

SIGRID RAJALO

University-industry collaboration:
interaction structure and
preconditions



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School of Economics and Business Administration, University of Tartu, Estonia

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LIST OF ORIGINAL STUDIES

The thesis is a collection of three original studies. Studies I and II have been published in international peer-reviewed journals. Study III has been peer-reviewed by two reviewers from an international journal.

Study I. Rajalo, S. and Vadi, M. (2017) University-industry innovation collaboration: Reconceptualization. *Technovation*, Vol 62–63, pp 42–54.

Study II. Rajalo, S. and Vadi, M. (2021) Collaboration potential between low-capacity SMEs and academic researchers determined by symmetry of motivation. *Technovation*, Vol 107, 102304.

Study III. Rajalo, S. and Vadi, M. (2023) The directionality and structure of academic engagement in university-industry collaboration. *Submitted for publication in the Journal of Business Economics*.

INTRODUCTION

Motivation, aim and novelty of the research

The journey of my PhD thesis has been long and challenging but intellectually rewarding, as I have always found it interesting to learn more about how to reinforce innovation. I have conducted the research while working full-time in the public sector designing Estonian innovation policy to support companies. My PhD studies and full-time job have complemented each other over the years. With regards to the PhD thesis, in retrospect, taking the time to concentrate on quality enabled me to, on one hand, publish three consecutively linked studies in high-quality journals, and on the other hand, there have been regular spill-overs from my research to my daily job. I have aimed to offer something new and meaningful to university-industry (U-I) collaboration literature. Therefore, the main keywords characterising my research are theory development and interdisciplinarity. Subsequently, I recall the main deliberations in setting the thesis focus.

The challenge for companies and, eventually, economies, lies in finding the balance between exploitation and exploration (March, 1991). Exploitation refers to a short-term perspective and the usage of existing resources for which specific stability and standards are required. Exploration, on the contrary, sets long-term goals and, for the sake of the survival of the company or economy, requires a break-up from existing goals, norms and standards (Nooteboom, 2009). The latter entails innovation and, potentially, growth and sustainability of companies or economies in the long run.

Practitioners and policymakers have long considered university-industry collaboration a potentially effective economic growth and innovation vehicle. Knowledge and technology transfer from academia to industry and a combination of heterogeneous knowledge can spur innovation that, by definition, means new products, services, processes, etc, have been implemented (OECD/Eurostat, 2018). The emphasis is on the word “implemented”, which indicates that this new knowledge or technology can be considered an innovation only when it has secured its niche in the market and among clients. This means that the collaboration expected to lead to such an outcome serves the needs of the company that aims to use this innovation to secure its position in the market. To actually achieve these aims, it is necessary to understand how U-I collaboration functions and its critical preconditions and underlying mechanisms. The perspective to contribute to adding value to this knowledge was the starting point of this thesis.

University-industry collaboration is not a new phenomenon, and there is abundant literature on it. The expectations from policymakers and practitioners for the collaboration to yield economic growth have been there all along, driving the research. During my daily job as a policymaker in the Ministry of Economic Affairs and Communications, I repeatedly came across the statements and facts that these expectations have yet to be realised in the EU

compared to other parts of the world. For instance, “Lab-Fab-App”, a report of an independent high-level group of experts on maximising the impact of EU Research & Innovation programmes states that “At the heart of Europe’s slow growth lies its innovation deficit. Europe does not capitalise enough on the knowledge it has and produces,” (European Commission, 2017).

*We need to pay more attention to the gap in Europe between what we produce in science and what we produce in innovation (new products and services). This is nothing new we’ve been saying it for quite a bit of time, but we are pretty clear that in the future, we definitely need to close this gap. It’s been there too long, it’s too large and it’s too much of a drag on future European growth, so a big effort must be made. **Not only in turning money into science, but in turning science into money.***¹

Former World Trade Organization Chief Pascal Lamy, who chaired the group of experts in the “Lab-Fab-App” report.

Not only the EU, but for instance, Canada has also been struggling to find out why research policy that has been focusing on industrial innovation for a few decades has not yielded the expected results on the macro level (Veletanlić and Sá, 2019). The policy evaluation study of Veletanlić and Sá concluded that there is a misalignment at the micro and meso level between what governmental programmes have aimed and what they have actually incentivised for the interactions between academic researchers and firm representatives, thus calling for further research on an individual level.

Technology and knowledge transfer between universities and industry have long been a priority in regional, national and even global innovation policies (Perkmann *et al.*, 2021). Policymakers, U-I collaboration researchers and U-I collaborators have expected a new value to rise from the combination of different knowledge, capacity, and mode and aim of jobs and roles. However, this kind of collaboration does come with challenges. This has offered food for thought and research for policymakers and scholars, resulting in generous U-I collaboration literature.

U-I collaboration researchers have studied a variety of collaboration-affecting factors, for instance, facilitators and enablers (e.g., Galan-Muros and Plewa, 2016; Bellini *et al.*, 2019; O’Dwyer *et al.*, 2022), barriers (e.g., Jara-Olmedo *et al.*, 2020; Bjursell and Engström, 2017; McCabe *et al.*, 2021), intermediaries (e.g., Alexandre *et al.*, 2021; Albats *et al.*, 2022), etc. Nevertheless, the majority of studies present the most obvious collaboration-affecting factors that emanate from the fact that the partners originate from very different realms. These results offer a limited explanatory capability for an otherwise complex interaction. In addition, U-I collaboration literature specifically lacks individual or micro-level analysis (Steinmo and Rasmussen, 2016; Villani *et al.*, 2017) that

¹ <https://ec.europa.eu/research-and-innovation/en/horizon-magazine/next-eu-science-fund-should-be-doubled-size-pascal-lamy>

measures the phenomena at the first unit of observation (Cunningham and Menter, 2020; Roncancio-Marin *et al.*, 2022).

Qualitative research, which requires micro-perspective and often individual-level analysis, has effectively challenged the existing perspectives of certain phenomena and theory building (Yin, 2018; Eisenhardt, 1989). In recent years, exploratory research strategy has also found its way into U-I collaboration literature (Villani *et al.*, 2017; O'Dwyer *et al.*, 2022; Fernandes and O'Sullivan, 2022). It has been argued that qualitative research suits studies focusing on knowledge transfer-related issues (Siegel *et al.*, 2004; Ankrah *et al.*, 2013). Thus, using this research approach provides another example of how it can benefit U-I collaboration research, and I was motivated to use it to provide new avenues in further explaining U-I collaboration underlying mechanisms.

In using the exploratory methodology, the researcher has to be attentive to allow the emergence of new patterns. This means that the researcher should not approach the data with a very specific research question in mind because it limits the possibility of emerging new and unexpected topics/ themes/ concepts/ patterns. Although this is a methodological consideration, it clearly guided my approach to the thesis. After having identified that the majority of U-I collaboration studies had produced explicit results with limited explanatory capability and reminding myself that, as a policymaker, I have missed policy recommendations that could be applicable, I resorted to an exploratory approach and limited the research to micro-perspective, however, considering the potential interplay between individual and institutional levels (see more in the research design chapter). U-I collaboration research has mainly focused on the macro-perspective. Thus, several researchers have called upon balancing the focus towards the micro-perspective to provide more information-rich data on the interaction between collaborating partners (Bjerregaard, 2009; Fernandes and O'Sullivan, 2023).

As per my previous academic background, in communication and media studies, I was motivated to apply an interdisciplinary approach to analysing U-I collaboration. U-I collaboration in this thesis is studied as an interaction, which entails communication between individuals. I used and adapted the interaction model from semiotics which is based on the realisation that there has to exist certain common ground for the interaction to take place and for added value to arise. The discipline of semiotics, which investigates the creation of meanings and their communication, fits well for studying U-I collaboration interaction because, as previous U-I collaboration literature has already extensively pointed out, collaborating partners originate from very different realms and, therefore, differences in creating meanings and communicating them between each other are bound to arise and affect the collaboration.

I also used social psychology and organisational theory. A renowned researcher of innovation policy, organisational studies and entrepreneurship Bart Nooteboom has said that although economists have been cautious about using psychology in their research, they inevitably need to use it more, "*to avoid an ongoing blindness to realities of motivation and behaviour*" and because

“innovation entails learning and learning is psychological and social”. (Nooteboom, 2009:ix).

Nooteboom’s realisation assured me that combining different strands of theory and choosing an exploratory approach has been a worthwhile risk to take. Another assurance has been given by the recognised journals, which have published the articles this thesis is based on or, in the case of the third article, have taken it in for a review.

The unit of analysis in this thesis is the interaction between collaborating partners. During data and theory triangulation, this thesis focused on collaboration preconditions and their symmetry between partners. Thus, this thesis aims to explain the relevance of critical preconditions and their symmetry (in other words, proportionate and balanced similarity) for the benefit of interaction between partners. During the research’s exploratory phase, the motivation and behaviour of academic researchers further attracted my attention when looking for possible solutions to situations where there was a clear asymmetry of preconditions between partners.

The thesis comprises three studies, each feeding into the next, thus motivating further research. Although most research methods were qualitative in their nature, in Study II, I used a quantitative research method as well (see more in the summaries of Studies I–III). Study I explained the underlying mechanisms of U-I collaboration and concluded that symmetry of preconditions between partners is necessary for the collaboration to succeed. Three types of collaboration were presented based on the degree of precondition symmetry: excellent, promising, and modest collaborators. The modest type of collaboration sparked further scholarly interest, as the majority of studies in U-I collaboration literature have focused on studying organisations and their groups or individuals that are already experienced collaborators. In contrast, low-capacity companies have received scant scholarly attention (Spithoven *et al.*, 2011).

Therefore, Study II focused on low-capacity small and medium-sized enterprises (SMEs) and their possibilities to have meaningful interactions with academic researchers. Study II concluded that higher motivation of collaborating researchers can enable low-capacity SMEs to collaborate and help build their internal innovation capacity. These findings, in turn, motivated focusing on the academic researcher. Thus, Study III analysed academic researchers’ engagement in collaboration activities with companies.

Novelties related to the thesis

After having familiarised myself with the generous U-I collaboration literature, and at one point realising that the majority of research failed to offer remarkably new contributions that would broaden our knowledge about U-I collaboration, I decided to apply an exploratory approach that does not assume very clear research questions in the beginning but does challenge the existing perspectives and offers the potential for theory building by providing information-rich data. Thus, the novelty of my thesis lies in offering new perspectives in U-I collaboration literature.

My thesis's main key concept to U-I collaboration literature is "symmetry". Partners in U-I collaboration need certain preconditions to enter and proceed with an interaction. However, the collaboration-affecting factor is not the existence of these preconditions *per se* but rather their symmetry or, in other words, their match between partners. The notion of symmetry offers new perspectives in U-I collaboration literature as it explores not just the plain-sight factors that affect U-I collaboration (like barriers, facilitators, etc) but the critical preconditions and their interplay between partners. Focusing on the symmetry of preconditions enables otherwise tacit mechanisms to unfold; this thesis is an example of it.

The thesis presents a renewed conceptual framework to study U-I collaboration, critical preconditions and their symmetry, and the compensating mechanisms that could help low-capacity companies realise their innovation potential. The conceptual framework proposes a solid base for further research on U-I collaboration. In developing the renewed framework, the thesis combined different strands of theory: semiotics, organisation theory and social psychology.

The thesis is a collection of three separate studies that, in combination, form a synergetic whole. The studies are intertwined in a way that each following grew out of the previous. Together, they focus on U-I collaboration as an interaction from a micro-perspective yet considering the surrounding group-based and institutional settings. The viewpoints of both partners – the academic researcher and the business practitioner – are explored and analysed. The specific novelties of each study are introduced followingly.

Novelties related to Study I

Study I develops and empirically tests a new conceptual approach in analysing interaction between collaborating partners from academia and business. The backbone of the approach is based on the semiotic interaction model proposed by renowned semiotic Juri Lotman (Lotman, 2009) combined with boundary-crossing ideas from organisational theory. Although a methodological novelty, this approach presents a strong basis for further research.

The study tests the relevance of both collaborating partners' absorptive capacity and motivation and concludes that the symmetry of these preconditions is relevant in collaboration. For U-I collaborations to thrive, a certain degree of symmetry has to be reached between partners. The study categorises U-I collaboration, based on symmetry, into three different collaboration types and explains the potential of U-I collaboration in each type. The new conceptual approach and overall novelty in Study I have been well received by U-I collaboration scholars, and the article has received more than 140 citations.

Novelties related to Study II

Study II analyses the possibilities of low-capacity SMEs being engaged in U-I collaboration. The rationale for focusing on low-capacity SMEs has been the realisation that although SMEs are considered the backbone of Europe's economy, most U-I collaboration research has focused on the ones that exhibit

internal innovation capacity and are thus mature and experienced to successfully collaborate with academic researchers. On the other hand, SMEs that face innovation resource constraints and have limited collaboration experience with academic scholars have received scant research attention. Thus, there is a clear gap in the literature about how, or if at all, companies that face a deficiency of internal capacity or have asymmetrical levels of preconditions compared to their partner can partake in U-I collaboration.

Study II accentuates the relevance of motivation, especially academic researchers' motivation in securing a smooth and successful collaboration. Paradoxically, business practitioners expect academic researchers to have a higher motivation than themselves for the collaboration to succeed. This indicates the relevance of technical knowledge and social competence for the benefit of U-I collaboration. Thus, the novelty of Study II lies in studying low-capacity SMEs, which existing studies have largely overlooked, and in contributing to the U-I literature by providing evidence of the relevance of a sociopsychological phenomenon – motivation.

Novelties related to Study III

Study III focuses on academic engagement in U-I collaboration. Academic researchers who harness specialised knowledge are also key to knowledge and technology transfer. Study III analyses how and why academic researchers unlock and use their resources to benefit their collaboration partners. The study explains the relevance of structure and directionality of academic engagement.

Study III emphasises the gatekeeper role and provides a novel approach. Namely, Study III analysed the gatekeeper role outside the gatekeeper employing organisation, thus attributing to this role the boundary-spanning and knowledge-transfer functions. This realisation further extends our understanding of the gatekeeper role for the benefit of U-I collaboration and the growth of SMEs' internal innovation capacity.

Research objective, design and summary of studies

From the very beginning, the objective of this thesis has been to make meaningful contributions to U-I collaboration literature, and therefore, an exploratory, theory-building approach was chosen. This approach does not require the formulation of very specific research questions at the beginning of the research. Instead, a general gap in the literature was defined, and the subsequent research design followed an iterative process of theory and data circulation to propose new perspectives (Yin, 2018; Eisenhardt, 1989) and narrow down to more specific research questions. After repeatedly returning to literature after data analysis, key concepts can arise, and meaningful additions can be made to existing literature. A micro-perspective lens was applied during this iterative process, and a multidisciplinary approach was used.

Research questions:

The research started with an open and relatively broad hypothesis that there are latent mechanisms affecting U-I collaboration that have yet to reach the attention of most U-I collaboration scholars. Focusing on U-I collaboration interaction rendered the usage of the interaction model from semiotics, and after having inserted the collaboration preconditions into the model, the hypothesis was strongly supported. This outcome provided the keyword “(a)symmetry” and directed the research towards another, more specific hypothesis that in the case of asymmetry, there are compensating mechanisms that allow the low-capacity companies to still partake in U-I collaboration. This hypothesis also found support in the form of strong academic engagement.

RQ1: “What latent mechanisms in U-I collaboration interaction affect the effectiveness of collaboration?”



RQ2: “What are the compensating mechanisms for low-capacity companies to be engaged in U-I collaboration?”

The iterative research design can be followed step-wise:

1. U-I collaboration literature review (Section 1 “Theoretical background”).
 - a. Exploring the usage of the semiotic interaction model, defining the relevant preconditions for U-I interaction
 - b. Exploring the structure and directionality of academic engagement
2. Empirics (Section 2 “Empirical studies I–III”).
 - a. Sampling, data collection, data analysis
 - b. Revisiting literature \longleftrightarrow revisiting data
3. Emergence of key concepts and contribution to U-I collaboration literature (Section 3 “Discussion, conclusion and contributions”)

The iterative research design is further explained and visualised in Figure 1. After having proposed RQ1, analysed the semiotic interaction model, and included the preconditions (absorptive capacity and motivation), the empirical research among collaborating partners was carried out, followed by literature and data triangulation (marked by the circular arrows). The main key concept “(a)symmetry” emerged, proposing further research avenues. If symmetrical, in other words, a balanced and proportionate similarity of preconditions of both partners proposes a fair base for effective collaboration, then I was more interested in the asymmetrical situation. Here, RQ2 emerged, and the focus shifted towards exploring the potential compensating mechanisms. A research process similar to RQ1 rendered new key concepts: the structure and directionality of academic engagement.

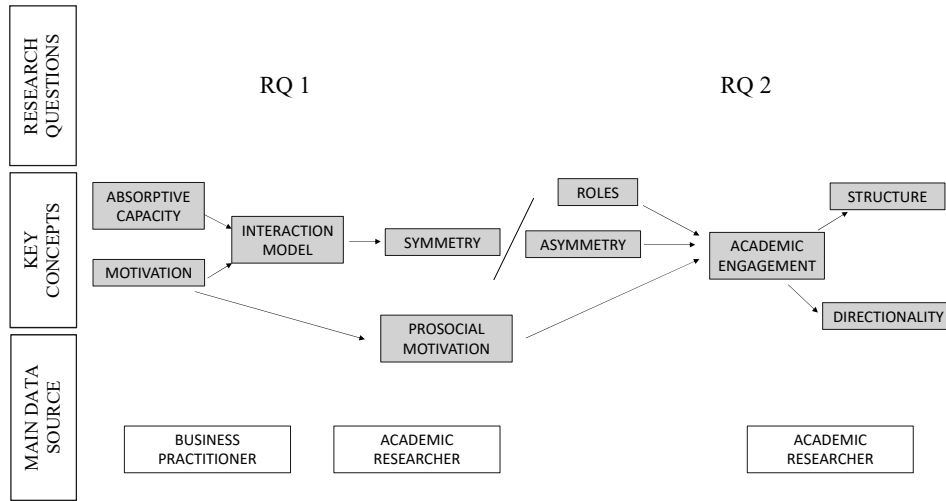


Figure 1. The emergence of key concepts from the iterative research process

Empirical considerations:

The thesis comprises three empirical studies (Studies 1–3) that, in combination, propose new avenues to U-I collaboration literature. The studies employ mixed data collection and analysis methods: qualitative as well as quantitative. To collect the data interviews and questionnaires were carried out and complemented with secondary data sources (database of innovation vouchers and data from Estonian Business Registry).

The unit of analysis is collaboration interaction, but as interaction takes place on an individual level, between individuals, the semi-structured interviews and questionnaires were conducted among individual researchers and company representatives, the partners directly and actively involved in collaboration projects. In the university setting, the academic researchers included in studies first and foremost represented their research groups. And if companies were small and medium-sized (and in the majority of cases, they were), the interviewees represented their companies.

In the case of large companies, the interviewees represented their respective departments. In the first study, 2 out of 12 companies were large; the rest were micro, small, and medium-sized. In the second study, all questioned companies were SMEs. The third article focused on academic researchers. The research design throughout the studies can be described as exploratory (Yin, 2018), using multiple sources of evidence and circulating data and theory.

As the unit of analysis is collaboration, then directly interacting partners proposed a valid research object to make conclusions about the collaboration interaction, which has been the aim of the thesis. Micro-perspective that has been applied throughout the three studies encompasses individual as well as group dynamics.

Micro-perspective combining individual and group levels has often been applied in sociology and social psychology. Applying this perspective in U-I

collaboration research is a relatively recent trend (Albats *et al.*, 2018; Adegbile *et al.*, 2021). The majority of U-I studies have focused on the macro level. However, the main criticism about these studies is that they have focused too much on the outcomes, and the mechanisms of actually executing collaboration have received scant attention (Albats *et al.*, 2018.; Fernandes and O’Sullivan, 2023; Nsanzumuhire and Groot, 2020). Gulbrandsen and Thune (2010) have also stated that there has been little effort to explore U-I collaboration interaction and, therefore, called for further research. Focusing on individual micro-processes has been helpful in explaining the social impact of U-I collaboration in emerging economies (Roncancio-Marin *et al.*, 2022).

Emergence of key concepts:

From the first round of the iterative process of theory and data triangulation, the key concept “(a)symmetry” arose, which refers to the balanced and proportionate similarity of preconditions between partners. The symmetry of critical preconditions (motivation and absorptive capacity) can explain the differences in U-I collaborations. Based on this outcome, another round of theory and data triangulation was undertaken to study a potential compensating mechanism for the “asymmetry” situations in U-I interaction. Additional key concepts arose, namely the realisation that the structure and directionality of academic engagement in U-I interaction has the power to explain collaboration in a situation of asymmetry.

Summary of studies:

Study I proposes a renewed and empirically tested conceptual approach to analyse U-I innovation collaborations. The approach combines aspects of U-I collaboration literature with an interaction model borrowed from semiotics and boundary-spanning ideas from organisation theory. Based on the interaction model, the study proposes three types of collaboration based on the symmetry of absorptive capacity and motivation levels between collaborating partners.

Study II focuses on small and medium-sized (SMEs) companies’ low internal innovation capacity and analyses their collaboration experiences with academic researchers. Motivation for this study emerged from Study I results, which proposed three collaboration types. Study II aims to analyse how companies lacking one critical precondition can collaborate with academic researchers.

Study III turned attention from business practitioners to academic researchers. Based on the result from Study II that perceived higher motivation of the academic partner was expected, the study aimed to analyse the motivational aspects of collaborating academic researchers. The study resorts to role theory and other-focused psychological processes to present new insights into how and why researchers activate their resources in innovation collaboration with companies. The study concluded that empowered with prosocial motivation, the gatekeeper role has strong potential to enhance the company’s absorptive capacity.

Table 1. Summary of studies

Study	Literature stream	Gap in previous research	Research approach	Data
Study I	Interaction model from semiotics and boundary crossing ideas from organisational theory	Lack of understanding the critical preconditions of U-I collaboration and their symmetry.	Multiple case-study research; Case = U-I collaboration; Data and theory triangulation.	Qualitative: In-depth interviews with both collaborating partners; Altogether 24 paired interviews (12 cases)
Study II	U-I collaboration literature	Lack of research on how low-capacity SMEs engage in U-I collaboration and the potential compensating effect of motivation.	Exploratory approach, following the reasoning of purposive sampling, assessing data quality and relevance and revisiting research rigour with qualitative data from the questionnaire; The analysis was conducted using the one-way analysis of variance (ANOVA) in SPSS Statistics Version 26.	Quantitative and qualitative, based on purposive sampling of two databases and an online survey: 1) The Estonian innovation voucher database (2,014 projects in total); 2) Data from the Estonian Business Registry about SMEs that had used the voucher (715 SMEs in total); 3) An online survey data among SMEs that used vouchers to collaborate with an academic researcher (229 responses, response rate 31%)
Study III	Role theory from organisation theory and prosocial motivation from social psychology.	Lack of research on the role of academic researchers in U-I collaboration, prosocial motivation, and a specific (gatekeeper) role in aiding the collaboration.	In-depth interviews were manually coded and categorised; Usage of code co-occurrence analysis method; Theory and data triangulation.	Qualitative: In-depth interviews with academic researchers; Altogether 11 interviews

Source: created by the author

Contribution of authors

Sigrid Rajalo and Maaja Vadi co-authored all individual studies included in this thesis. The author of this thesis is the first author of all three individual studies. The collaboration pattern between the two authors was similar throughout all three studies: the first author proposed the idea of the study; studied the main literature; gathered the empirics in studies II and III; wrote, rewrote and edited the articles. The second author proposed additional literature streams and empirics for the first author to study; read and commented on the various draft versions of all the articles. Throughout all articles, the co-authors regularly held discussions to improve the manuscripts. The second author, who is also the supervisor of the first author, contributed greatly to guiding the first author towards better framing the manuscripts and writing sharper and more to-the-point conclusions and contributions.

Study I

The author of the thesis proposed using the semiotic interaction model that became the backbone of the whole thesis. The first author studied the extensive U-I collaboration literature and proposed the usage of absorptive capacity and motivation in the semiotic interaction model. The authors discussed and agreed upon the research questions and design. The thesis author drafted the interview questions, and the second author helped organise the interviews to be conducted. After data collection, the first author conducted a triangulation of data and theory analysis; in between the cycles, discussions were held with the second author. The first author designed all the figures used in the manuscript. The first author wrote and rewrote the article multiple times following regular discussions with the second author. The second author helped find proof-readers for all the articles.

Study II

The author of the thesis proposed the focus of the study (low-capacity SMEs' engagement in U-I collaboration) and the main database, analysed the existing research, designed the survey questionnaire, and carried out the survey. The second author contributed by assisting in analysing the data. In collaboration and after discussing the results of the empirics, the authors came up with the typology. After discussions with the second author, the first author wrote and rewrote the manuscript multiple times.

Study III

The first and the second authors came to their conclusion of focusing on academic researchers. The first author designed the sample and the interview questionnaire, carried out all the interviews and analysed the data. The second author proposed the inclusion of the organisation theory. During data and theory triangulation, several discussions were held between the authors.

1. THEORETICAL BACKGROUND

This thesis explores university-industry collaboration with the aim of adding new perspectives to the theory. Thus, the thesis is interdisciplinary, and the theories discussed subsequently are intertwined. An overview of the theories and their interplay is presented in Figure 2.

The literature review is structured as follows. Section 1.1 introduces the U-I collaboration concept. Section 1.2 discusses methodological choices, introducing the interaction model from semiotics (Section 1.2.1) and the necessary preconditions of absorptive capacity and motivation (Section 1.2.2). This interaction model is crucial for developing and testing a new approach in U-I collaboration research that enables this thesis to add value to the existing U-I collaboration literature. U-I collaboration is an interaction between partners from different backgrounds who aim to learn from each other to present innovative outcomes, and the semiotic model also focuses on partners from different realms. The preconditions form the basis of the interaction model and, in the subsequent analysis, enable the concept of “(a)symmetry” to arise.

Section 1.3 focuses on the directionality and structure of academic engagement, namely prosocial motivation (Section 1.3.1) and role theory (Section 1.3.2). Prosocial motivation adds another explanatory layer to the concept of “motivation”, enabling the study of whether motivation directionality towards others is relevant to unravelling the U-I collaboration underlying mechanisms. Role theory provides structure in analysing the potential compensating mechanisms in U-I collaboration. The interdisciplinary nature of this thesis is depicted in Figure 2, visualising the interconnectedness between disciplines, theory strands, empirical studies and emerging new concepts. Horizontal arrows indicate synergy (multidisciplinarity in case of combining different disciplines), and vertical arrows show the origin of theory strands from disciplines, the usage of theory strands in studies, and the emergence of key concepts.

Although boundary-spanning ideas are discussed mainly in Study I and briefly touched on in Study III, this concept is voluminous and, to keep the research in focus is not included in this thesis.

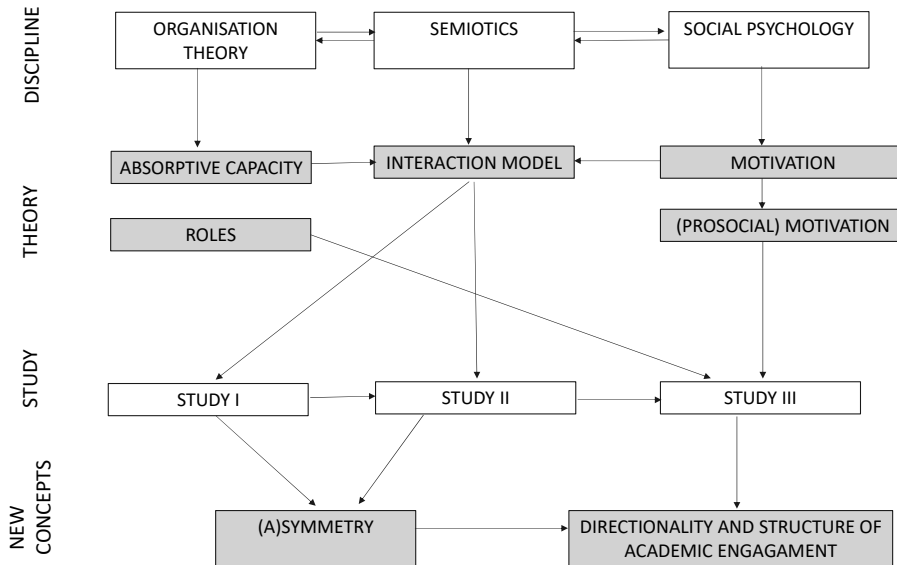


Figure 2. Structure of the literature review and links to studies compiled by the author.

1.1 University-Industry collaboration

Organizations that aim to stay in competition cannot rely solely on internal paths to innovate but must look for external partners (Chesbrough, 2003). Companies, especially small- and medium-sized (SMEs) that have acknowledged their internal innovation resource constraints, need to use external innovation sources to secure their position in the market (Leckel *et al.*, 2020). University-industry collaboration has been often heralded by policymakers, practitioners and researchers as having the potential to contribute to the economic growth of companies, regions and countries (Spithoven *et al.*, 2013).

Acknowledging that there are various modes of collaboration between universities and businesses, this thesis focuses on innovation-specific contracted collaboration between representatives from academia and business that serve the company's needs. The following relevant characteristics have been attributed to the collaboration between academic researchers and business representatives: 1) the collaboration involves people who are members of different professions, 2) the collaboration takes place between individuals or teams, and 3) the collaborators are not all from the same organization (Amabile *et al.*, 2001).

Academic researchers harness specialised knowledge; therefore, governments actively promote the transfer of this knowledge to the economic agents to turn it into economic growth. Creativity and innovation literature has long suggested that useful and applicable new ideas can arise from combining different viewpoints (Senge, 1990). The partners in U-I collaboration are from academic and entrepreneurial realms and bring very heterogeneous standpoints to

the interaction process. Thus, uncovering the underlying mechanisms of this interaction requires heightened scholarly attention.

The specificities of joint undertakings between academic researchers and business representatives have attracted major scholarly interest (Perkmann *et al.*, 2021). Although previous studies have identified numerous barriers and obstacles (e.g., Kleiner-Schaefer and Schaefer, 2022; Moraes Silva *et al.*, 2020; Tootell *et al.*, 2020), cultural differences (e.g., de Wit-de Vries *et al.*, 2019; Davenport *et al.*, 1999), conflicting expectations (e.g., Bjerregaard, 2010) and facilitating intermediaries (e.g., Albats *et al.*, 2022) to name only a few, the evidence is inconclusive about what determines one collaboration to thrive while another to struggle.

Against this background, this thesis set out to contribute to U-I collaboration literature by providing new perspectives on U-I interaction. Thus, an exploratory and interdisciplinary approach combining different theories and their concepts was developed and tested. The thesis followingly resorted to semiotics and social psychology.

1.2 Methodological considerations to study U-I interaction

1.2.1 The skeleton of interaction model

U-I collaboration is based on interaction between partners from very different realms (Baleeiro Passos *et al.*, 2022; Puliga *et al.*, 2023; Ankrah and AL-Tabbaa, 2015). To reach the innovation collaboration expected outcomes they need to find ways to interact in a situation where they might have differing terminology, cultural values, competencies, and other aspects that affect interaction. The legendary semiotician Juri Lotman published a 1992 interaction model explaining the circumstances under which two communicators from different semantic fields are able and interested in interacting (Lotman, 2009). Although Lotman used it to exemplify language practices and communication, the model is also suitable for U-I collaboration analysis, as proven in Study I. The model enables the application of an exploratory and theory-building approach to studying U-I collaboration.

When the two semantic fields meet (as in U-I collaboration), the actors must look for similarities in their intersecting areas to continue the collaboration. According to Lotman, interaction is only possible if the partners share a minimal level of similarities; in other words, there has to be a minimal common ground of shared language. If partners share no common ground, collaboration is impossible. Paradoxically, if their intersecting area becomes too large (the partners are very much alike), the collaboration becomes meaningless as there is nothing new to discover from the partners' realm.

In an innovation-specific collaboration situation, the added value arises from the combination of new ideas derived from the "unknown" spheres (Kirton, 1976; Senge, 1990). Therefore, the U-I collaboration partners also need to look

for an equilibrium of similarities between themselves when they embark on joint work. Thus, the paradox is the following: the partners can interact if there is an intersection between their realms, but they are most interested in the “unknown area”.

The semiotic interaction model is similar to the firm’s cognitive theory of business economics, introduced by prof Bart Nooteboom (2009). The cornerstone of the cognitive theory of the firm states that different people have different perceptions, understandings and views that have been constructed along their previous life paths. According to Nooteboom, the differences in understanding propose a source of innovation (Nooteboom, 2009). To realise this potential, Nooteboom presented an optimal cognitive distance model explaining that for the company to explore and implement novelties, collaborators must have neither too short nor too long cognitive distance between each other. The semiotic interaction model complements Nooteboom’s discussions and thus contributes also to business economics literature.

1.2.2 Preconditions: absorptive capacity and motivation

The interaction model in this thesis is applied to analysing university-industry collaboration; therefore, U-I collaboration-specific characteristics need to be considered: absorptive capacity and motivation. This thesis builds on the concept of absorptive capacity as proposed by Cohen and Levinthal (1990), which refers to the firm’s ability to recognise and apply new external knowledge for commercial ends. Absorptive capacity is based on prior related knowledge, on knowledge sources (Todorova and Durisin, 2007), and is affected by the surrounding environment (Nooteboom, 2000).

Firms look for external knowledge bearers and, to explore and exploit (March, 1991) new knowledge, need the facilitating effect of their internal capacity. Previous research has identified strong links between absorptive capacity and innovation outputs and outcomes (Zahra and George, 2002). Absorptive capacity has been determined as a relevant factor in U-I collaboration (Santoro and Bierly, 2006; de Wit-de Vries *et al.*, 2019), so it has been included in this thesis as a necessary prerequisite. Moreover, a firm’s absorptive capacity can be enhanced via collaboration with universities (Bishop *et al.*, 2011; Rangus *et al.*, 2017).

Absorptive capacity is especially crucial for the collaborating companies to tap into the academic researchers’ knowledge resources. Companies use academic alliances to expand and complement their absorptive capacity (Scott, 2003). On the other hand, academic researchers need to understand the specificities of the business field. Previous research has abundantly proven the co-dependency between U-I collaboration and absorptive capacity (e.g., Zhang *et al.*, 2022; Abbate *et al.*, 2021; Apa *et al.*, 2021; Østergaard and Drejer, 2021; Fernández-Esquinas *et al.*, 2016; Spithoven *et al.*, 2011).

Although there is burgeoning literature on absorptive capacity, the operationalisation of this term that goes beyond R&D investments as the primary indi-

cator still needs improving (Bishop *et al.*, 2011; Schmidt, 2005; Vega-Jurado *et al.*, 2008). In its original definition by Cohen and Levinthal (1990) absorptive capacity was introduced as a firm-level tacit characteristic. However, in the case of U-I collaboration, it manifests in individuals, and that includes academic researchers as well. In U-I collaboration, both partners need to realise abilities to recognise the external knowledge introduced by their collaborating partner, assimilate it and apply it. Absorptive capacity is fundamental in studying organisational learning (Noblet *et al.*, 2011).

As the operationalisation of absorptive capacity needs further research, the same applies to operationalising it on a group and individual level. Nevertheless, similar terms that indicate individuals' or groups' ability to learn and accumulate knowledge have received attention in psychology. Absorptive capacity can be affected by external or internal factors. Daghfous (2004) has proposed that internal factors include prior related knowledge, individual absorptive capacity, the level of education, individual background, HR strategy, organisation's size, culture, R&D investments, and so on. Thus, the organisational-level absorptive capacity strongly relies on individual absorptive capacity. In this thesis, absorptive capacity was identified as previous related knowledge – not only scientific and technological but also as knowledge of their collaboration partner's field. In collaboration interaction, both partners are expected to have an absorptive capacity for the transfer to take place.

When absorptive capacity constitutes the knowledge base necessary for collaboration, according to Lotman's interaction model, the existence of motivation acts as a collaboration driving force. Motivation is a psychological process that explains certain individual and organisational actions and behaviours (Grant, 2008). Researchers have a surge of interest in studying motivation as a specific determinant for U-I collaboration (Perkmann *et al.*, 2021). Previous literature has analysed motivation mainly as an intrinsic or extrinsic trigger. Extrinsic motivation manifests in stimuli like money or reward. For instance, the researchers have been found to be motivated to collaborate to secure contractual funding (Tartari and Breschi, 2012). Researchers' intrinsic motivation could be driven by, e.g., professional curiosity or the perspective to apply knowledge (Ramos-Vielba *et al.*, 2016).

In this thesis, motivation is an essential precondition in the U-I interaction model, but in a rather one-dimensional mode – either explicitly existent or not. However, motivation as a concept was studied further during the research, revealing that it could explain academic engagement in U-I collaboration. Therefore, motivation is further explained in the following subchapter.

1.3 The directionality and structure of academic researcher engagement in U-I collaboration

Following the exploratory course of this research, the relevance of the academic researcher's engagement in U-I collaboration arose. Therefore, the structure and directionality of an academic researcher's job in U-I collaboration gained prominence. The following theoretical reasoning builds on motivation theory and role theory, the former explains the directionality of the engagement, and the latter aids in defining the structure. The concept of directionality incorporates prosocial attitudes and explains their relevance in U-I interaction. The structure of academic engagement analyses the various roles that academic researchers need to deal with in fulfilling their job. Both concepts emerged from the triangulation of theory and data as the key concepts that have the power to propose new perspectives to U-I collaboration.

1.3.1 Prosocial motivation – directionality

When aspects of absorptive capacity have found their way into innovation literature and U-I research, motivation as another prerequisite for joint undertaking has received limited scholarly attention. Even though Perkmann *et al.* (2021) have noted a slight increase in studying motivation in U-I collaboration, the research has remained rather one-dimensional. Namely, motivation has been studied mainly in the vertical of intrinsic vs extrinsic motivation. Extrinsic motivation indicates that the stimuli originate from the surrounding environment and materialises in money, reward or acknowledgement (van Rijnsoever and Hessels, 2021). Intrinsic motivation is the inner driver and manifests in professional interest, curiosity, job satisfaction, enjoyment, and self-determination (Grant and Berry, 2011). The usage of intrinsic and extrinsic motivation concepts has failed to fully explain motivation's function in keeping the collaboration in the process regardless of all the challenges arising from the partners' specific domains. Thus, drawing general inferences about motivation's function in collaboration interaction has remained challenging.

To provide more explanations, the existing literature was complemented with the concept of prosocial motivation originating from social psychology that has found its way into psychology and organisational research (Bolino and Grant, 2016; Podsakoff *et al.*, 2013), behavioural economics (Fehr and Fischbacher, 2002), entrepreneurship studies (e.g., Murnieks *et al.*, 2020; Renko, 2013), etc. Prosocial motivation is associated with generating an other-focused perspective (Grant and Berry, 2011), which gives directionality to motivation in U-I collaboration. In this thesis, academic researchers' motivation is expected to be directed towards the company, enabling collaboration to proceed regardless of asymmetry between partners.

As pro-socially motivated people are more likely to adopt the perspective of others, perspective-taking has been found to facilitate the collaboration process between academics and business practitioners (Mohrman *et al.*, 2001). Further-

more, taking their partner's perspective influences the perceived usefulness of collaborative projects (Mohrman *et al.*, 2001), improved problem-solving engagement, and achieving higher joint outcomes (De Dreu *et al.*, 2000).

Apart from a few exceptions (Iorio *et al.*, 2017), less attention has been paid to social ties, prosocial attitudes, individual behaviour, and incentives (Filippetti and Savona, 2017). Therefore, focusing on perspective-taking, other focused motivation, or prosocial motivation has the potential to contribute to explaining academic engagement in U-I collaboration. Pro-sociality is embedded in the academic researcher's role and other professional roles. Academic researchers are expected to fulfil several other-focused tasks (e.g., benefit the society and economy, spread knowledge, educate), which require making motivational choices.

1.3.2 Role theory – structure

Borrowing the role theory from social psychology, which deals with expectations, provides a valid basis to analyse academic researchers' behaviour and patterns of prioritising actions. The concept of role has been analysed on organisational as well as individual levels (Heikkinen *et al.*, 2007; Katz and Kahn, 1966). The construction of individual roles has implications for the organisation they belong to. However, individuals can adjust their roles based on other influencing factors, e.g., collaboration with external partners who have their own specific role structure. In this thesis, the academic researcher's behaviour on the individual level is studied, but as the role concept includes expectant behaviour from the surrounding environment (Thomas and Biddle, 1966), the institutional-level attributes are also recognised.

Roles have expectations from others (Katz and Kahn, 1966), and role actors can shape and modify their roles (Heikkinen *et al.*, 2007). In U-I collaboration, where the aim for both partners is to tap into each other resources, the task-related and relationship-related roles are relevant (Heikkinen *et al.*, 2007).

The symbolic interactionist view (Thomas and Biddle, 1966) of role theory stresses the emergent nature of the role, meaning that actors can interpret their role expectations and, thus, reorganise, modify and negotiate specific roles (Heikkinen *et al.*, 2007). This indicates that acting in a role can be characterised by expectations and being emergent. A role can be acted out based on the expectations of others, and a role can also be emergent, including intentional construction and changing of the role by the actors themselves (Heikkinen *et al.*, 2007).

In this thesis, role theory is applied to studying an academic researcher whose job is multifaceted, suggesting that it encompasses several roles that, at times, could conflict. U-I collaboration-specific roles were identified from a variety of roles that the rich role theory has proposed. In the initial data analysis, the gatekeeper, planner and producer roles were studied (Heikkinen *et al.*, 2007). However, sent roles and self-centeredness emerged during data and theory triangulation (Shivers-Blackwell, 2004). Thus, an exploratory approach

to role theory among other disciplines proposes new perspectives to U-I collaboration.

The following studies explore rich field of university-industry collaboration by combining different strands of theory and by triangulating data and theory. The backbone throughout the studies is interaction between academic researchers and business practitioners and the critical preconditions of both partners. The following studies have been conducted via applying multidisciplinary lenses and by being open to the emergence of certain patterns that could provide explanations to the specifics of U-I collaboration.

2. EMPIRICAL STUDIES I-III

3. DISCUSSION, CONCLUSION AND CONTRIBUTIONS

University-industry collaboration has attracted the attention of innovation policy designers, practitioners, and scholars for decades. U-I collaboration has been expected to spur innovation in companies and economic growth on the macro level. Paraphrasing Pascal Lamy, who led a group of experts advising the European Commission in designing the Horizon Europe programme (2017): *we know how to turn money into science but need to learn how to turn more science into money*. The term “European paradox” was coined in the mid-1990s, marking the perceived failure of European countries to translate scientific results into innovations (that is, marketable products and services). Some other regions in the world are facing the same challenges.

There is abundant literature on U-I collaboration, but this thesis sought latent mechanisms that could encompass more explanatory power to the different U-I collaboration-affecting factors. Aiming to provide meaningful insights into U-I collaboration theory, an exploratory approach of data and theory triangulation was used. And following previous researchers’ calls (e.g., Albats *et al.*, 2018; Fernandes and O’Sullivan, 2023; Nsanzumuhire and Groot, 2020), a micro-perspective was applied.

An exploratory approach and the usage of mixed methods revealed detailed empirical evidence of the relevance of preconditions’ symmetry between collaborating partners. The research also explains how the structure and directionality of academic engagement could benefit an asymmetrical U-I interaction. The thesis is informed by three lines of research – organisation theory, social psychology and semiotics – and explains the main concepts – (a)symmetry and directionality and structure of academic engagement – and their contribution to the U-I collaboration literature. Based on empirical studies, the conclusions help expand our knowledge about U-I collaboration.

3.1 Discussion

To position the thesis in the U-I collaboration literature, I discuss the emergence of the central key concept – **(a)symmetry** – and its relevance to theory building by enabling the depiction of distinct U-I collaboration patterns and describing an otherwise latent collaboration-affecting mechanism.

In data and theory triangulation, the interaction between partners was elaborately analysed. The foundation of the analysis is the interaction model proposed by a renowned semiotic Juri Lotman (2009). U-I collaboration literature rendered the two critical preconditions – motivation and absorptive capacity – which were included in the interaction model.

The interaction of two partners from different realms and their working together can be multidimensional and heterogeneous, to say the least. A renewed interaction model was developed to present detailed results that explain the collaboration-affecting factors more explicitly. Semiotics lent the instruments to

understand different semantic domains, such as the academic and the industrial. Juri Lotman's interaction model suggests that dialogue between representatives from different domains can occur if they share the same language at a minimal level. In this thesis, the critical absorptive capacity and motivation preconditions formed the shared area.

According to Lotman, something must also be unknown in the partner's realms for learning and innovation to take place. This notion is in line with discussions by Bart Nooteboom (2009), who has described the interconnectedness of cognitive distance and absorptive capacity and has come to a similar realisation that from the firm's perspective, there has to be a balance between new and known information for the sake of novelty and efficient absorption (Nooteboom, 2009).

As U-I collaboration, first and foremost, is about knowledge transfer (technology transfer also requires knowledge), then certain capacity-intensive preconditions are relevant to consider. U-I collaboration encompasses the transaction of codified and tacit knowledge, which is difficult to articulate. Absorptive capacity, specifically its level and the match of levels between partners, is the core of U-I collaboration. Partners are interested in tapping into each other's knowledge resources. It requires the capacity to absorb this new resource made available in the collaboration interaction. Thus, the level of absorptive capacity and match of levels between partners is essential in collaboration.

Another relevant precondition for collaboration is motivation – the mechanism that activates the interaction between partners and fuels the collaboration in its implementation phase. In analysing these two preconditions and their interplay between partners, it became clear that the **symmetry of preconditions between partners** can characterise U-I collaborations that thrive. Figure 3 illustrates a collaboration between partners encompassing a symmetrically moderate level of preconditions (A' and B'). They can move forward with their collaboration, tap into each other resources, and learn and develop joint projects (evolve into "C, D" in Fig 3).

Partners more often found mechanisms to cross organisational boundaries if they shared at least a moderate absorptive capacity and motivation. This situation, in turn, resulted in successful outcomes perceived as such by partners. If the precondition levels were asymmetrical between partners, they faced more significant challenges in overcoming the barriers. The empirics (Study I) provided cases where the collaboration yielded no results or negative outcomes. However, it also proposed a hypothesis that a compensating mechanism could be embedded in motivation in the case of asymmetrical collaboration.

(A)symmetry as a concept has yet to be extensively used in U-I collaboration literature. Nonetheless, scholars have been interested in studying the similarities and differences between collaborating partners. For instance, Martin Hemmert has described how similarities in decision processes in the research group and firm can benefit academic researchers in acquiring technological knowledge (Hemmert, 2017). Similarities between partners' cognitive factors could pro-

mote a smoother transfer of knowledge (Steinmo, 2015; O'Reilly and Cunningham, 2017).

To analyse the similarities, a proximity matrix has been proposed, consisting of spatial (physical distance), social (network membership), organisational (working culture), and technological proximity (knowledge base) (Johnston 2021). Out of these, technological proximity can be compared to absorptive capacity symmetry because both concepts indicate the necessity for similar knowledge bases that benefit collaboration, and organisational proximity includes the aspect of motivation. However, the notions of similarity, familiarity or proximity are limited in explaining the proportion of similarities.

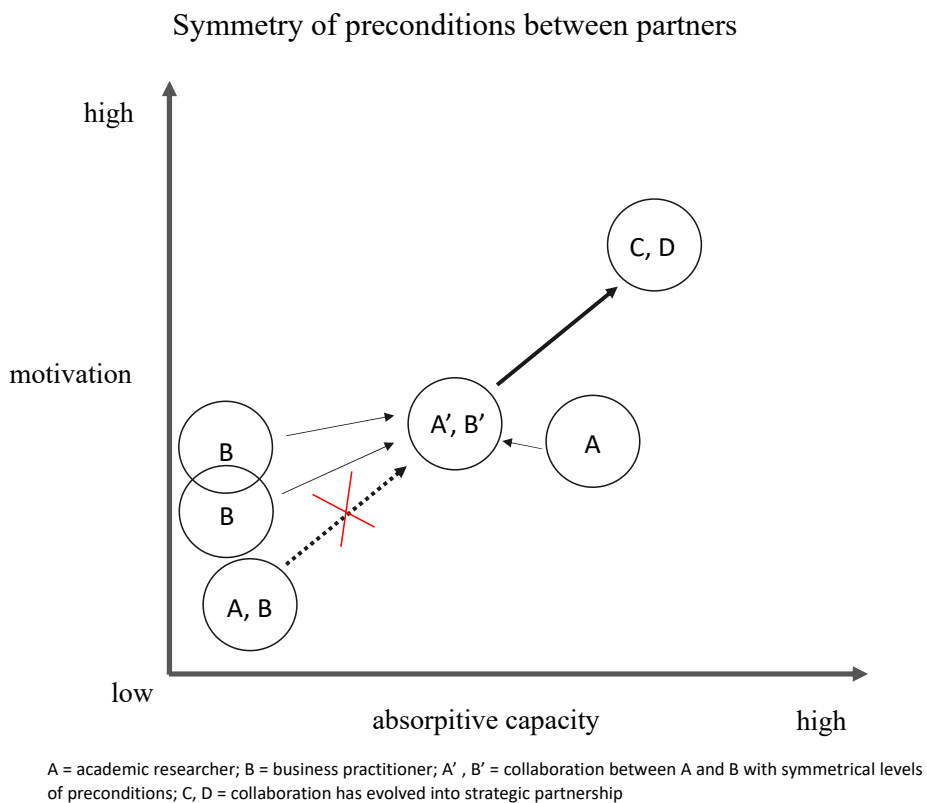


Figure 3. Symmetry of preconditions between partners. Composed by the author.

Recalling RQ1: The concept of (a)symmetry enabled a description of the otherwise latent mechanism that affects U-I collaboration interaction and its possible effectiveness. Based on the mutual level of symmetry or symmetry-asymmetry of preconditions shared between partners, the collaboration could be perceived as either smooth or complex. Realising the relevance of symmetry in the U-I

collaboration critical preconditions adds another explanatory layer in further understanding the specificities of U-I interaction, which is why it emerged as the central concept in this thesis. U-I collaborators will always have countless differences emerging from their previous backgrounds, their organisational culture, professional language, and working routines, for that is where innovation can arise – from the combination of diverse partners and their capital. Therefore, defining the variety of, for instance, barriers and facilitators does not qualify as a mechanism to explain the U-I interaction. Rather, the differences that sometimes translate into barriers are the inevitable starting point of all U-I collaborations.

The true driver of collaboration is and always will be motivation, and the enabling vehicle is absorptive capacity. If partners share a balanced and similar proportion of these critical preconditions, then the remaining differences between them become opportunities rather than challenges, proposing mutually complementary learning options.

After identifying and empirically testing the necessary preconditions and their symmetry for U-I collaboration, the thesis focused on investigating the collaborations where the starting point was not beneficial, namely, where one partner faced a deficit of one precondition, and it was clear that there was no symmetry of preconditions between partners. The focus was turned towards motivation as a potential aiding mechanism because analysis revealed how the low-capacity companies expected higher motivation from academic researchers than themselves (Study II). The subsequent analysis focused on understanding the academic researchers' in-depth motivation and the structure of tasks the researcher has to undertake to collaborate with a business representative (Study III).

Subsequent data and theory triangulation uncovered a mechanism in academic researchers' motivation, namely prosocial motivation, a psychological process directed towards the needs of a collaborating partner. Role theory provided an understanding of academic researchers' structure on tasks, and some roles in combination with prosocial motivation emerged more prominently than others, enabling to explain how academic researchers have the power to use their resources to balance out the asymmetrical situations in U-I interaction.

Academic researchers' **motivational directionality** towards their partners and using the **gatekeeper role** strongly benefited the interaction. The gatekeeper role has mainly been studied within the gatekeeper's employer-organisation, but this thesis provides evidence of its function in facilitating collaboration between organisations. The effective execution of the gatekeeper role requires good command of communication skills. As U-I interaction, in its essence, is based on communication, then it can be concluded that in a situation where one collaborating partner lacks the critical precondition (s), then the academic partner has the power to employ a compensating mechanism. It can also be concluded that social competence, besides technological knowledge-based competence, is relevant for smooth and successful U-I collaboration. If one partner is in a deficit of one U-I collaboration precondition (absorptive

capacity), the other partner must take the extra steps and reach out. This notion refers to the relevance of mechanisms emanating from social competence.

Recalling RQ2: This thesis analysed the academic researchers' role structures and motivation directionality and uncovered that the compensating mechanisms could be triggered if the collaborating academic researcher is willing to activate their resources to benefit their collaborating partner. Figure 3 illustrates the situation, depending on whether the partners (A, B) have the necessary preconditions and whether their levels are symmetrical. The collaboration will likely not proceed if both partners have very limited preconditions.

If the business practitioner has limited absorptive capacity, but the academic researcher is willing to activate their resources for the partner's benefit, then the collaboration could proceed and even evolve into a more strategic partnership (see "C, D" in Fig. 3). If both partners have similarly low levels of preconditions, there does not seem to be potential for a compensating mechanism and, therefore, this collaboration has a low probability to proceed and yield effective results (see bottom-left circle of A and B; the dotted line marks the improbability). The semiotic interaction model explains the scope of similarities between collaborating partners.

Recalling Figure 1, it can be concluded that the concept "(a)symmetry" opens up the U-I interaction mechanism and proposes potentially rich research avenues for U-I collaboration scholars. This thesis followed the "asymmetry" route, where exploring complementary mechanisms revealed the relevance of academic engagement. Academic researchers possess the resources and means to facilitate U-I collaboration, provided they are pro-socially motivated and willing to structure their job accordingly. Hence the thesis provides insights into the practicalities of academic engagement.

3.2 Contributions to theory

First, the thesis offers an understanding that **the symmetry of absorptive capacity and motivation levels between partners** can determine U-I collaboration perceived success or failure. Interaction is the easiest, and collaboration outcomes are most likely perceived as successful when both partners share at least moderate levels of preconditions. The more the U-I collaboration partners differ in their precondition levels, the more this asymmetry affects the collaboration.

An ideal equilibrium for a potentially successful U-I collaboration is where the partners share moderate absorptive capacity and motivation levels. This realisation adds an understanding to U-I collaboration literature of interaction-affecting mechanisms that go beyond one-dimensional barriers and facilitating factors. "(A)symmetry" is the key concept that emerged during this research and explained different types of U-I collaboration. It can be concluded that the symmetry of preconditions between collaborating partners is the main characteristic of the interaction structure. As stated in the previous subchapter, "(a)symmetry" as a concept has not been used in U-I collaboration literature.

Concepts similar to it – proximity, familiarity, similarity – do not include the aspect of comparable similarity and its relevance to critical preconditions. The aspect of (a)symmetry enables the emergence of U-I collaboration patterns that enable further analysis of the potential effectiveness of certain collaborations. This research analysed three different collaboration patterns based on the level of symmetry or asymmetry, drawing links between the symmetry levels and the collaboration's perceived success.

Second, although symmetry of the critical preconditions between collaborating partners is necessary for the collaboration to proceed, in practice, there are situations where asymmetry between partners exists. This thesis also provides a potential compensating mechanism for these situations. Namely, the outlook for low-capacity companies to work with academic researchers is promising **if the researchers activate their resources to benefit the companies**. In other words, the academic researcher engaged in U-I interaction can provide compensating mechanisms if the company lacks the critical preconditions. The perceived higher motivation of the academic researcher can help capitalise on the collaboration potential and support the building of the company's internal innovation capacity. The empirical analysis revealed that motivation is a multi-dimensional phenomenon in U-I collaboration that has received limited scholarly attention. If the academic researcher were pro-socially motivated to collaborate with a business practitioner, then the collaboration would proceed regardless of the business practitioners' scarcity of innovation resources. Academic researchers enjoy professional autonomy, and their individual performance is driven by self-motivation (Perkmann *et al.*, 2013). Following the call of Perkmann *et al.* (2013), this thesis shows that academic researchers can choose to act pro-socially for the benefit of others. The concept of prosocial motivation adds another layer to the otherwise one-dimensional concept of motivation.

Third, stemming from the previous contribution, a specific mechanism besides prosocial motivation emerged that appeared to play a crucial role in a collaboration between a low-capacity company and an academic researcher. Namely, **the gatekeeper role offered a bridging function between partners**. Previous research has pointed out that gatekeepers exhibit boundary-spanning functions (Allen *et al.*, 1979).

The gatekeeper role has so far been studied by innovation and organisation theory scholars as a mechanism within one organisation. In this thesis (Study III), it functioned as a communication tool between organisations. This is in line with previous research, which has also emphasised the gatekeeper role's communication and translating skills (Wilhem and Dolfsma, 2018; Hung, 2017) and their skills to discover, identify, absorb, and transform external knowledge (Cohen and Levinthal, 1990), but this thesis showed empirically, that gatekeepers could also act as boundary spanners between organisations for the benefit of the collaborating organisation.

The fourth conclusion is methodological. An **interdisciplinary approach** was used, combining semiotics, social psychology and organisation theory to study an open innovation interaction – the collaboration between university and industry. This approach proved operational in uncovering the tacit mechanisms affecting U-I collaboration.

3.3 Practical implications

For the collaborating partners – academic researchers and company managers – the realisation that there needs to be symmetry provides a tool to analyse oneself and their potential partners in terms of these critical preconditions before and during joint ventures.

A better understanding of the needs of low-capacity companies offers a far better basis for policymakers to design respective support measures to realise their innovation potential. However, these policy tools must go hand in hand with respective incentives in academic institutions as they have the autonomy to decide how to incentivise their employees to collaborate with external commercial partners more. Academic researchers pro-socially motivated to collaborate with companies that might lack either of the critical preconditions are potentially well-equipped to provide a compensating mechanism. However, academic researchers have a very heterogeneous role-set and sometimes conflicting expectations towards them. Therefore, they need incentives and possibilities to meet the needs of U-I interaction. Universities, as organisations that aim to strengthen ties with industry, should design organisational culture and organisation-specific incentives for their employees to foster such prosocial motivation towards business practitioners.

In designing new or complementing existing policy measures, policymakers could test new out-of-the-box interventions, for instance:

- a recommendation system for proven pro-socially motivated academic researchers ready to take on new collaboration projects. However, this also has to reflect in the organisation-specific career system;
- quick self-diagnostic tools for academic researchers and business practitioners to test their compatibility and symmetry of critical preconditions;
- requesting that basic research grant applicants provide letters of interest from one or more companies declaring their theoretical interest in the research topic. This does not mean that an applicable outcome is expected after the grant project, but the area under research should be of interest to the private sector in the near future. In other words, the basic research grant project should have the potential to feed into prospective technology trends.

Changes in the basic funding formula to consider more U-I collaboration projects should be flexible to avoid affecting these research groups excelling in basic, blue-sky science. Again, this should be up to the academic institution to find the right balance between fostering basic and applied research.

Understanding the gatekeeper role as a bridging mechanism between collaborating companies and academic researchers offers another powerful tool for policymakers to design better-targeted support measures. For instance, every policy measure that aims to foster technology of knowledge transfer from academia to industry should accommodate the aim of supporting pro-socially motivated researchers to further use their “gatekeeper” skills.

A methodological contribution is provided for U-I collaboration researchers. The above-described interdisciplinary approach to studying U-I interaction added value to U-I literature. Therefore, U-I collaboration researchers can be encouraged to apply interdisciplinary approaches to add new value to the U-I collaboration literature.

3.4 Limitations and avenues for future research

The thesis and the studies have limitations and need further research. All the studies focus on the initiation and implementation phases, the finalisation phase is not included. Study I included interviews from both partners (researchers and business practitioners), Study II was based on a survey among the business practitioners, and Study III analysed academic researcher interviews.

Further research could again study both partners as in Study I. Studies II and III individually have limitations concerning self-reporting. Namely, the empirical research in Study II is based on self-reporting from companies. As in Study III, a comparable survey could be conducted among academic researchers and comparable interviews among business practitioners.

The main contributions to U-I collaboration literature provide a rich basis for further research. Symmetry as the main key concept can be applied to different collaboration determining factors, such as organisational boundaries and boundary-spanning mechanisms. Role theory also offers various avenues for future research; for instance, the business practitioner’s role-set has not been explored in this thesis, and perhaps the symmetry concept can also be applied to analysing partners’ roles.

The studies do not come without limitations, mainly self-reported data gathered from the interviews and survey. In addition, the success or failure of U-I collaboration in this thesis was perceived by the collaborating partners subjectively, not objectively measured. Future studies could overcome these limitations by using multiple data sources and including meso- and macro-perspectives to micro-perspectives.

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SUMMARY IN ESTONIAN

Ülikoolide ja ettevõtete koostöö: interaktsiooni struktuur ja eeltingimused

Motivatsioon ja töö uudsus

„We, europeans are excellent in making science with money. But we are not so good at making money out of science,“ on öelnud Euroopa Komisjoni president Ursula von der Leyen.

Oskamatust genereerida kõrgetasemelisest teadusest sisendeid innovatsiooni ja majanduskasvu on juba 1990. aastatel nimetatud Euroopa paradoksiks. See probleem ei kimbuta ainult Euroopat – kõik innovatsiooni väärtustavad riigid seisavad silmitsi väljakutsetega siirata teaduslikku ja tehnoloogilist teadmist kommertsialiseeritavateks toodeteks ja teenusteks. Seetõttu on ülikoolide ja ettevõtete koostöö mitme kümnendi jooksul pakkunud innovatsiooniteadlastele rikkalikku uurimisainest.

Minu doktorantuuri tee on olnud pikk ja väljakutsete rohke, aga intellektuaalselt rahuldust pakkuv, kuna mind on alati huvitanud uudsed võimalused innovatsiooni toetamiseks. Samaaegselt doktoriõpingutega olen töötanud täiskohaga Majandus- ja Kommunikatsiooniministeeriumis, disainides innovatsioonipoliitikat. Seega on doktorantuur ning igapäevatöö üksteist pidevalt täiendanud.

Käesolev töö annab oma panuse ülikoolide ja ettevõtete koostööalasesse teaduskirjandusse, avades seniste uuringutega võrreldes enam mehhanismi, mis kirjeldab potentsiaalselt eduka koostöö eeldusi ning pakkudes välja uue empiirilisel testitud kontseptuaalse mudeli teadlaste ja ettevõtjate vahelise interaktsiooni uurimiseks.

Praktikud ja poliitikakujundajad on pikka aega pidanud ülikoolide ja ettevõtete koostööd potentsiaalselt tõhusaks majanduskasvu veduriks ja innovatsiooni allikaks. Teadmiste ja tehnoloogia ülekanne akadeemilistest ringkondadest ettevõtlusesse ning heterogeensete teadmiste kombineerimine võib ergutada innovatsiooni, mis definitsiooni järgi tähendab uute toodete, teenuste, protsesside jms juurutamist (OECD/Eurostat, 2018). Rõhk on sõnal „juurutatud“, mis viitab, et uut teadmist või tehnoloogiat saab innovatsiooniks pidada alles siis, kui see on kindlustanud oma niši turul ja klientide seas. Nende eesmärkide saavutamiseks on vaja mõista, kuidas ülikoolide ja ettevõtete koostöö toimib, millised on selle kriitilised eeldused ja aluseks olevad mehhanismid.

Ülikoolide ja ettevõtete koostööalasest teaduskirjandusest leiab palju uurimusi, mis on keskendunud koostöö mõjuteguritele, näiteks soodustajatele ja võimaldajatele (nt Galan-Muros ja Plewa, 2016; Bellini *et al.*, 2019; O'Dwyer, *et al.*, 2022), tõketele (nt Jara-Olmedo, *et al.*, 2020; Bjursell ja Engström, 2017;

McCabe *et al.*, 2021), vahendajatele (nt Alexandre *et al.*, 2021; Albats, *et al.*, 2022) jne. Sellegipoolest on enamik uuringutulemusi pakkunud üheplaanilisi selgitusi koostöö erisustele, piirdudes üldiste nendingutega, mis lähtuvad asjaolust, et partnerid on pärit väga erinevatest valdkondadest. Ülikoolide ja ettevõtete koostöökirjanduses napib ka konkreetset mikrotasandi analüüsi (Steinmo ja Rasmussen, 2016; Villani *et al.*, 2017; Cunningham ja Menter, 2020; Roncancio-Marin *et al.*, 2022).

Töö põhineb kolmel uuringul, mis on omavahel sünergiliselt seotud, iga järgneva uuringu lähtekoht kasvas välja eelmise tulemustest. Uuringu objekt on koostööd tegevate ülikooli teadlaste ja ettevõtjate vaheline interaktsioon. Selle analüüsimiseks laenati interaktsioonimudel tunnustatud semiootik Jüri Lotmanilt (2009) ning täiendati seda koostöö jaoks oluliste eeldustega: motivatsiooni ning innovatsiooni absorbeerimisvõimekuse (*absorptive capacity* – ingl k) kontseptsioonidega. Metodoloogiliselt on töös valitus uurimuslik (*exploratory* – ingl k) lähenemisviis, mis võimaldab esitada olemasolevale teooriale väljakutseid ning pakkuda uurimusobjektidele uusi vaatenurki.

Lisaks on töös integreeritud erinevaid teooriaid: sotsiaalpsühholoogiat ja organisatsiooniteooriat. Tunnustatud innovatsioonipoliitika, organisatsiooniuuringute ja ettevõtluse uurija Bart Nooteboom on öelnud, et kuigi majandusteadlased on psühholoogiat kasutanud väga ettevaatlikult, peavad nad paratamatult seda rohkem kasutama, „et vältida jätkuvat pimedust motivatsiooni ja käitumise tegelikuse suhtes“ ja kuna „innovatsioon hõlmab õppimist ja õppimine on psühholoogiline ja sotsiaalne“ (Nooteboom, 2009:ix).

Uuringu tulemusel kerkis esile töö keskne mõiste – **(a)sümmeetria**. Eelduslikult sujuva koostöö huvides on tarvis, et partnerite sisemine motiveeritus ja absorbeerimisvõimekus oleksid võrreldaval tasemel ehk sümmeetrilised, mis loob tugeva aluse potentsiaalselt sujuvaks koostööks.

Uurimiseesmärk ja -disain

Kuna töö eesmärk on pakkuda uudseid vaatenurki ülikoolide ja ettevõtete koostöö uurimusse, valiti selleks uurimuslik lähenemisviis, mis võimaldab pakkuda lisandväärtust olemasolevale teooriale. Uurimuslik lähenemisviis ei eelda väga konkreetsete uurimisküsimuste püstitamist, vaid kesksel kohal on empiirilise andmestiku ja teooria triangulatsioon.

Uurimisküsimus 1: Millised ülikoolide ja ettevõtete interaktsiooni varjatud mehhanismid mõjutavad koostöö võimalikku efektiivsust?



Uurimisküsimus 2: Millised kompensatsioonimehhanismid võimaldavad madala võimalusega ettevõtetel osaleda ülikoolide-ettevõtete koostöös?

Iteratiivse uurimustöö ülesehitus:

1. Ülikoolide ja ettevõtete koostööalase kirjanduse ülevaade
 - a. Semiootilise interaktsioonimudeli analüüs, koostöö kriitiliste eeltingimuste määramine
 - b. Ülikooli teadlaste koostöösse hõlmamise struktuuri ja suuna uurimine
2. Empiiriline uurimus
 - a. Valimi loomine, andmete kogumine ja analüüs
 - b. Teooria ja empiirilise andmestiku triangulatsioon
3. Võtmemõistete esile kerkimine, ülikoolide ja ettevõtete alasesse teaduskirjandusse panustamine.

Uurimuse objekt on koostöö ülikooli teadlaste ja ettevõtjate vahel, kasutatud on nii kvalitatiivseid kui ka kvantitatiivseid uuringu andmeid ja analüüsiviise. Töös on kasutatud nn mikroperspektiivi, mis võimaldab uurida koostööd nii individuaalsel kui ka grupi tasandil. Suurem osa ülikoolide ja ettevõtete alastest uuringutest on keskendunud makro-tasandile, mikroperspektiiv on võrdlemisi uus lähenemisviis (Albats, *et al.*, 2018; Adegbile *et al.*, 2021; Roncancio-Marin, *et al.*, 2022).

Uuringute kokkuvõtted:

Uuring 1 raames arendati välja ja testiti empiiriliselt uudset kontseptuaalset lähenemist ülikoolide ja ettevõtete koostöö uurimiseks. Selleks kombineeriti ülikoolide ja ettevõtete koostööspetsiifiline teaduskirjandus semiootikast laenatud interaktsioonimudeliga ja organisatsiooniteooriast pärit eri organisatsioonide vaheliste piiride ületuse ideedega. Interaktsioonimudeli alusel kerkib analüüsi tulemusel esile kolm eri koostöö tüüpi, mille keskmes on absorbeerimisvõimekuse ja motivatsioonitasemete sümmeetria partnerite vahel.

Uuring 2 keskendub madala innovatsiooni absorbeerimisvõimekusega väikese- ja keskmise suurusega ettevõtetele ja uurib nende koostöökogemusi ülikooli teadlastega. Uuringu eesmärk on selgitada, kuidas nimetatud ettevõtted, kel napib üht kriitilist koostöö eeltingimust, suudavad siiski teadlastega koostööd teha. Uuringu tulemusel selgub, et ettevõtjad eeldavad koostöös suuremat motivatsiooni ülikooli teadlastelt kui iseendilt.

Uuring 3. Põhinedes 2. uuringu tulemustel, kus selgus, et teadlaste kõrgem motivatsioon kompenseerib ettevõtjate hinnangul nende endi nappi innovatsiooni absorbeerimisvõimekust, keskendub uuring 3 ülikoolide teadlastele. Uuringus kasutatakse rolliteooriat ja teistele (vastupidisele enesekeskusele) keskenduvat psühholoogilist protsessi, prosotsiaalset motivatsiooni. Teadlased, kes lähtuvad koostööpartneri vajadustest ning kasutavad väravavahi rolli, suudavad pakkuda madala innovatsiooni absorbeerimisvõimekusega ettevõtete koostöösse hõlmamisele kompensatsioonimehhanismi.

Töö tulemuste kokkuvõte

Uue dimensiooni ülikoolide ja ettevõtete koostöö uurimisse lisab käesolevast tööst tõusetunud mõiste „(a)sümmeetria“, mis ei ole ülikoolide ja ettevõtete koostööle keskenduvast teaduskirjanduses laialdaselt kasutust leidnud. See mõiste võimaldab analüüsida koostöö mustreid, mis vastasel juhul ei pruugi empiirilisest uuringust esile kerkida. Käesoleva töö fookuses on koostööd tegevad teadlased ja ettevõtjad ning uuringu objekt on nende vaheline interaktsioon. Kui koostööpartnerid on väga erinevatest valdkondadest ning harjunud eri rutiinidega, saab järeldada, et võrreldaval tasemel motivatsiooni ja absorbeerimisvõimekusega on neil võimalik teha edukat koostööd. Ebasümmeetriliste eeldustega koostöösuhte korral on teadlasel võimalik vastava motivatsiooni olemasolul pakkuda lahenduseks väravavahi rolli, mis tähendab ise teadmiste siirde ülesannete täitmist kahe organisatsiooni vahel.

Panus teooriasse:

1. Esmalt saab käesoleva dissertatsiooni tulemustest järeldada, et ülikoolide ja ettevõtete koostöö võimalik edukus või ebaedukus sõltub koostööpartnerite motivatsiooni ja absorbeerimisvõimekuse sümmeetrilistest tasemetest. Ideaalsel juhul on see tase mõõdukas, mitte liiga madal ega ka liiga kõrge, sest viimasel juhul võib tekkida paradoksaalne olukord, kus partnerilt ei pruugi olla enam midagi õppida ning seega ei sünni või sünnib vähe innovatsiooni. (A)sümmeetria mõiste võimaldab koostöömustrite esile kerkimist ja selle pinnalt koostöö kohta sügavama detailsusastmega järelduste tegemist.
2. Praktikas esineb palju juhtumeid, kus koostööpartnerite suhe ei baseeru võrreldaval tasemel kriitilistel eeltingimustel. Kui ettevõtjal napib innovatsiooni absorbeerimisvõimekust, siis ülikooli teadlase kasutuses on vahendid selle kompenseerimiseks ja koostööga siiski jätkamiseks. Teadlane peaks olema esmajärjekorras motiveeritud lähtuma partneri (mitte enda) vajadustest, sellisel juhul on koostöö algsele ebasümmeetrilisele vaatamata tugevamatel alustel.
3. Väravahi rolli on senine teaduskirjandus käsitlenud peamiselt ühe organisatsiooni siseselt, kuid käesolev töö näitab, kuidas ettevõtjaga koostööd tegeva teadlase võimuses on astuda väravavahi rolli ettevõtja huvides. Nimelt on väravavahil oluline kommunikatsiooni ja teadmiste edasikandja funktsioon ehk just see, millest madala võimekusega ettevõtetel vajaka jääb.
4. Interdistsiplinaarne lähenemine ülikooli ja ettevõtluse vahelise koostöö uurimiseks võimaldas jõuda eelpool nimetatud järeldusteni.

Poliitikasoovitused:

1. Ülikooli teadlase prosotsiaalset motiveeritust tasub ülikoolidel kui tööandjatel oma töötajate töötulemuste hindamisel arvesse võtta, et sedalaadi käitumist veelgi soodustada. Poliitikakujundajatele pakuvad uuringutulemused erinevaid võimalusi täiesti uuteks poliitikainstrumentideks:

2. Soovitussüsteemi alusel koostada nimekiri prosotsiaalselt motiveeritud teadlastest, kes on valmis uuteks koostööprojektideks. Soovitussüsteem peab olema kooskõlas ülikooli kui organisatsiooni sisemise karjäärimudeliga.
3. Luua kiired enesediagnostika tööriistad teadlastele ja ettevõtjatele, et testida kriitiliste eeltingimuste omavahelist kooskõla.
4. Luua baasteaduse rahastusgrantide taotluste juurde võimalus lisada ettevõtte huvi väljendav toetuskiri või märkida muul moel ettevõtluse huvi baasteadusliku projekti toetuseks.

Peamised piirangud ja soovitused edasisteks uuringuteks

Käesolev töö keskendus koostöö initsieerimise ja rakendamise faasidele, välja jäi koostöö lõpetamise faas, seega kõik järeldused võimaliku eduka koostöö kohta on vaid hinnangulised, lähtudes ettevõtjate ja teadlaste tajutud ootustest koostöö tulemi suhtes.

Uuringu andmestik põhineb muu hulgas intervjuudel ja küsitlusel, mis on nn enesekohased informatsiooniallikad, sisaldades endas seega erapoolikust.

Uuringu peamised tulemused pakuvad rikkalikku materjali edasisteks uuringuteks. Sümmeetriat kui võtmemõistet ülikoolide ja ettevõtete koostööuuringutes on võimalik laiendada organisatsioonide vaheliste piiride ületuste analüüsimisele; rolliteooria sisaldab veel mitmeid võimalusi sümmeetria kasutamiseks koostöö uurimisel.

Uuring 1 hõlmas intervjuusid nii ettevõtjate kui ka teadlastega. Uuringud 2 ja 3 seevastu keskendusid kumbki ühele koostööpartnerile. Järgnevates uuringutes oleks paslik keskenduda taas mõlemale koostööpartnerile korraga.

CURRICULUM VITAE

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Education

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2021–... Member of the Board, Tartu Science Park
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2017–... Member of the Board, Tallinn Science Park Tehnopol
2013–2021 Chief Specialist, Strategic Advisor, Ministry of Economic
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2008–2013 Editor-in-chief, University of Tartu Magazine Universitas
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Awards

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