Management*, *36*(2), 381–404.

Zimmer, L. (1988). Tokenism and Women in the Workplace: The Limits of Gender-Neutral Theory. *Social Problems*, *35*(1), 64–77.

Zucker, L., Darby, M., & Armstrong, J. (1998). Geographically localized knowledge: Spillovers or markets? *Economic Inquiry*, *36*(1), 65–86. https://doi.org/10.1111/j.1465-7295.1998.tb01696.x

Zucker, L., Darby, M., & Brewer, M. B. (1998). Intellectual Human Capital and the Birth of U.S. Biotechnology Enterprises. *American Economic Review*, *88*(1), 290–306.

Appendix

A | Paper I: Interview guides for postdoctoral students (English) and transfer managers (German)

B | Paper II: Interview guides for transfer experts and experienced entrepreneurs (German)

C | Paper III: Interview guides for transfer managers (English)

D | Paper IV: Interview guides for academic founders, jury members and coaches (German)

A | Paper I

Interview guide for postdoctoral students

Interviewee – career state

- Could you please describe your position and key responsibilities? Which of these are leadership-related, if any? What kind of leadership, institutionalised or project-related [disciplinal responsibility / with regard to contents]? If project-related, who is your institutional senior and how would you describe his or her leadership style? [further question: career development]

- Did you decide to pursue a career in science deliberately? If yes, when and what was your reasoning? What alternatives did you consider at that point? Why did you opt against them?

- When and why did you take your current position? What expectations did you have at that point? [focus on interesting content? On qualification, networks/connections?] To what degree would you say that these expectations have been met?

- At what point in your career did you thoroughly understand your own career development options? Would you have made different choices if these had been equally clear to you before?

Career development – options and goals

- What motivates you in your career? What do you hope to achieve? What are you looking for with regard to your future work? [Open response: Does the interviewee argue based on positions or based on content / freedom of (scientific) research? "Primarily, we don't focus certain positions with that question, but rather desirable work content and surrounding conditions", e.g. I want to lead a team, I want to determine my own research agenda, work in a team]

- Do you have any clear career goals? Is there a particular position to which you aspire?

- How important is it to you to be able to have clear career goals? Why? ["You cannot plan a career", "There is no need for planning…"] Does anybody (partner, colleagues) support your planning? Who is it?

- Could you imagine achieving these goals in some other way? What would be the pros and cons? [alternatives inside and outside the ORG]

— What challenges have you had to overcome by this point in your career development? How did you do it? Are there any particular challenges that you are currently facing you or that you can foresee?

— Are you aware of any career development programmes at your organisation? How did you become aware of them? Which of them have you utilized? Did they actively boost your career strategies or did they only enhance your subject skills? What other forms of support have you wished and/or would you wish for?

— Rather than a "purely" scientific career, have you ever considered a career in science management such as its administration, institute management, etc.? How appealing do you find such a career? How appealing do you find a career that leads to a so-called "expert" status?

— [Wenn nicht bereits erörtert] Could you ever see yourself self-employed / starting your own company or working for the industry, for example, in research and development – as opposed to employed at an academic or scientific institution? [Do you have / possess the required skills / aptitude / qualifications for an industry career?]

Organisation – culture and structures

— Could you please characterize the work culture in your immediate working environment with 3 to 5 adjectives? Which of these words would you say apply: to your working unit alone, to your whole organisation, or to your whole scientific field? What would you say is typical for work culture of the whole German scientific "space"?

— Do you feel appreciated by your co-workers and seniors? What does that mean, what does it mean? How do you know that someone's input is appreciated? [e.g. leading / participating in an important project, increased compensation, conference participation, appropriate standing, reasonable career advancement]

— What are both your actual and contractual workloads in hours per week? On average, how many days a week do you spend on business trips? Are you reachable after work and on weekends? How satisfied are you with your current workload and the work distribution in your team?

— Who determines how flexible working schedules and locations can be? [Can you work from home?] Are flexibility options promoted? Do these options work in practice? If not, what are the reasons, in your opinion? In your experience, is taking advantage of these options truly accepted by managers and co-workers? [Required presence?] Do you personally have the opportunity to determine when and where you work? For example, can and do you work remotely?

— How do you set the priorities between work and life? Have there been situations where there was a conflict between your professional and personal responsibilities? How did you resolve these situations? [Ask for number of children, share of family commitments, occupational goals of partner / spouse]

— Could you please imagine your next career step? [not necessarily in ORG] What will have to change? [mobility, responsibility, work contend, workload] What would be your preferred work to life ratio? Can you foresee potential work-life conflicts? What would need to be done to overcome them? [partner/spouse, dual career]

Performance expectations

— What are the success factors / performance expectations in your field? Are these the same or similar for everyone in your unit and/or in your whole institute? Are these clearly defined and "written in stone"? Who determines them? Are they communicated clearly? Are there performance measures and if yes, what are they?

— Do these (expectations/) factors influence individual career progression? [using his/her connections // by pulling the strings (fam.)] When a particular employee's performance fails to meet these expectations, what consequences could it have?

— Are there any further informal success factors that can influence career progression, for example, networks?

— Do you find performance expectations in your organisation fair and reasonable? Which factors would you like to be considered in the future?

Appeal and vision

— Could you please imagine a friend – a woman – who has just graduated from a university and is considering a scientific career? She is seeking your advice and would like to know both why that would be a fantastic idea [Pause] and what challenges she would have to overcome. What would you tell her? Under which conditions could you definitely recommend a scientific career to a male friend?

— What inspires you in your work? What discourages you, what is frustrating?

— In your opinion, what does your institute/organisation already do particularly well with regard to providing appealing career prospects? [Institute] [Surrounding conditions, services, etc.]

— Where do you still see potential for improvement? [Institute]?

— Are you interested in setting long-term career goals within your current organisation? What could it do to increase this interest?

— Given 10 million euro, what would you do to make scientific careers at your organisation even more appealing? How would you spend the money?

— If you were the Minister of Research and Education, what would you change in German research system to make scientific careers more attractive?

Interview guide for transfer experts

Vorstellung

— Bitte stellen Sie sich und Ihre Organisation/Abteilung kurz vor.

  + Was sind Ihre Aufgaben bei [Org/Abt]? Für was sind Sie verantwortlich.

WTT-Verständnis und Rolle im WTT-Prozess

— Was verstehen Sie unter dem Begriff "Wissens- und Technologietransfer"?

Danach: vorlegen eines stark vereinfachten Modells unseres WTTs (mit Unterscheidung Wirtschaft, Forschung, Mittler, Stakeholdern). Daran soll die eigene Rolle und Beziehungen zu anderen Akteuren verdeutlicht werden. Kurze Erläuterung.

— Wie würden Sie die Rolle Ihrer Organisation/Abteilung im WTT beschreiben?

Backup: Wenn Sie an Innovationsprozesse denken - von der ersten Idee bis zum marktreifen Produkt oder bspw. einer Ausgründung, wie würden Sie die Rolle Ihrer Organisation/Abteilung beschreiben?

— Können Sie dies bitte in der Grafik markieren?

- *ebenfalls anhand der Grafik – Erklärung: die Einordnung der Interviewpartner und ihrer Organisation in den jeweiligen Kontext ist uns wichtig, damit wir zu einem guten Verständnis der Beteiligung & Integration von Frauen und der "Genderdimension" im WTT-Prozess gelangen*

  + Wer sind Ihre Hauptauftraggeber/-innen?
  + In welchem Kontext besteht bereits eine gute Vernetzung mit Kooperationspartnern? Wer sind Ihre Kooperationspartner/-innen bei der Durchführung von Projekten?
  + Welche Rolle haben typischerweise Ihre Partner aus Wirtschaft / Forschung / Mittler // Stakeholder? Wie ist eine Wi-Ws-Kooperation gestaltet – wer ist federführend? Wo bzw. in welchen Positionen sind bevorzugt Frauen beteiligt?
  + Mit welcher Art von Kooperationen sind Sie zufrieden? Welche Kooperationen würden Sie (grundsätzlich) gern verändern?
  + Wo und in wieweit bestehen bei Ihrer Arbeit Anknüpfungspunkte zu weiteren Akteuren und Interessengruppen (bspw. Scientific Community, Venture-Capitalists) des WTT? Wo bzw. in welchen Positionen finden sich verstärkt Frauen?
  + *Für Nicht-Forschungs-Orgs:* Inwiefern haben Sie Kontakt mit außeruniversitären Forschungsorganisationen?

— Geht Ihre Geschäftstätigkeit über Projekte im Bereich des WTT hinaus? Wie viel Prozent Ihrer Geschäftstätigkeit macht der WTT aus?

— *Bei großen Orgs:* Gibt es darüber hinaus noch weitere Bereiche in Ihrer Organisation, die sich mit dem WTT beschäftigen?

  + Welche? Aufgabe?
  + Inwiefern besteht eine Zusammenarbeit?

Entscheidungsprozesse und -positionen im Arbeits- und Projektverlauf

— Wie viele WTT-Entscheidungspositionen gibt es in Ihrer Abteilung?

<u>Definition Entscheidungsposition</u>: Position auf Ebene des strategischen Managements mit Gestaltungsspielraum

  + Wie werden Entscheidungspositionen besetzt?
  + Wie setzen sich diese Entscheidungspositionen zusammen – wie viele Frauen und wie viele Männer gibt es (in Ihrer Abteilung)?

<u>Backup</u> bei einer Person: wie kam der/die Befrage in die aktuelle Position

— Wie ist die Zusammensetzung (Männer / Frauen) in Ihrem Verantwortungsbereich insgesamt?

  + Aufgrund welcher Kriterien werden Teammitglieder ausgesucht?

— *Bei großen Orgs:* Wissen Sie, wie die Zusammensetzung in anderen WTT-relevanten Bereichen Ihrer Organisation ist?

— Wie laufen WTT-Projekte bzw. Vorhaben in Ihrer Organisation/Abteilung typischerweise ab? Bitte beschreiben Sie den Prozess von dem Punkt an, an dem Projekte neu in Ihrer Organisation aufkommen (oder von außen an Ihre Organisation herangetragen werden) bis zu dem Punkt, an dem Ihre Arbeit abgeschlossen ist.

— Wer entscheidet bei [Org/Abt] über die Realisierung und die inhaltliche Ausrichtung von Projekten?

+ Wie laufen diese Entscheidungsprozesse ab? [formeller, informeller, zeitl. Rahmen]

+ Welche Akteure, Interessengruppen oder Rahmenbedingungen beeinflussen dies darüber hinaus (= die Auswahl und thematische Ausrichtung von Projekten)?

— Wer entscheidet über die tiefere, exakte inhaltliche Ausgestaltung von Projekten?

— Welche Überlegungen bzw. welche Aspekte steuern die inhaltliche Ausgestaltung der Projekte?

+ Welche Märkte spielen für [Org/Abt] eine bedeutende Rolle? [Wachstumsmärkte?]

+ Werden Adressaten Ihrer Geschäftstätigkeit/Dienstleistung/Produkte bzw. zukünftige Nutzerinnen und Nutzer mit in die Überlegungen einbezogen? [Frauenmärkte?]

Genderdimension

— Inwieweit spielen Gender-Aspekte – bzw. Geschlechterunterschiede – eine Rolle für Ihre Arbeit?

— *Die "Genderdimensionen" im WTT-Prozess zu analysieren ist eine relativ neue Betrachtungsweise des Innovationsprozesses* - Welche Assoziationen ruft das Begriffspaar "Gender und WTT" bei Ihnen hervor?

Erläuterung später: Def.: (1) der qualitative, thematische Einbezug von Gender-Aspekten &
(2) der quantitative Einbezug von Frauen wg. Innovations- und Qualitätsgewinn

— Werden derzeit von Ihrer Organisation/Abteilung Frauen adressiert, z.B. durch Ihre Angebote oder als Nutzerinnen, als Kundinnen?

  + Wie schätzen Sie die Möglichkeiten von [Org/Abt] ein, Frauenmärkte explizit zu adressieren?
  + Wenn keine Frauen in Team sind: Auf welchem Weg werden die Sichtweisen von Frauen einbezogen/erhoben?
  + Ergeben/Ergäben sich daraus Vorteile für Ihre Organisation/Abteilung? Wenn ja, welche?

— Können Sie in Ihrer alltäglichen Arbeit feststellen, dass die geschlechtergemischte Zusammensetzung eines Teams einen Zugewinn ergibt?
  (a) Im Arbeitsprozess? / (b) Bezogen auf das Arbeitsergebnis?
  Bitte an BSP erläutern.

— Wie schätzen Sie die Bereitschaft der oben benannten Entscheidungsträgerinnen / Entscheidungsträger ein, eine "Geschlechterdimension" bei der Ausrichtung von Projekten mitzudenken? *Könnten Sie eine typische Szene, Situation oder Person beschreiben, die Sie gerade im Kopf haben?*

  <u>Backup</u> bei einer Person: Wären Sie als Entscheidungsträger/in dazu bereit, in Zukunft stärker eine "Geschlechterdimension" bei der Ausrichtung von Projekten mitzudenken?

  <u>Beispiel:</u>

  + *Technik im Allgemeinen und Werkzeuge im Speziellen „traditionell männlich".*
  • *→ Bosch 2003 IXO speziell für Frauen, besonders leicht und handlich*
  • *→ Mit inzwischen zwölf Mio. verkauften Einheiten ist der IXO mittlerweile das mit Abstand erfolgreichste Elektrowerkzeug der Welt.*
  + *Frauen haben andere Transportwege als Männer: Sie nutzen das Auto häufiger, für kürzere Strecken und mit mehr Personen. → Daher achten sie eher auf Funktionalität.*
  + *Unterschiedliche Ansprüche an den öffentlichen Nahverkehr (Frauen: fahren kürzere Strecken, Beleuchtung an Haltestellen)*
  + Nochmals: Welche Vorteile könnten sich dadurch aus Ihrer Sicht für [Org/Abt] ergeben? *Bitte an BSP erläutern.*
  + Wo bestehen bei [Org/Abt] besondere Herausforderungen oder sogar Hindernisse, eine "Genderdimension" mitzudenken?

— In Deutschland sind am WTT-Prozess prozentual gesehen weniger Frauen beteiligt als in anderen Ländern – woran liegt das Ihrer Meinung nach?

  Beispiele: 20% Frauen in F&E; 3,5-5% bei Patentanmeldungen; 8% bei High-Tech Gründungen

+ Haben Sie eine Idee, was sich verändern müsste, um mehr Frauen anzusprechen?
+ Was könnte helfen, Frauen besser **im** WTT-Prozess zu integrieren? Was sind Ihrer Meinung nach mögliche Ansatzpunkte, um verstärkt Frauenmärkte zu adressieren? Was würden Sie tun?
•

Internationale Vergleichbarkeit

— Inwiefern ist der WTT-Prozess in Deutschland mit dem Prozess anderer Ländern vergleichbar?
  + Was läuft aus Ihrer Sicht am Innovationsstandort Deutschland besonders gut? Wo könnten andere Länder von Deutschland lernen? [Fokus: Frauen]
  + Wo sehen Sie Handlungs- und Verbesserungsbedarf? Wo können andere Länder als Vorbild für den deutschen WTT-Prozess fungieren? Kennen Sie "Good Practices"? [Fokus: Frauen]

— Wie hoch ist der Internationalisierungsgrad Ihrer WTT Aktivitäten?
  + Nennen Sie uns bitte Kooperationen, die typischerweise international sind (Technologien / Institutionen / etc.)?
  + Allg. Einschätzung: Wie international/national ist der Wissens- und Technologietransfer in Deutschland insgesamt?

— Können Sie sich vorstellen, welchen Nutzen eine stärkere Partizipation von Frauen im WTT erbringt? [bereits erörtert: andere Märkte]
  + ...hinsichtlich einer stärkeren Internationalisierung?
  + ...andere Ideen?

— Was macht Ihre Organisation/Abteilung aus Ihrer Sicht heute schon besonders gut, wenn es darum geht, effektive und erfolgreiche WTT-Prozesse zu gestalten?
  + Was sind aus Ihrer Sicht Erfolgsfaktoren?
  + Welche Hemmnisfaktoren bestehen heute noch (mit Bezug zum WTT)?

— Wenn Zeit und Einfluss keine Rolle spielten: was würden Sie tun, um den WTT in Deutschland effektiver und erfolgreicher zu gestalten? [& Einbezug von Gender]

B | Paper II

Interview guide experienced entrepreneurs *(the interview guide for transfer experts is the same as in paper I as paper I conducted a secondary analysis of the same data; the second interview guide will therefore not be outlined again)*

Vorstellung

Bitte stellen Sie sich und Unternehmen kurz vor.

+ Was sind Ihre Aufgaben? Für was sind Sie verantwortlich?

Gründungshistorie

Bitte beschreiben Sie Ihre individuelle Gründungsgeschichte.

+ Aus welchem Fachbereich/Sektor, aus welcher beruflichen Position?
+ Einzel- oder Teamgründung?
+ mit neuer Technologie/eigenem Patent?
+ Zeitlicher Ablauf

— Was war Ihre Motivation auszugründen?
[necessity oder opportunity]

Bei Ausgründung aus Organisation: Welche Strukturen und Rahmenbedingungen bei Ihrem früheren Arbeitgeber haben Ihnen der Prozess der Ausgründung erleichtert? Welche waren hinderlich?

Durch wen / welche Akteure wurden Sie bei Ihrer Ausgründung unterstützt?

+ durch (fachliche) Beratung?
[Businessplan, Finanzierung, rechtliche Beratung, Personal]
+ durch finanzielle Mittel?
[Anteil Bankkredit / eigene Mittel / private Kredite / öffentliche Förderung / Venture Capital Geber]

— **A + A = ❤**

— **Individuelle Situation**

+ Was waren Ihre ersten Berührungspunkte mit dem Thema Start-Up / Gründung?
+ Haben Sie in Ihrem beruflichen oder privaten Umfeld schon vorher Gründungen erlebt?

+ Wie hat Ihr Umfeld auf Ihren Gründungswunsch reagiert? Können Sie sich an eine bestimmte Situation erinnern und uns diese erzählen?
[Familie, Freunde, Kollegen, Vorgesetzte]
+ Haben Sie, bevor Sie ausgegründet haben, eine Ausgründung als sozialen Auf- oder Abstieg wahrgenommen? Wie ist das heute?
+ Können Sie sich an eine Situation erinnern, als Sie darüber nachgedacht haben, auszugründen? Was haben Sie damals gedacht, würde sich durch die Gründung für Sie verändern?
+ Haben sie vor Ihrer Ausgründung persönlichen Kontakt zu andere Gründerinnen/ Gründern gesucht, um Ihre Vorstellungen zu validieren?

Produkt und Zielgruppe

Welches war die Idee, die Sie beschlossen haben in eine Gründung umzusetzen?

Wie hat sich diese zu einem marktfähigen Produkt / einer marktfähigen Dienstleistung entwickelt?

+ An welche Zielgruppe richtet sich Ihr Produkt / Ihre Dienstleitung? Berücksichtigen Unterschiede zwischen männlichen und weiblichen Kunden?
+ Wurden Sie in diesem Prozess beraten? Von wem?
+ Wurde eine Marktanalyse gemacht? Wurde die Marktanalyse geschlechtsspezifisch ausgewertet? = speziell untersucht, ob Frauen und Männer unterschiedliche Bedarfe an Ihr Produkt / Ihre Dienstleistung haben?

— [Bei Hightech-Gründungen]

+ Wie haben sie die Gründungsbedingungen in der High-Tech-Branche erlebt?
+ Wo begegnen Sie in ihrem beruflichen Umfeld Frauen? An welchen Stellen, in welchen Positionen?
+ Wo bestehen bei [Org/Abt] besondere Herausforderungen oder sogar Hindernisse, eine "Genderdimension" mitzudenken?

Entscheidungsprozesse und -positionen im Arbeits- und Projektverlauf

— Wie viele Entscheidungspositionen gibt es in Ihrem Start-Up/Unternehmen?

Definition Entscheidungsposition: Position auf Ebene des strategischen Managements mit Gestaltungsspielraum

+ Wie werden Entscheidungspositionen besetzt?

  + Wie setzen sich diese Entscheidungspositionen zusammen – wie viele Frauen und wie viele Männer gibt es (in Ihrer Abteilung)?

— Wie ist die Zusammensetzung (Männer / Frauen) in Ihrem Verantwortungsbereich insgesamt?

  + Aufgrund welcher Kriterien werden Teammitglieder ausgesucht?

Kooperationspartnerinnen und Kooperationspartner

— In unserem Projekt geht es um den Wissens- und Technologietransfer. [Modell zeigen] Können Sie anhand des Modells aufzeigen, mit welchen Akteuren des WTTs Sie intergieren? Wo bzw. in welchen Positionen finden sich verstärkt Frauen?

  + Welche Rolle haben typischerweise Ihre Partner aus Wirtschaft / Forschung / Mittler // Stakeholder? Wie ist eine Wi-Ws-Kooperation gestaltet – wer ist federführend? Wo bzw. in welchen Positionen sind bevorzugt Frauen beteiligt?

  + Mit welcher Art von Kooperationen sind Sie zufrieden? Welche Kooperationen würden Sie (grundsätzlich) gern verändern?

Genderdimension

— In Deutschland gründen Männer mehr als doppelt so häufig wie Frauen. Außerdem gründen Frauen kleiner, später und häufiger im Dienstleistungsbereich.
Können Sie anhand Ihrer eigenen Gründungserfahrung Faktoren identifizieren, warum das so ist?

— Backup: Gibt es für Frauen und Männer unterschiedliche Gründungsbedingungen? Bezogen auf Familiensituation, Rückhalt, Finanzierung, Überzeugungskraft, Glaubwürdigkeit, Durchsetzungsvermögen, Netzwerke…

Schluss

— Wie würden Sie die nationalen Rahmenbedingungen für Gründungen beurteilen? Was macht es Gründerinnen und Gründern in Deutschland leicht, was fällt schwer?

  + Kennen Sie andere Länder, in denen Gründen leichter fällt?

- Wenn sie nun auf Ihren Gründungsprozess zurückschauen, an welcher Stelle hätten Sie am ehesten Unterstützung gebrauchen können? Durch wen und in welcher Form?

- Wenn Sie durch eine Zeitreise die Möglichkeit hätten, mit Ihrem früheren Ich zu sprechen, was würden Sie sich selbst in Bezug auf die Gründung raten?

C | Paper III

1. Interviewee and workplace

Let me begin by asking you a few questions about your field of work. We are particularly interested in how researchers can be encouraged to patent and market their inventions; in other words, how we can increase the number of patents and academic spin-offs.

- What is your job title? Could you please briefly describe your primary job responsibilities?
- What does your [*office/division/center/[NAME]]* do, what goals does it pursue?
- When was your [*office/division/center/[NAME*]] founded? [Were there any predecessors?]
- Why was it founded, what and/or who was the driving force behind it?
- If we talk about the structure of your organization, how is your [*office/division/center/[NAME]]* positioned in that structure? Who is your immediate supervisor?
    - → How is your [*office/division/center/[NAME]]* funded?
    - → Do you find this funding sufficient? Is this funding based on performance evaluations?
    - → Approximately how much money does your organization have available for promoting transfer activities in total?
- How many spin-offs have you accompanied within the last year?
    - → Were these rather technological or service-oriented spin-offs?
    - → How were the founding teams compound?
- How many **patents** have you accompanied within the last year?
    - → Which **disciplines** spawned the patents?
    - → Who applied for the patents? [*roughly men-to-women ratio*]

<u>*Transfer Office traits*</u>

- How many **people** does your [office/division/center/[NAME]] employ?
    - → *What is roughly the men-to-women ratio?*
    - → From what educational and professional **backgrounds** are these people drawn?
- In your ***office/division/center/****at* ***[NAME]***, most employees are men/women [MERKER: …employees are equal parts men and women]. **Why** do you think is that so?

- Do you believe that in this ***office/division/center/****at* ***[NAME]***, employees being **equal parts men and women** would affect its goals, **the ways** in which in it operates, and its **results** [directions, work styles]?
- What are your typical hiring practices for this ***office/division/center/[NAME]***? [Do you typically seek candidates inside or outside of the organization? What is a typical number of candidates]?
- How is [your ***office/division/center/[NAME]***] organized? Who participates in making decisions and how?
  - → Do these people typically consider **points of view** that may be different from their own? For example, if a group of men is making a decision, will they consider how this decision might affect women?

2. Knowledge and technology transfer – meaning and activities

- What does the expression **knowledge and technology transfer** mean to you?
- Is there common understanding of this expression in your organization?
- Which particular **transfer activities** [patenting, licensing, spin-offs, contract research, and the dissemination of scientific findings] are most common, most important in your organization?

3. Implementation

Support programs

- What **services** does your [office/division/center/[NAME]] provide and how do you assist inventors and aspiring academic entrepreneurs? [MERKER: Do you help employees develop business and marketing skills and how? Do you help them build teams and how?]
  - → How do you typically help aspiring academic entrepreneurs [advisement, the development of business ideas, resource acquisition, etc.]?
  - → Do you advise them on their work-life balance options and how?
- Could you please describe a **typical advisement session** with an aspiring academic entrepreneur or entrepreneurs?
  - → Is there a **standard procedure** for them to follow? [MERKER: as an individual/ as a group]
  - → Is there such a procedure for **inventors** who apply for patents?

Spin-off support

- How does your organization help aspiring academic entrepreneurs obtain **financial resources**?
  - → For example, do you connect these people with **venture capitalists**?

What non-monetary support do you provide [equipment, office space, infrastructures]?

Participants

- **Who** typically comes to you for assistance [inventors, aspiring academic entrepreneurs]?
  - → Are these people typically **academic employees** or **students**? If employees, what positions do they typically occupy and what is their typical career history? Have they, for example, worked exclusively in academia or have they also worked in industry? How long have they typically worked in academia and/or industry?
  - → Typically, how developed are their business ideas when they first come to you? [MERKER Among those who do not have any specific ideas, what is the proportion of those who are determined to start their own business at some point?
  - → In which **fields** do they typically work?
  - → Are these people mostly men or women? In your opinion, why is that so?
  - → Do men and women typically seek different **kinds of assistance**?
- Would you say that men and women typically develop **different business ideas**?
  - → If yes, what are the typical differences between these ideas? [For example, do men and women respond to different people's needs?]
  - → Would you say that men and women approach entrepreneurship differently and **how**? What do you think are the similarities and differences between their **reasons** and **goals**?
- Is identifying entrepreneurially-minded employees part of your job?
  - → If yes, how do you it? Do you, for example, consider their fields of work, achievements, and/or personal traits? Do you approach them even if they do not have any specific business ideas?

4. Goals and strategies

- **Why** does your organization engage in and/or promote transfer activities? What are its **goals**? [MERKER: Do you have different reasons for encouraging patents and spin-offs?]

→ What **additional benefits** do you hope to realize by engaging in and/or promoting transfer activities?

- What other parts of your organization engage in and/or promote **transfer activities**? How are all these activities coordinated?
- How **significant** are transfer activities in your organization? Who directs these activities?
- Does your organization offer or promote **entrepreneurial education** (for example, business administration courses)? Which particular part of the organization does that? [Nicht bei Lehrenden:] Do you collaborate with teaching professors?
- Are transfer activities, particularly academic entrepreneurship, part of **job training** in your organization?
- **Whom** do you hope to reach by promoting transfer activities [students, employees, people outside of your organization]?

  → **What** do you do to reach these people? Do you approach different groups in different ways? [MERKER: Gender awareness programs]

- Are there any specific **programs** for women? If yes, what do they focus on and what makes them different?

  → Do you believe that if we want participants in transfer activities to be equal parts men and women, we will need to specifically **encourage women** to engage in these activities?

- Do you **collaborate** with **other organizations** and what kinds of organizations [commercial, scientific, etc.]?

  → **In what ways** do you do that? What are the goals of such collaboration, how does it benefit your organization and those [employees/students] that you assist?

- Do you maintain connections with **other transfer organizations**? Where are these organizations mostly located, in [LAND], outside of [LAND], or both?

  → Why do you maintain these **connections**, how do you use them?

5. Organizational and national specifics

- Which specific practices and aspects of organizational culture encourage transfer activities [patents and spin-offs] in your organization [the availability of role models, organizational commitment, particular HR and PR practices, incentives, prestige, etc.]?

  → What **incentives** [monetary and otherwise] do you provide?

→ Are there career benefits for those who engage in or promote transfer activities [patents, spin-offs]; in other words, is participation in or assistance with transfer activities a **performance criterion**?

- How would you describe **the general attitudes toward entrepreneurship** in [LAND]?
  → Do these attitudes **affect the ways in which your organization** operates and how?
- In your estimation, how available is **venture capital** to aspiring entrepreneurs in [LAND]?
- Are there any **national programs** that promote entrepreneurship, particularly academic? How effective do you consider these programs?

6. Drivers and barriers

- When it comes to promoting transfer activities [particularly patents and spin-offs], what do you believe does [Organization] do **best**?
- What is your **recipe for success**? [What helps you achieve your goals?]
- Do you have a spin-off **success story** to share?
  → ... either of a successful process or a successful outcome?
- In your opinion, what encourages [what national, organizational, and individual factors encourage] entrepreneurial attitudes in researchers in [LAND]?
  → Do men and women respond to these factors differently and how?
- In your opinion, what [national, organizational, and individual factors] may **discourage** entrepreneurial attitudes in researchers in your organization?
  → How do you think your organization could **improve** its assistance to entrepreneurially-minded employees?
- In your opinion, what are the hallmarks of a particularly **successful** transfer office?
  → What are the **performance evaluation criteria** for [your ***office/division/center/[NAME]***], if any?

7. Finishing up

- Is there anything that we may have overlooked, anything you would like to add?
- Can you recommend any other person or organization in [LAND] you think we should talk to? What would you say are the organizations in [LAND] that employ

exemplary transfer strategies, either in general or with regard to gender in particular?

We plan to present the results of our study online and also give interviewees the opportunity to contact one another. Would you be interested in our making your contact information available to other interviewees?

D | Paper IV

Interview guide for academic founders I

HERAUSFORDERUNGEN

I. Welche Ziele und Interessen verfolgst du mit dem Projekt? (*Merker: Ziel auf der Meta-Ebene; Interessen auf persönlicher Ebene*)
   - Vertreten alle Teammitglieder die gleichen Ziele und Interessen?
   - Gab es zwischen den einzelnen Disziplinen Ziel-bzw. Interessenkonflikte oder decken sich die Interessen mit denen der anderen Teammitglieder?
   - Wurden die Ziele und Interessen am Anfang klar kommuniziert? Wie habt ihr diese kommuniziert? (*Bzw. mit welchen Methoden?)*
   - Hättet ihr euch weitere Unterstützung gewünscht? (*Wenn ja, inwiefern?)*
   - Inwiefern hat euch das Einzel- und Teamcoaching bei der Zieldefinition unterstützt?

II. Sind deiner Meinung nach alle Teammitglieder auf dem gleichen Wissensstand?
   - Das heißt, wie gut verstehst du, was die anderen Teammitglieder sagen? Sprecht ihr eine gemeinsame Sprache?
   - Kam es beispielsweise zu fachspezifischen Missverständnissen? Wie seid ihr damit umgegangen?
   - Wie habt ihr eine gemeinsame Sprache erreicht?
   - Kennt ihr die Expertise/Fähigkeiten der anderen Teammitglieder? Könnt ihr diese nutzen? Wie habt ihr diese sichtbar gemacht/offen gelegt? *(Stichwort: Wissensintegration)*
   - Welches Medium benutzt ihr, um Wissen auszutauschen? Bei welchen Gelegenheiten und wie oft tauscht ihr euer spezifisches Wissen aus? *(Stichwort: Operationale Umsetzung)*

FÜHRUNG

I. Wie gestaltet sich Führung in deinem Team?
   - Zeichnen sich hierarchische Strukturen ab?
   - Gibt es einen klassischen Leader? Aus welcher Disziplin kommt der?
   - Siehst du in der Führung interdisziplinärer Teams eine besondere Herausforderung?
   - Hat das Teamcoaching euch bei der Findung von Führungsstrukturen unterstützt? Welche anderen Methoden habt ihr angewandt und wünschst du dir?

II. Wie laufen Entscheidungsprozesse in deinem Team ab?
   - Welche Herausforderungen sind bei Entscheidungsprozessen aufgetreten? Gab es aufgrund der unterschiedlichen Fachdisziplinen besondere Hürden? Gab es hierarchische Hürden bei Entscheidungsprozessen?
   - Wie sind Entscheidungsprozesse abgelaufen/welche Methoden habt ihr angewandt, um Entscheidungen zu treffen? Inwiefern hat euch das Teamcoaching unterstützt?
   - Wo wünschst du dir noch bessere methodische Untersetzung?

METHODISCHE UNTERSTÜTZUNG

I. Welche Unterstützungsleistung hat euch – aus deiner Sicht – bisher am meisten geholfen? Warum? (Operativ)
   - Welche weitere Unterstützung wünschst du dir in den nächsten 3 Monaten von uns?
   - Würdest du dir mehr externe Expertise (Markt- / Branchen-Experten, Technologie, Design, Teamcoaching) als Unterstützung wünschen?

QUALITÄT DER GRÜNDUNGSIDEE

I. Welchen Mehrwert für die Gründungsidee siehst du in der Kombination von Theorie- und Praxiswissen?
  - Welchen Mehrwert für die Gründungsidee siehst du in der Kombination verschiedener Disziplinen? *(Stichwort: Interdisziplinarität vs Transdisziplinarität)*

Wo siehst du den größeren Mehrwert: In der Kombination von praktischem und theoretischen Wissen oder der Kombination unterschiedlicher Fachdisziplinen? Warum?

Interview guide for academic founders II

EINSTIEG
Wie würdest du zusammenfassend die letzten 4 Monate beschreiben?
Was ist rückblickend dein persönlicher Eindruck vom Projekt?
Was hat deiner Meinung nach den Projektausgang am stärksten beeinflusst?

ZUSAMMENARBEIT

III. Wie würdest du die Zusammenarbeit in eurem Team beschreiben?
  - Warst du zufrieden mit der Zusammenarbeit?
  - Hast du den Eindruck, dass alle Teammitglieder mit der Zusammenarbeit zufrieden gewesen sind?
  - Bist du mit eurem bisherigen Arbeitsergebnis zufrieden?

IV. Was waren Erfolgsfaktoren bei der Zusammenarbeit?
  - Welche Rolle hat hier die Interdisziplinarität gespielt?

V. Hast du dich durch die Teamarbeit individuell weiterentwickelt?
  - Trug die interdisziplinäre Teamzusammensetzung besonders dazu bei, dass du neues gelernt hast? (Stichwort: Lerneffekt durch unterschiedliches Fachwissen, Arbeitsstile, Problemlösungsansätze)

VI. Inwiefern hat das Projekt eure Zusammenarbeit beeinflusst?

HERAUSFORDERUNGEN

I. Was war rückblickend die größte Herausforderung in dem Projekt?
  - Gab es noch weitere Probleme?
  - Kam es in der Zwischenzeit zu weiteren fachspezifischen Missverständnissen? Wie seid ihr damit umgegangen?
  - Hättet ihr euch in diesem Bereich weitere Unterstützung gewünscht? (z.B. in der Lösung von Interessenskonflikten, in der Kommunikation eigener Interessen etc.)

II. Haben sich deine im Projekt verfolgten Ziele und Interessen mit der Zeit geändert? (*Merker: Ziel auf der Meta-Ebene; Interessen auf persönlicher Ebene*)
  - Gab es in der Zwischenzeit zusätzliche Ziel- bzw. Interessenkonflikte zwischen den Disziplinen oder haben sich die Interessen aller Teammitglieder immer stärker angeglichen?

III. Hattest du das Gefühl, dass in deinem Team unterschiedliche starke Commitments vorgeherrscht haben? Falls ja: Hat das eine Herausforderung dargestellt?
  - Wie wichtig schätzt du ein einheitliches Commitment aller Teammitglieder ein?
  - Hat das Projekt euch eher gestärkt oder eher gehindert, ein einheitliches Commitment zu erreichen? (Stichwort: Teamcoaching Beate – Kommunikation von Prioritäten?)
  - Hat das Projekt unterschiedliche Commitments zugelassen?
  - Inwiefern hat das Projekt dein eigenes Commitment gestärkt?

FÜHRUNG

III. Wie gestaltet sich zum jetzigen Zeitpunkt Führung in deinem Team?
  - Zeichnen sich mittlerweile hierarchische Strukturen ab?
  - Gibt es einen klassischen Leader? Aus welcher Disziplin kommt er?

IV. Haben sich Entscheidungsprozesse in deinem Team mit der Zeit verändert?
V. Inwiefern hat das Projekt dazu beigetragen, dass sich funktionierende Führungsstrukturen etabliert haben?

MOTIVATION / TRANSFER

I. Was war deine initiale Motivation an dem Projekt teilzunehmen?
- Hat sich deine initiale Motivation durch das Projekt verändert?

II. Was hast du aus dem Projekt gelernt / mitgenommen – bezogen auf zukünftige Gründungen und deine persönliche Entwicklung?
- [Falls nicht angesprochen: Optimierung von Fähigkeiten, Interessen, Kontakten, Netzwerk, Motivation, Gründungsmentalität?]
- [Falls nicht angesprochen: Was würdest du bei Gründungen in Zukunft stärker berücksichtigen?]

III. Würdest du in Zukunft ein Unternehmen gründen?
- Inwiefern hat dich das Wissensdreieck Projekt in deiner Motivation, die Geschäftsidee voranzutreiben und zu gründen unterstützt? Inwiefern hat das Projekt deine Gründungsmotivaton allgemein gestärkt?
- Würdest du in Zukunft gerne mehr in interdisziplinären Teams zusammen arbeiten? Warum / Warum nicht?

KOMPETENZ

I. Bildet euer Team deiner Meinung nach die notwendigen Kompetenzen ab, um Marktpotenziale zu erkennen und Möglichkeiten für neue Geschäftsmodelle zu entdecken?
- Hat euch das Projekt in diesen Kompetenzen gestärkt?
- Inwiefern trägt die Interdisziplinarität in deinem Team deiner Meinung nach zur Entwicklung solcher Kompetenzen bei?

METHODISCHE UNTERSTÜTZUNG

II. Welche Unterstützungsleistung hat euch – aus deiner Sicht – am meisten geholfen? Warum bzw. inwiefern? (Operativ)
- Welche Methoden/ Unterstützungsangebote haben euch nicht weiter gebracht? Warum?
- Welche Unterstützungsangebote hättest du dir im Nachhinein noch mehr gewünscht?
- [Falls nicht angesprochen: Hättest du dir mehr externe Expertise (Markt- / Branchen-Experten, Technologie, Design, Teamcoaching) als Unterstützung gewünscht?]
- Hattet ihr Zugang zu allen notwendigen Ressourcen, um euer Gründungsvorhaben zu fördern? Hat euch etwas gefehlt?
- An welchen Stellen siehst du bei der Planung / Organisation oder dem Aufbau des Projekts Verbesserungspotenzial?

Interview guide for academic founders III

I. Zu welchem Zeitpunkt bist du ausgestiegen?
- Vor der Konzeptionsphase
- In der Konzeptionsphase
- Nach dem Jury-Pitch

II. Was ist die Ursache für den Ausstieg aus dem Projekt?

III. [Die folgenden Punkte nur ansprechen, wenn sie nicht schon genannt wurden]
- Bist du ausgestiegen, weil von deiner Kompetenz nicht Gebrauch gemacht werden konnte?
- Bist du ausgestiegen, weil sich deine Ziele und Interessen nicht mit denen der Gruppenmitglieder / anderen Teilnehmer gedeckt haben?
- Bist du aufgrund von persönlichen Gründen (Teamkonflikten, Krankheit, privates Umfeld, Vereinbarkeit) ausgestiegen?
- Bist du der Meinung aufgrund deiner Persönlichkeit nicht für die Gründung eines Unternehmens geeignet zu sein?
- Bist du aufgrund von Projekt-bezogenen Rahmenbedingungen (Aufbau, Finanzierung, Zeitplan, Interdisziplinarität) ausgestiegen?
- Bist du ausgestiegen, weil die Unterstützungsleistung zu gering / nicht passend war?
- Wann hast du den Entschluss gefasst, auszusteigen?

IV. Was war deine initiale Motivation an dem Projekt teilzunehmen?

V. Was hast du aus dem Projekt gelernt / mitgenommen – bezogen auf zukünftige Gründungen und deine persönliche Entwicklung?
- [Falls nicht angesprochen: Optimierung von Fähigkeiten, Interessen, Kontakten, Netzwerk, Motivation, Gründungsmentalität?]
- [Falls nicht angesprochen: Was würdest du bei Gründungen in Zukunft stärker berücksichtigen?]

VI. Würdest du in Zukunft ein Unternehmen gründen?
- Hat dich das Projekt eher gestärkt, in Zukunft ein Unternehmen zu gründen oder eher abgehalten?
- Würdest du in Zukunft gerne mehr in interdisziplinären Teams zusammen arbeiten? Warum / warum nicht?

VII.

VIII. Welche Methoden/ Unterstützungsangebote haben dich besonders weiter gebracht? Warum bzw. inwiefern?
- Welche Methoden/ Unterstützungsangebote haben dich nicht weiter gebracht? Warum?
- Welche Unterstützungsangebote würdest du dir in Zukunft noch mehr wünschen?
- Wie hätte man dich im Projekt halten können?

Interview guide for coaches

EINSTIEG

Wie würdest du das Projekt in den letzten 4 Monaten Revue passierend zusammenfassen? Was sind die eindrücklichsten Momente oder Erkenntnisse für dich?

QUALITÄT DER GRÜNDUNGSIDEE

I. Welchen Mehrwert hat für dich die interdisziplinäre Teamzusammensetzung?

II. Basierend auf deinen Erfahrungen, wie würdest du die Marktorientierung im Vergleich zu nicht interdisziplinär aufgestellten Teams einschätzen?

  - Wie stufst du vergleichsweise die Umsetzbarkeit der Ideen, den Innovationsgrad und den Ausarbeitungsgrad der interdisziplinären Teams ein?
  - Weisen die Teams deiner Meinung nach die notwendigen Kompetenzen auf, um Marktpotenziale zu erkennen und Möglichkeiten für neue Geschäftsmodelle zu entwickeln?
  - Inwiefern trägt die Interdisziplinarität Ihrer Meinung nach zur Entwicklung solcher Kompetenzen bei?

III. Wo siehst du den größeren Mehrwert: In der Kombination von praktischem und theoretischen Wissen oder der Kombination unterschiedlicher Fachdisziplinen? Warum?
  - Wie schätzt du die Wahl der 3 Fachgebiete (Design, Engineering, BWL) ein?

IV. An Business Coaches:
Welche Rolle spielt deiner Meinung nach die Interdisziplinarität bei dem Entwicklungsprozess der Gründungsidee? Ist diese eher fördernd oder hemmend? Warum?

TEAM

I. Wie würdest du unabhängig von der Gründungsidee die Stärke der Teams beschreiben?
  - Sind die Teams, abgesehen von der Idee, dazu in der Lage, sich gegen Andere durchzusetzen?
  - Wie wichtig schätzt du die Interdisziplinarität für die Teamstärke ein? Inwiefern ist die Interdisziplinarität ein Erfolgsfaktor / Mehrwert für die Teamstärke?
  - Hat der Wissensdreieck – Prozess dazu beigetragen, dass sich starke Teams bilden?
  - Sind die Teams deiner Einschätzung nach stark genug / in der Lage, die Gründungsideen umzusetzen?

HERAUSFORDERUNGEN

I. Welche Herausforderungen oder Hürden mussten deiner Meinung nach die Teams bewältigen?
  - Stellt die Interdisziplinarität der Teams eine besondere Herausforderung in Gründungsteams dar?

METHODEN

I. Wie würdest du den Aufbau des Projekts insgesamt bewerten?
  - Was fandest du bei dem Aufbau des Projekts besonders hilfreich für die Entwicklung von Gründungsideen?
  - Wo siehst du Potenziale / Verbesserungsspielräume für zukünftige Projekte (bzgl. Planung, Organisation, Aufbau)?

II. Wie würdest du die Unterstützungsleistung im Projekt Wissensdreieck insgesamt bewerten?
  - Welche Unterstützungsleistung war für die Teams – aus deiner Sicht – besonders wichtig? Warum?
  - Durch welche Unterstützungsleistung hätten die Teams deiner Ansicht nach noch besser performen können? [Wäre mehr externe Expertise (Markt- / Branchen-Experten, Technologie, Design, Teamcoaching) in dem Projektzeitraum sinnvoll gewesen?]
  - Verfügen die Teams deiner Meinung nach über die notwendigen Ressourcen, um ihre Geschäftsidee voranzutreiben und ihr Unternehmen zu gründen?
  - Inwiefern trägt die Interdisziplinarität deiner Meinung nach zum Vorhandensein der notwendigen Ressourcen bei?
  - Möchtest du uns abschließend noch etwas mitgeben?

Interview guide for jury members

EINSTIEG:

I. Was ist Ihr allgemeiner Eindruck von dem Projekt?

QUALITÄT DER GRÜNDUNGSIDEE

V. Welchen Mehrwert hat für Sie die interdisziplinäre Teamzusammensetzung?

VI. Basierend auf Ihren Erfahrungen, wie würden Sie die Marktorientierung im Vergleich zu nicht interdisziplinär aufgestellten Teams einschätzen?
- Wie stufen Sie vergleichsweise (1) die Umsetzbarkeit der Ideen, (2) den Neuheitsgrad und (3) den Ausarbeitungsgrad der interdisziplinären Teams ein? Können Sie bitte zu allen drei Aspekten Stellung nehmen?
- Weisen die Teams Ihrer Meinung nach die notwendigen Kompetenzen auf, um Marktpotenziale zu erkennen und Möglichkeiten für neue Geschäftsmodelle zu entwickeln?
- Inwiefern trägt die Interdisziplinarität Ihrer Meinung nach zur Entwicklung solcher Kompetenzen bei?
- Sind die Ideen der Teams ihrer Meinung nach konkurrenzfähig?
- Trauen Sie den Teams finanziellen Erfolg zu?

VII. Wo sehen Sie den größeren Mehrwert: In der Kombination von praktischem und theoretischen Wissen oder der Kombination unterschiedlicher Fachdisziplinen? Warum?
- Wie schätzen Sie die Wahl der 3 Fachgebiete (Design, Engineering, BWL) ein?

TEAM

II. Wie würden Sie unabhängig von der Gründungsidee die Stärke der Teams beschreiben?
- Sind die Teams, abgesehen von der Idee, dazu in der Lage, sich gegen Andere durchzusetzen?
- Wie wichtig schätzen Sie die Interdisziplinarität für die Teamstärke ein? Inwiefern ist die Interdisziplinarität ein Erfolgsfaktor / Mehrwert für die Teamstärke?
- Hat der Wissensdreieck – Prozess dazu beigetragen, dass sich starke Teams bilden?
- Sind die Teams Ihrer Einschätzung nach stark genug / in der Lage, die Gründungsideen umzusetzen?

METHODEN

I. In Anbetracht der Performance der Teams, welche methodische Unterstützung würden Sie den Teams darüber hinaus empfehlen?
- Wo sehen Sie Defizite?
- Verfügen die Teams Ihrer Meinung nach über die notwendigen Ressourcen, um ihre Geschäftsidee voranzutreiben und ihr Unternehmen zu gründen?
- Inwiefern trägt die Interdisziplinarität Ihrer Meinung nach zum Vorhandensein der notwendigen Ressourcen bei?

ABSCHLUSS

I. Wo sehen Sie die Potenziale in dem Prozess?

II. Welche Aspekte finden Sie besonders wichtig / erfolgsversprechend?

III. Möchten Sie uns abschließend noch etwas mitgeben?