Ekaterina Albats

FACILITATING UNIVERSITY-INDUSTRY COLLABORATION WITH A MULTI-LEVEL STAKEHOLDER PERSPECTIVE
Ekaterina Albats

Facilitating university-industry collaboration with a multi-level stakeholder perspective

Thesis for the degree of Doctor of Science (Technology)

to be presented with due permission for public examination and criticism in the Auditorium of the Student Union House at Lappeenranta University of Technology, Lappeenranta, Finland on the 26th of May, 2018, at noon.
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ISBN 978-952-335-234-6 (PDF)
ISSN-L 1456-4491
ISSN 1456-4491

Lappeenrannan teknillinen yliopisto
LUT Yliopistopaino 2018
Abstract

Ekaterina Albats
Facilitating university-industry collaboration with a multi-level stakeholder perspective
Lappeenranta 2018
146 pages
Acta Universitatis Lappeenrantaensis 798
Diss. Lappeenranta University of Technology

University–industry collaboration has been acknowledged as a vital source of innovation. However, despite its rather long history, a number of barriers to such collaboration remain, and the ways to overcome them have remained unknown. The research field particularly calls for a thorough exploration of the ways to connect the key stakeholders of the Triple Helix (university, industry, government), including the involvement of a fourth stakeholder, the collaboration' intermediary. The university–industry collaboration is a complex collective action, which reflects in the heterogeneous nature of its key stakeholders' goals, knowledge bases, perceptions, culture, and power. Furthermore, this collective action happens across different levels of analysis: from the intra-organisational, through the organisational towards the inter-organisational level and the ‘impact agenda’ calls it to have an influence on the society level. Given the complexity of stakeholders collective actions, the research field has been lacking cross-level links between the related theoretical streams. This doctoral dissertation assists in finding ways to facilitate university–industry collaboration by studying each of the focal stakeholders’ perspectives at the various levels of analysis and contributes to the development of a multi-level stakeholder-based lens. Aiming at a multi-level approach to the diverse stakeholders, the dissertation studies distinct literature streams, which include the stakeholder theory; the entrepreneurial university concept; the knowledge-based and relational views of the firm; the open innovation concept and human capital; innovation intermediation; and the Triple, Quadruple and Quintuple Helixes. Combining a systematic literature review with a survey and multiple case study, this dissertation proposes multiple ways to facilitate university–industry collaboration for each stakeholder across levels of analysis and develops a holistic, multi-level, multi-stakeholder framework, which bridges multiple theoretical streams. In addition to developing the research field, this dissertation provides implications on facilitating university–industry collaboration for university employees, industry representatives and policy makers.

Keywords: university–industry collaboration, stakeholder, multi-level, Triple Helix, innovation, open innovation, human capital, knowledge transfer, intermediary
Acknowledgements

Wow! If I look back, it indeed has been a long journey – not in terms of the number of years, but rather in terms of learning, self-development and research discoveries. None of that would be possible without all the tremendous support and encouragement that I received from so many people, who were around along this journey. That is another big ‘wow’ and I would like to thank each and every one who helped this journey to happen.

First of all, I am grateful to my supervisors, Marko Torkkeli and Juha Väätänen. Marko has always encouraged me to work hard and smart and “keep pushing”. Marko’s professional network has always been opened to me and it has been of a great value for this dissertation and for my entire career. Juha has always been a supportive, wise mentor to me, and I am endlessly grateful for his guidance and for the invaluable lessons he taught me, generously sharing his professional insights and experience with me.

For the completion of the dissertation, it is very difficult to overstate the importance of a thorough review. It is a great honor for me to receive very critical and demanding feedback from you, Marko Seppänen and Wim Vanhaverbeke. This dissertation has got to its final shape thanks to the great amount of work you have done reviewing it and sharing your professional expertise. I would also like to thank Allen Alexander, Irina Fiegenbaum, Daria Podmetina and Anya Nowozhilowa for their help in polishing the dissertation.

Immediate colleagues, co-authors and very good friends (yes, all in one and I am the lucky one to be surrounded by them), thank you! Daria Podmetina, thank you so much for being my academic mom, mentor and friend and being available – no matter the time or the place, or what topic we needed to discuss. Roman Teplov, thank you for your support, research methods trainings and inspiring talks! Irina Fiegenbaum (yes, for me you are a part of the team, no matter where you are based), you have always been a role model, tough and still a very cool supervisor as well as a very reliable friend, thank you! Antero Kütvonen, my interest in the topic started all thanks to the discussion you and I had, thank you! Justyna Dabrowska, thank you so much for your careful guidance, your experience shared and your support, I have learned a lot from you! I am also grateful to the other members of the LUT research family, who have been tremendously helpful – Joona Keränen, Kirsimirja Blomqvist, Paavo Ritala, Sanna-Katriina Asikainen, Argyro Almpanopoulou, Henna Järvi, Arash Hajikhani, Samira Ranaei, Igor Laine, Nina Tura, Maria Uzhegova and others. Experts in rather distinct research fields – Mariia Kozlova, Maria Palacin Silva, Iuliia Shnai, Leonid Chechurin, Jari Porras – thanks to you my professional experience got even richer. I would also like to thank our new team members – Jaan-Pauli Kimpimäki and Iryna Maliatsina – you have made the month leading up to my defense that much easier.

I definitely would not be where I am without the help of my co-authors and friends from outside of LUT. Allen Alexander, Marcel Bogers, James Cunningham, Irina Fiegenbaum, Kristel Miller, Maral Mahdad, Ger Post – working with you is a great honor for me and I have learned a lot throughout these few years thanks to our joint research efforts. I would
also like to thank the entire team of the OI-Net project (www.oi-net.eu)! It has been the biggest project I have ever been coordinating, but thanks to the immediate team (Daria, Marko and Roman – all coordinated by Justyna) we made it! It is truly hard to pick just a few names out of the list of 52 partners from 35 countries. Of this network, I would still like to specially thank Anne-Laure Mention, Simona Lache, Yvonne Kirkels, Arie Nagel, Bruno Woeran, Christophe Terrasse, Anna Trifilova, Marcin Baron, Henry Lopez Vega, Monique Landy, Monika Petraite, Sandra Dingli and Yves Boisselier. Thanks also to Agnieszka Radziwon for sharing expertise – hope to meet you in person one day! Networking would have never been so productive and fun without all the hard work of the ISPIM team, its network and the ISPIM band. My special thanks to John Bessant for the inspirational and supportive talks throughout the ISPIM events. UIIN network and its management team have always made me feel welcome and a part of their family.

I am grateful for the financial support received from the Finnish Foundation for Economic Education and LUT Tukisäätiö.

I would like to address my deep thanks to the administrative and support team of LUT. Pirkko Kangasmäki, Eva Kekki, Terttu Hynynen, Sanna Tomperi, Petri Hautaniemi – your help with administrative issues was essential in allowing me to focus on research. My special thanks to the LUT Doctoral School masters – Saara Merritt and Sari Damsten. LUT helpdesk team – Ilmari Laakkonen, Mikko Kuusio – you are truly problem solvers and I am grateful for your patience! Riitta Salminen, my entire LUT journey started with meeting you and Juha back in 2011, so, I would not be where I am without your hard work and kind support!

Friends… you are all around the world, but I know that no distance, no time difference matters as you are always ready to support me, make me smile, laugh and cry, dance and re-charge, feel happy, love and be loved. I just list a few names here: Lera, Marias, Elenas, Tatiana and family, Kirill, Ruslan, Slava, Polina, Liana, Ludmila, Alexander, Mikhail and family, Nikita, Pavel, Sergey, Evgenia, Olgas, Javier. Dancing friends and coaches (old and new), thanks for challenging myself, for inspiration, for hard work, support, trust and fun! Anya, you are just the one.

My family… parents and brother, your support has always been something exceptional; you have always made me feel special. Greater gang: Inga, Katjas, Annas, Olga, Leon, Vladik, Dasha, Sasha, Hanna, Mila, Pavel, Nadya, Valentina, Maria and Irina – thanks for being a family, for your love and for believing in me.

My deepest gratitude and appreciation goes to my beloved husband, Alexander.

Ekaterina Albats
2018, Lappeenranta, Finland
Not knowing something is exciting – you still have a chance to learn it and enjoy this new learning!

This work is dedicated to my family.
Contents

Abstract

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<tbody>
<tr>
<td>HEI</td>
<td>Higher Educational Institution</td>
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<tr>
<td>IP</td>
<td>Intellectual Property</td>
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<tr>
<td>IPR</td>
<td>Intellectual Property Rights</td>
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<td>ISO</td>
<td>International Organization for Standardisation</td>
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<tr>
<td>KBV</td>
<td>Knowledge-based view</td>
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<tr>
<td>KPI</td>
<td>Key Performance Indicator</td>
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<tr>
<td>KTI</td>
<td>Knowledge Transfer Intermediary</td>
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<tr>
<td>MIT</td>
<td>Massachusetts Institute of Technology</td>
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<td>OI</td>
<td>Open Innovation</td>
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<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
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<tr>
<td>RBV</td>
<td>Resource-based view</td>
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<td>RQ</td>
<td>Research question</td>
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<td>RSQ</td>
<td>Research sub-question</td>
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<tr>
<td>RTO</td>
<td>Research and Technology Organisation</td>
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<td>SME</td>
<td>Small and Medium-sized Enterprise</td>
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<td>TCT</td>
<td>Transaction Cost Theory</td>
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<td>TTO</td>
<td>Technology Transfer Office</td>
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<td>UIC</td>
<td>University–industry collaboration</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom</td>
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<td>US</td>
<td>United States</td>
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List of publications and author’s contribution

This thesis is based on five publications. The list of publications and the author’s contribution to each is described in detail below. The rights have been granted by the publishers to include the papers in the dissertation.

PUBLICATION I


All the authors have contributed to this publication equally. The publication idea as well as its research strategy (systematic literature review methodology, a pro-forma for analysis, selection of the research themes) have been developed by all the co-authors jointly during a series of dedicated interactive brainstorming sessions. The further work (collecting and analysing the papers, writing the actual manuscript) has been split evenly between the co-authors according to each author’s own expertise and in correspondence with the selected research themes. The author of this dissertation has been contributing to this publication equally with the other authors from its conception, including the development of the initial idea and the methodology through the entire research process of data collection and analysis as well as writing and revising the publication. Dr Miller has volunteered to handle the submission process and was appointed as a corresponding author. The other authors were listed without further consideration simply in the chronological order of joining the research team at the very inception of this publication. The research team was formed before the brainstorming sessions for the publication and hence each author had an opportunity to contribute equally throughout the whole process of research, analysis, editing and publication.

PUBLICATION II


The author of this dissertation was responsible for the research idea and research design of this publication. The author was also responsible for the literature review, data collection and analysis and writing and revising the paper as well as was presenting the publication at the conference. The dissertation’s author is the corresponding author of this publication.
PUBLICATION III


The authors have contributed to this publication equally. The author of this dissertation has contributed to the initial idea development and conceptualisation of this publication, reviewing the literature, developing and validating the data collection instrument, collecting and analysing the data and writing and reviewing the actual manuscript.

PUBLICATION IV


The author of this dissertation was responsible for the research idea and research design of this publication. The author was also responsible for the literature review, data collection and analysis and writing and revising the paper as well as presenting the publication at the conference. The dissertation’ author is the corresponding author of this publication.

PUBLICATION V


The author of this dissertation was responsible for the research idea and research design of this publication. The author was also responsible for the literature review, data collection and analysis and writing and revising the publication. The dissertation’s author is the corresponding author of this publication.
Part I: OVERVIEW OF THE THESIS
1 Introduction

This chapter introduces the topic of this dissertation, its research goals and research questions and outlines the key concepts used in this work.

1.1 Research background

Throughout the emergence of the knowledge-based economy, interest in university–industry knowledge transfer providing one of the core contributions to innovation and economic development has been growing steadily (Lee, 1996; Saad and Zawdie, 2011). Drawing upon Waddock’s (1991, p. 481) definition of ‘social partnership’, Ha and Kwon (2016, p. 2) outline university–industry collaboration (UIC) as ‘a method of social cooperation, or a voluntary effort made by industrial entities and educational and research institutions to solve problems or issues of common interest cooperatively’. UIC may take very diverse forms (Perkmann and Walsh, 2007; Alexander and Martin, 2013) in such domains as education (e.g. joint curriculum design and delivery), research (e.g. collaborative R&D) and valorisation (e.g. cooperation for commercialising university research results) (Galán-Muros and Plewa, 2016). This dissertation approaches UIC in the broad sense of voluntary cooperation between industrial/business entities and universities for the common good and with a strong emphasis on innovation as an immediate or long-term outcome of that cooperation.

UIC as a phenomenon has a rather long history. Among the first documented cases, MIT’s Research Laboratory of Applied Chemistry entered into a paid research contract as early as 1927 (Kenney, 1987). Despite this rather long history, a number of problems in UIC remain unsolved. The research field particularly calls for exploring ways to facilitate UIC and connect actors with often conflicting goals, such as profit for companies and scientific discoveries for universities (Parker, 1992; Siegel et al., 2003; Galán-Muros and Plewa, 2016). Any attempt to bridge gaps between the diverse types of stakeholders for the purpose of their successful collaborative innovation requires diving into the context of the environment and analysing the attributes of each of the stakeholders (goals, knowledge bases, capabilities and competences, perceptions, culture, power and position) – across different levels of analysis (Corsaro, Cantù and Tunisini, 2012; Gattringer et al., 2014; Bogers et al., 2017). This dissertation aims to shed light on ways to facilitate UIC through exploring the aforementioned attributes of heterogeneous types of UIC stakeholders across multiple levels of analysis.

1.2 Research gap

This subchapter outlines the research gap addressed by this dissertation along the perspectives of the key stakeholders in UIC, namely the three core actors of the Triple Helix (university, industry, government) (Etzkowitz and Leydesdorff, 2000) and innovation intermediaries, which technically represent one of the Triple Helix actors (Howells, 2006; Wright et al., 2008).
Studying university–industry collaboration is largely (but not solely) devoted to developing the ways of global economic and innovation growth achieved through such collaboration (Perkmann and Walsh, 2007; Galán-Muros and Plewa, 2016). It may also be purely education-focused (Galán-Muros and Plewa, 2016) or devoted to solving big social problems (Waddock, 1991), which may also not be mutually exclusive with the innovation growth goal. Both the university–industry collaboration and collaborative innovation as phenomena and as constructs are complex in nature as they require the involvement of multiple stakeholders. This, in practical terms, makes them collective actions – a ‘series of ongoings between collective parts (e.g. individuals)… which enable collective phenomena to emerge’ (Morgeson & Hofmann 1999, p. 252), which are labelled by scholars as collective constructs (Morgeson and Hofmann, 1999; Gupta, Tesluk and Taylor, 2007).

One of the greatest scientific problems in studying such collective actions is the need to approach them from multiple levels of analysis – intra-organisational, organisational, inter-organisational, extra-organisational and industrial/regional/social (Bogers et al., 2017) – while the current research landscape lacks a holistic, multi-level theoretical lens and the cross-level linkages between the theories (Gupta, Tesluk and Taylor, 2007; Bogers et al., 2017). When applying a stakeholder approach towards university–industry collaboration, the complexity is reflected by the multiple combinations of cross-level collaborations occurring between multiple stakeholders. Furthermore, when introducing the government as the third actor of the Triple Helix concept (Etzkowitz and Leydesdorff, 2000), the policy level needs to be added when aiming to construct a multi-level stakeholder lens for studying UIC (Munari, Roberts and Sobrero, 2002).

The great variety of the existing scientific works that study UIC allows a certain level of understanding of each of the key stakeholders in isolation (either university, industry or government) and at a particular analysis level – from the individual (intra-organisational) to policy levels (Perkmann et al., 2013). However, from the variety of combinations of stakeholders and levels of their collective actions, a number of gaps in the research still exists in relation to each of the stakeholders individually and at the various levels of analysis, hence confirming the multi-level nature of the UIC phenomenon (Perkmann et al., 2013). Furthermore, the research field of UIC, similar to general organisational studies or the innovation research landscape, requires developing the cross-level linkages between the theories currently framing our understanding of each of the UIC stakeholders at each of the analysis levels (Gupta, Tesluk and Taylor, 2007; Perkmann et al., 2013; Bogers et al., 2017). The following discussion outlines the five gaps in research related to each of the UIC stakeholders at the various levels of analysis and leads to scoping the focal research gap addressed by this dissertation – a lack of a multi-level stakeholder-based theoretical lens to assist in finding ways to facilitate university–industry collaboration.

First, if taking university as a stand-alone stakeholder in UIC context, a large body of the existing scientific evidence shapes our understanding of the university perspective towards UIC on the policy and organisational levels (Perkmann et al., 2013). This is due
to the presence of such policy measures as the Bayh–Dole Act in the US, the follow-up initiatives of university ownership rights for publicly funded research in Europe (Ejermo and Toivanen, 2018) and ‘professor’s privilege’ in Sweden and Italy (Färnstrand Damsgaard and Thursby, 2013; Lissoni et al., 2013). The increasingly pervasive philosophy of the ‘entrepreneurial university’ (Mowery and Sampat, 2004; Martinelli, Meyer and Tunzelmann, 2007; Perkmann et al., 2013) adds a concept to the organisational-level research on university–industry collaboration. However, debates on the policy measures towards university entrepreneurship remain. For instance, Ejermo and Toivanen (2018) highlight that the US Bayh–Dole Act ‘involved a decentralization of ownership [from governmental to university ownership], whereas later European reforms implied centralization [from the individual researcher ownership/professor’s privilege to university level]’ and outline how particularly in Finland the reform caused a negative impact on patenting – ‘opposite of what had originally motivated it’. Similarly, the literature suggests that the bottom-up perspective towards studying university as a stakeholder in the UIC context is less commonly applied and thus less understood (Perkmann et al., 2013; Nyeko and Sing, 2015). This is why, at the intra-organisational (individual) level, one of the key stakeholders in UIC – the university academic (particularly, their personality, motives and challenges and the principal differences between entrepreneurial academics and academic entrepreneurs) – remains unexplored (Nyeko and Sing, 2015; Miller et al., 2016) and needs to be studied to assist in building cross-level theoretical linkages (Perkmann et al., 2013). This outlines the research gap around university as a stakeholder in UIC on its intra-organisational (individual) level. Given the great diversity and context dependency of university-level organisational policies (Friedman and Silberman, 2003; McNie, Parris and Sarewitz, 2016) and, consequently, industry engagement practices (Perkmann and Walsh, 2007), the bottom-up, intra-organisational approach to the university perspective in UIC is called to link the phenomenon with its micro-foundations (Crossan and Apaydin, 2010).

Second, when studying UIC for innovation from a company perspective, one of the theoretical approaches commonly applied by scholars is open innovation (introduced by Henry Chesbrough in 2003). The open innovation concept or paradigm explains the organisation’s usage of inflows and outflows of knowledge for value creation and in the UIC context invites an analysis of the company-university relationships from the perspective of external knowledge sources (Perkmann and Walsh, 2007), knowledge exploitation (Bozeman and Boardman, 2014) and the commercialisation of the university’s R&D (D’Este and Patel, 2007; Perkmann et al., 2013). Despite the significant and multi-dimensional developments of innovation research on the organisational level (Crossan and Apaydin, 2010), the open innovation literature still ‘neglects the human side’ (Gassmann et al. 2010, p. 6; Hosseini et al. 2017). As for the UIC literature, analysis of the organisational intellectual capital required for company-university innovation so far mainly focuses on company social capital (Thune, 2007), leaving the required human capital components unexplored (Bjerregaard, 2010). This outlines the research gap around company as a UIC stakeholder on the organisational level.

Third, despite the constantly growing popularity of the ‘open innovation’ concept in
Introduction

studying knowledge exchange and related value capture strategies (Gassmann, Enkel and Chesbrough, 2010; Bogers et al., 2017), a certain conceptual ambiguity around it exists, which may become particularly notable when scholars attempt to apply it to the UIC context on the inter-organisational level (Vrande and Man, 2011). That becomes problematic due to the gap between organisational-level perceptions towards ‘open innovation’ as a practice and as a concept within and between communities of academics and practitioners (Dabrowska, Fiegenbaum and Kutvonen, 2013), which in turn hinders further theory development (Trott and Hartmann, 2009; Vrande and Man, 2011). This forms the research gap around both of the key UIC stakeholders (universities and companies) on the organisational level.

Fourth, one of the known ways to facilitate UIC is to involve intermediaries in the process (Howells, 2006), which from the organisational structure perspective represent one of the Triple Helix actors (Howells, 2006; Wright et al., 2008). The phenomenon of online marketplaces as intermediaries in the knowledge transfer process also continues to emerge in the UIC arena; however, we still know very little about this phenomenon generally (Dushnitsky and Kluer, 2017) and particularly in the UIC context (Soendergaard, Bergenholtz and Juhl, 2015). Thus, although intermediaries by definition are serving the inter-organisational link (Yusuf, 2008), there is still a need to explore the role of the online intermediary as an organisation in UIC – that is, its value and types of functions such organisation may fulfil in UIC. This outlines the research gap of intermediary as a stakeholder in UIC on the organisational level.

Fifth, even when well-functioning forms of UIC and knowledge transfer are found (e.g. university-intermediary-industry link is up and successfully running), due to the strategic importance of UIC for global economic and innovation development, the assessment of UIC performance and its impact on society becomes crucial for facilitating it as ‘what gets measured gets managed’ (Drucker 1954, p. 70). This is why the government as a third actor in the Triple Helix (Etzkowitz and Leydesdorff, 2000) and a policy maker devote an increasing share of their attention towards evaluating UIC and its impact on society (Witty, 2013; Kauppila et al., 2015; Rossi and Rosli, 2015). However, the evaluation of UIC and the development of the relevant key performance indicators (KPIs) is admittedly an extremely challenging task (Rossi and Rosli, 2015), also because of the differences in the basic rationale between academia, business and government – as heterogeneous stakeholders (Corsaro, Cantù and Tunisini, 2012; Gattringer et al., 2014). Approaching the perceptions of these stakeholders at the inter-organisational level of analysis (focusing on inter-organisational alliances (Bogers et al., 2017)) may help to (1) find a mismatch in their perceptions towards UIC evaluation and relevant KPIs and as a result (2) reveal the directions for bridging these perceptions (Kauppila et al., 2015).

Overall, the brief discussion above outlines five gaps in the UIC research, which together limit our current understanding of university–industry collaboration in general and the possible ways to facilitate it in particular. The following subchapter summarises the corresponding goals and research questions of this dissertation.
1.3 Research goals and questions

Following both the practical need to facilitate university–industry collaboration for the development of the knowledge-based economy (Héraud and Lévy, 2005; Youtie and Shapira, 2008) and a number of gaps identified in the literature (see the above subchapter), Table 1 outlines the goals to be achieved and research questions answered by this dissertation.
<table>
<thead>
<tr>
<th>Research Gap</th>
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<th>Goals</th>
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<tr>
<td>A lack of a multi-level stakeholder-based theoretical lens to assist in finding ways to facilitate university–industry collaboration</td>
<td>RQ 1: How can university-industry collaboration be facilitated taking into account the perspectives of the stakeholders involved at multiple levels?</td>
<td>To find the ways to facilitate university–industry collaboration taking into account the perspectives of the stakeholders involved at multiple levels.</td>
<td>Paper I</td>
<td>Entire dissertation</td>
<td>Paper I</td>
</tr>
<tr>
<td></td>
<td>RQ 2: What distinguishes academic entrepreneurship from entrepreneurial academics?</td>
<td>To critically review the literature on academic entrepreneurship and entrepreneurial academics and identify the key patterns and research gaps.</td>
<td>Paper I</td>
<td></td>
<td>Paper II</td>
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<td></td>
<td>RQ 3: What are the skills required for sustainable collaboration with universities, and how do they differ from those required for collaborating with other types of external partners?</td>
<td>To identify the components of organisational human capital required for successful collaboration.</td>
<td>Paper II</td>
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<td>Paper III</td>
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<td>The gap between organisational-level perceptions towards open innovation as a concept and as a practice and as a concept within and between communities of academics (university) and practitioners (industry)</td>
<td>RQ 4: How does factual open innovation adoption vary for companies that claim to be open innovation adopters and those that claim they do not adopt open innovation?</td>
<td>To compare business and academic perspectives towards the open innovation concept.</td>
<td>Paper III</td>
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<td></td>
<td>RQ 5: What open innovation activities, identified as such by academic researchers, are not considered open by business practitioners?</td>
<td>The gap between organisational-level perceptions towards open innovation as a concept and as a practice and as a concept within and between communities of academics (university) and practitioners (industry) hinders further theory development (Trott and Hartmann, 2000; Vande and Man, 2011).</td>
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</table>
From the perspective of an intermediary as a stakeholder in UIC, at the organisational level there is a need to explore the role of the online intermediary as an organisation in UIC – its value and the types of functions such organisation may fulfil in UIC (Yusuf 2008; Soendergaard 2015).

The differences, similarities and ways to bridge the perceptions of university, industry and government towards evaluating UIC at the inter-organisational level of analysis (focusing on inter-organisational alliances (Bogers et al. 2017)) need to be studied.

To identify the novel forms of online intermediation platforms in the UIC sphere; to analyse the role they fulfil and identify what functions they offer for UIC.

From the perspective of an intermediary as a stakeholder in UIC, at the organisational level there is a need to explore the role of the online intermediary as an organisation in UIC – its value and the types of functions such organisation may fulfil in UIC (Yusuf 2008; Soendergaard 2015).

RSQ6: What are the emerging types of online intermediaries in UIC?
RSQ7: What are the roles and functions these different types of intermediaries have in UIC?

To identify the UIC KPIs already applied by external UIC evaluators and generally relevant for different collaboration contexts. To understand which of the KPIs known by external evaluators are only applicable for certain specific contexts of collaboration. To identify the indicators perceived relevant by collaborating actors but not yet applied by respective evaluation bodies.

RSQ8: What are (1) the common and (2) context-specific key performance indicators of UIC at the micro level?

1.4 Definitions of the key concepts

Table 2 below outlines the key concepts used and referred to in this dissertation and clarifies the meaning of each of these concepts as applied in this dissertation.

Table 2: Concepts and definitions applied in this dissertation

<table>
<thead>
<tr>
<th>№</th>
<th>Concept name and synonyms applied</th>
<th>Definition applied in this dissertation</th>
<th>Reference(s)</th>
<th>Example(s) and notes</th>
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</thead>
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<tr>
<td>1.</td>
<td>University/Higher Educational Institution (HEI)/Institution</td>
<td>‘a high-level educational institution in which students study for degrees and academic research is done’.</td>
<td>(Stevenson, 2010)</td>
<td>The definition of a ‘university’ may vary significantly depending on the country and even region and is usually set by a government agency (e.g. Privy Council in the UK, the examples of the global top universities in UK for 2018 are University of Cambridge, University of Oxford</td>
</tr>
</tbody>
</table>
1 Introduction

In the US the ‘university’ status is defined on a state level (see Massachusetts Board of Education 2008). Top US universities form the global top 3 for 2018: Massachusetts Institute of Technology (MIT); Stanford University; Harvard University (QSWorldUniversityRankings, 2018).

This dissertation limits its scope to higher educational institutions, which in addition to educational activities also carry out research-related activities and thus are prone to contribute to industry innovation beyond educating students as future companies’ employees. Thus, it does not limit the scope to solely universities having the right of granting PhD degrees and considers such institutions, such as Fontys University of Applied Sciences, The Netherlands. At the same time, ‘Research and Technology Organisations’ (RTOs), such as VTT in Finland, Fraunhofer Institutes in Germany and TNO in The Netherlands (Barlatier, Giannopoulou and Pénin, 2017), are not in the core focus of this dissertation as they are primarily research (and not primarily educational) institutions.

2. Industry/Business/Companies

‘wealth-creating businesses contributing to the national economy and interacting with the university in a local or global space. Industry involves hence the different sectors and levels of the economy...’.

This dissertation approaches ‘Industry’ primarily at the organisational (company) level. Examples of top companies by market capitalisation for 2017 include (PwC, 2017): Apple (USA, sector – technologies); Tencent (China, technologies); Samsung Electronics (South Korea, consumer goods); Santander (Spain, financials); BASF SE (Germany, basic materials), etc.
<p>| 3. | <strong>Collaboration</strong> | <em>The interaction of two or more actors, which provides equal or various extent of benefit (both tangible and intangible) to each side...</em>. | (Albats 2013, p. 17; Abramo et al. 2011; Bozeman et al. 2013; Perkmann et al. 2013) | The processes of interaction between two or more entities described as collaboration vary greatly and can be: joint ventures (e.g. AutoLatina – a joint venture of Ford &amp; Volkswagen in South America in 1987), networks (e.g. Open Innovation Academic Network – <a href="http://www.oienet.eu">www.oienet.eu</a>), alliances (Bayer–Millennium strategic alliance in 1998–2003 (Ziegelbauer and Farquhar, 2004)), consortiums, associations (Gajda, 2004), etc. This is why it is critically important to define the collaborating entities (universities and industry in this dissertation) and the collaboration scope (education, research and valorisation (Galán-Muros and Plewa, 2016)). |
| 4. | <strong>University–industry Collaboration (UIC)</strong> | <em>a method of social cooperation, or a voluntary effort made by industrial entities and educational and research institutions to solve problems or issues of common interest cooperatively</em>. | (Ha &amp; Kwon 2016, p. 2; Waddock 1991) | One of the recent examples of university–industry collaboration (in particular fields of education and innovation) is Siemens FutureMakers Challenge of 2018, where students of 5 U.S. universities compete in developing a next-generation software concepts as a part of a programme designed to foster innovation and develop the next-generation digital engineering workforce (Kelly, 2018). |</p>
<table>
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<tr>
<th></th>
<th><strong>Introduction</strong></th>
<th><strong>Key Performance Indicator (KPI)</strong></th>
<th><strong>Stakeholder</strong></th>
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<tbody>
<tr>
<td>5</td>
<td>Innovation</td>
<td>a broad definition: ‘the successful exploitation of new ideas’</td>
<td>Following Bessant and Tidd (2015, pp. 7-9) innovation is about:</td>
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<td></td>
<td>and more precise: ‘Innovation is: production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and establishment of new management systems. It is both a process and an outcome’.</td>
<td></td>
<td>• identifying or creating opportunities (drugs and vaccination have opened new opportunities in health and wellbeing);</td>
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<td></td>
<td></td>
<td></td>
<td>• identifying or creating new ways of serving existing markets (low-cost airlines such as Ryanair);</td>
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<td></td>
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<td>• growing new markets (Ford Model T – a car for the mass market);</td>
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<td></td>
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<td>• rethinking services (Amazon in retail, Google in advertising);</td>
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<td></td>
<td>• meeting social needs and improving operations (doing what we do better).</td>
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<td>6</td>
<td>Key Performance Indicator</td>
<td>‘an item of information collected at regular intervals to track the performance of a system’.</td>
<td>E.g. a profit growth rate or number of innovative products launched for a company; number of students graduated/employed upon graduation or number of publications and their impact – for a university.</td>
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<td>7</td>
<td>Stakeholder</td>
<td>‘A stakeholder in an organization is (by definition) any group or individual who can affect or is affected by the achievement of the organization’s objectives’.</td>
<td>For a company these are investors, shareholders, customers, employees, etc. For a city development project they can be citizens, a municipality, local businesses, investors, etc.</td>
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<td>8</td>
<td>Knowledge</td>
<td>‘a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organizations, it often becomes Prusak (1998, p.5)</td>
<td>E.g. an experienced driver ‘knows how to drive, rapidly accomplishing a series of complex actions without having to think about them, as a beginner would’ (Davenport &amp; Prusak 1998, p. 9). In this dissertation each of the core stakeholders (universities and companies) possess their unique</td>
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<th>#</th>
<th>Knowledge Transfer (KT)</th>
<th>Knowledge Transfer Intermediary (KTI)</th>
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<td>9.</td>
<td>‘Two-directional interaction with knowledge passing from the University to the Commercial Partner and from the Commercial Partner to the University’.</td>
<td>An entity whose “midwifery” assists knowledge exchange between universities and the business community through the creation of bridging ties and interfaces, by diagnosing needs and articulating the demand for certain kinds of innovation, by instituting a dynamic framework for change and working to achieve the change through financing and other means’.</td>
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<td></td>
<td>E.g. teachers and parents sharing their knowledge with the new generations. In fact, it is always a two-way exchange as children also provide avenues for new learning to adults. Similarly with universities and companies – it is a bi-directional knowledge transfer (Albats, Fiegenbaum and Cunningham, 2018).</td>
<td>This may be entities internal or external to the focal organisation (Wright et al., 2008): for example, a university technology transfer office (e.g. Stanford Office of Technology Licencing – <a href="http://www.otl.stanford.edu">www.otl.stanford.edu</a>); commercial innomediaries, such as Yet2.com, Innocentive (Vanhaverbeke, 2017) or UIC-specialised such as Telanto; public centres involved in knowledge and technology transfer, such as VTT in Finland, Fraunhofer Institutes in Germany, TNO in the Netherlands (Barlatier, Giannopoulou and Pénin, 2017), etc.</td>
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2 Theoretical background

This chapter provides an overview of the literature on university–industry collaboration (UIC). It starts with a historical overview of the works in this field. Then, the dissertation outlines the studies that address the perspectives of each of the focal UIC stakeholders (university, industry, intermediaries and government) at the various levels of analysis. After that, a description of the collaborative links between these stakeholders and problems emerging in stakeholder collaboration, which are recognised by the existing literature, are outlined. The chapter continues by introducing the stakeholder theory as a lens for studying the phenomenon of university–industry collaboration. The end of the chapter provides a brief summary of the literature insights and research problems and areas to which this dissertation aims to contribute.

2.1 The evolution of the university–industry collaboration’ literature

University–industry collaboration has a rather long history. As mentioned in the first chapter, among the first known cases, MIT’s Research Laboratory of Applied Chemistry entered into a paid contract on research as early as 1927 (Kenney, 1987). Despite this rather long history, it has been acknowledged that the phenomenon of university–industry collaboration has started to develop rather intensively and widely since the introduction of the Bayh-Dole Act in the United States in 1980, when universities and individual researchers received the right to pursue ownership of their inventions developed with federal funding. The Bayh-Dole Act thus became a driver for the growth of university (and individual) patenting and licencing processes and hence kicked-off the next 40 years of intensively developing university–industry collaboration research, where each decade has provided numerous insights into our current understanding of this phenomenon (Grimaldi et al., 2011; Mahdad, 2016). Following the insightful review of the last 40 years of UIC research, developed in the PhD dissertation on micro-dynamics of university–industry collaboration by Mahdad (2016), and the literature reviews on UIC done previously (Bozeman, 2000; Agrawal, 2001; Costello et al., 2007; Perkmann et al., 2013), the following discussion provides a historical overview of UIC research taking a multi-level stakeholder perspective. Figure 1 below outlines the research works which appear particularly meaningful for the topic of this dissertation against the timeline of the last 40 years (adopted from the review by Mahdad 2016).

The first decade focused mainly on the university perspective and the effects of the Bayh-Dole Act, which stimulated much debate around academic capitalism, the actual models of exploiting university-based inventions (Seppänen et al., 2010), ethical issues and fundamental questions on the role of the university in society and economy (Kenney, 1987). All these issues shaped the entire decade of research as a period of debates (Mahdad, 2016). The majority of studies from 1980 to 1990 are focused on academia and particularly on the level of individual academics (Bird and Allen, 1989; Louis et al., 1989). The work by Etzkowitz (1983) was among the first well-recognised studies to have
linked the two analysis levels (organisational and intra-organisational) via researching the phenomenon of entrepreneurial university, academic teams and entrepreneurial motives among individual university academics.

Figure 1: The last forty years of university–industry collaboration research (Adopted from Mahdad, 2016) – taking a multi-level stakeholder perspective

The period from the 1990s to the 2000s has become particularly insightful for the UIC research landscape. In addition to bringing in the perspectives from regions other than the US (particularly, Europe (Van Dierdonck, Debackere and Engelen, 1990; Meyer-Krahmer and Schmoch, 1998) and Asia (Fujisue, 1998; Branscomb, Kodama and Florida, 1999)), the concept of the Triple Helix, which emphasises the importance of the three stakeholders in UIC (university, industry and government, see Figure 2), was introduced (Etzkowitz and Leydesdorff, 1995, 2000). Although the Triple Helix framework has sufficiently enriched our understanding of UIC particularly at the policy level (as it emphasises the multi-stakeholder nature of UIC processes), it has received a considerable amount of critique for being theoretically ambiguous and empirically problematic (Weingart, 1997; Fuller, 1998; Shinn, 2002; Mahdad, 2016). Nevertheless, the concept of the Triple Helix became one of the major theoretical and analytical frameworks for UIC developments particularly at the policy level (Cooke, 2005; Park and Leydesdorff, 2010; Kim, Kim and Yang, 2012; Rodrigues and Melo, 2013), and this concept was then developed and extended over the next decades.

The following decade, the 2000s to the 2010s, became a ‘period of delight’s in the field
2.1 The evolution of the university–industry collaboration’ literature

of UIC research (Mahdad, 2016). First, the studies by Siegel et al. (Siegel et al., 2003, 2004; Siegel, Waldman and Link, 2003) emphasised the importance of university organisational-level capabilities and stressed the importance of intermediaries in UIC. The intermediation phenomenon was holistically analysed by Howells for the general innovation landscape (Howells, 2006) and also in the UIC context (Wright et al., 2008; Yusuf, 2008). The second meaningful contribution during the 2000s (meaningful particularly in respect to the topic of this dissertation) is reflected in a shift towards the company perspective in UIC, when Laursen and Salter (2004) introduced an ‘open search strategy’ and approached the university as a knowledge source for companies. Around the same time, the concept of open innovation (OI) was introduced (Chesbrough, 2006), encouraging companies to use both internal and external sources of knowledge (including universities among the external sources). This concept started to assist in developing UIC research from a company perspective, where the study by Bruneel et al. (2010) was among the first to follow the firm’s perspective towards UIC. The in-depth analysis of collaborative links assisted in exploring the UIC at the inter-organisational level and also in discovering the influences across individual, organisational and inter-organisational levels (D’Este and Patel, 2007; Perkmann and Walsh, 2007). Furthermore, the work by Perkmann and Walsh (2007) became the first impactful study that attempted to bridge UIC research with open innovation research.

Finally, since entering the last decade, UIC scholars have put increasingly more effort into evaluating UIC from the perspectives of multiple stakeholders and also at the different analysis levels, with the inter-organisational level (alliance level) particularly driving the evaluation focus (Perkmann, Neely and Walsh, 2011; Seppo and Lilles, 2012; Piva and Rossi-Lamastra, 2013; Kauppila et al., 2015). The open innovation research field, which generally represents a firm perspective towards UIC, appeared to ‘neglect the human side’ (Gassmann, Enkel and Chesbrough, 2010; Hosseini et al., 2017). This in turn stimulated a research interest among scholars towards studying company human capital in the open innovation context (Mortara et al., 2009; Ahn et al., 2016). At the policy level, the negative effects of the abolishment of ‘professor’s privilege’ (a decrease in patenting levels) in Europe were also found during the last decade (von Proff, Buenstorf and Hummel, 2012; Czarnitzki et al., 2015; Ejermo and Toivanen, 2018). Furthermore, issues of geographical versus organisational proximity have been particularly emphasised in recent years (D’Este, Guy and Iammarino, 2012), which in the current era of digital transformation and ICT developments has led to research interests towards online knowledge marketplaces and digital intermediaries in UIC (Søndergaard, Bergenholtz and Juhl, 2015; Dushnitsky and Klueter, 2017). Given the growing importance of intermediaries in UIC, these may be highlighted within the Triple Helix, as technically UIC intermediaries represent either a university technology transfer office (TTO), a governmental institution or a commercial body (industry side of the Triple Helix) (Schoen, van Pottelsbergh de la Potterie and Henkel, 2014) – see Figure 2, left. In the last decade, the Triple Helix vision of UIC has also been evolving towards a larger number of the key stakeholders. Particularly, two new layers have been added and two more Helix-concepts have emerged: the Quadruple Helix, with ‘society’ or end-users as the context or an additional stakeholder, and the Quintuple Helix, with the natural
environment or social ecology as a context (Carayannis and Campbell, 2010; Carayannis and Rakhmatullin, 2014) – see Figure 2, right.

Despite the emphasis on the multiple-level and multiple-stakeholder nature of UIC emerging in the literature particularly in the last decade (Perkmann et al., 2013), the problem of theoretical approaches being fragmented across analysis levels and different stakeholders’ perspectives (Perkmann et al., 2013; Bogers et al., 2017) limits our current understanding of UIC, and, consequently, it limits the scope of the known ways to facilitate UIC. To advance this understanding, this dissertation proceeds with an in-depth analysis of the literature from the perspectives of each of the key UIC stakeholders: university/academia, industry/companies, intermediaries, government and multiple stakeholders in their social context.

2.2 Academia perspective towards UIC

As the historical overview of UIC shows, compared to the 20th century, when educating the next generation of employees for industry used to be the core university–industry link, nowadays the academia or university perspective towards industry engagement is to a large extent driven by the ‘impact agenda’ (PACEC, 2012; Eggington, Osborn and Kaplan, 2013). This implies a need for research funding to turn back into economy growth and contribute to solving social challenges (PACEC, 2012). The other side of that coin is
argued by Mazzucato (2015): many breakthrough technologies (e.g. the internet, GPS, medical drugs), discoveries and applied research outcomes, which have led to successful commercial products and services, have been funded by government. Thus, when it comes to the returns on the resulting innovative products and services, the question of whether the government should be on both sides (supply and demand) remains (Mazzucato, 2015). Institutional theory explains the ‘impact agenda’ by organisations being subject to societal expectations and obligations (DiMaggio and Powell, 1983; Hall and Taylor, 1996; Collier, Gray and Ahn, 2011). In the context of university as an instance of publicly funded (or partially publicly funded) science, the university research results are expected to be shared openly and widely following the principles of ‘communalism, universalism, disinterestedness, originality and scepticism’ (Collier et al. 2011, p. 3; Merton 1973). Collier et al. (2011) suggest that as a result of lack of funding, universities had to rethink their role, and, in addition to generating scientific results, universities became responsible also for capturing the economic value of these results (Rhoten and Powell, 2007; Collier, Gray and Ahn, 2011).

The earlier mentioned Bayh-Dole Act introduced in the US in 1980 and the follow-up initiatives in other countries enabled universities to retain the intellectual property arising from publicly funded research, boosted technology transfer initiatives and increased the number of inventions disclosed, licences issued and royalties generated (Sampat, 2006; Aldridge and Audretsch, 2011; Grimaldi et al., 2011). The follow-up shift of the university role and respectively university perception have increased the importance of universities in the area of economic development (Saad and Zawdie, 2011; Schultz, 2012; Guerrero, J. Cunningham and Urbano, 2015). At the same time, the negative effects of the abolishment of ‘professor’s privilege’ in Europe were also found during over a decade of studying the effects of this policy change (von Proff, Buenstorf and Hummel, 2012; Czarnitzki et al., 2015; Ejeremo and Toivanen, 2018). This also stressed the ethical issues of academic capitalism (Renault, 2006), which brought together the constructs of institutional theory and the theory of entrepreneurship (Kirby, 2006; Jong, 2008; O’Shea, Chugh and Allen, 2008; Wadhwani et al., 2017). This intertwining of theoretical streams and the contradictory nature of the focal phenomena create a conceptual ambiguity around the concepts of the entrepreneurial university, entrepreneurial academic and academic entrepreneur (Nyeko and Sing, 2015). This has a risk of creating a barrier for managerial science in regard to solving real-life problems (Gulati, 2007; Vrande and Man, 2011).

2.2.1 Entrepreneurial university: Definition and research prospects

Professor Etzkowitz coined the term ‘entrepreneurial university’ more than 30 years ago (Etzkowitz, 1983). Despite the term being not that new (Jacob, Lundqvist and Hellsmark, 2003), the phenomenon is being referenced as one which is still being developed and also as having a different origins in Europe and in the US. Particularly, the literature suggests that in the US the entrepreneurial university has been emerging ‘bottom-up’, while in Europe it has been thus far rather a ‘top-down’ policy-based development (Soete, 1999; Etzkowitz, 2003). Although the conceptualisation of the term as well as the methodology for evaluating the entrepreneurial dimension in universities are still going through the
development stage (see Entrepreneurial and Engaged University Accreditation – Kliewe 2017), the literature still shares some examples of entrepreneurial university. Among them the following institutions are mentioned: Harvard, MIT, Stanford and Wharton Business School in the US (Hsu, Roberts and Eesley, 2007; Guerrero and Urbano, 2012; Miller, Alexander and Albats, 2016); Cranfield University, IMD, INSEAD, University of Twente in Europe (Lazzeretti and Tavoletti, 2005; Miller, Alexander and Albats, 2016) and the National University of Singapore and Singapore Management University in Asia (Wong, Ho and Singh, 2007; Miller, Alexander and Albats, 2016).

Jacob et al. (2003, p. 1556) highlight the ‘entrepreneurial university’ concept as being ‘susceptible to swings in popularity’ and discuss the different dimensions of it according to the various activities being central and meant to foster university entrepreneurship as, for example, entrepreneurial education and training, university restructuring or enhancing the transformation of inventions into innovations and businesses. Following the recent trend of emphasising the latter dimension (invention-business transformation), Jacob et al. (2003, p. 1556) define the ‘entrepreneurial university’ as ‘a university that has developed a comprehensive internal system for the commercialisation and commodification of its knowledge’. As can be seen, a rather institutional or organisational perspective is applied in this definition, and while the components of the proposed ‘system’ contain several measurements on the infrastructure and organisational development (Clark, 1998; Jacob, Lundqvist and Hellsmark, 2003), the level of individual academics remains insufficiently explored.

Guerrero and Urbano (2012), still considering the entrepreneurial university on the institutional level, point our attention to the role of individual academics: the ‘entrepreneurial university is an instrument that not only provides a workforce and value added with the creation or transformation of knowledge but also improves the individual’s values and attitudes towards these issues’ (Guerrero & Urbano 2012, P. 54). The literature on the role of individual academics in the entrepreneurial university is reviewed in the following subchapter and it reveals the linked research problem that is addressed by this dissertation.

2.2.2 ‘Entrepreneurial academic’ vs. ‘academic entrepreneur’

As discussed above, despite the long-term growing demands for universities to become more entrepreneurial (Etzkowitz, 1983), until recently, the role of policy makers and university management in transforming the higher education institution (HEI) into an entrepreneurial one remained the most evident. However, the role of the vital actor in this transformation – the academic – has remained insufficiently explored by the existing literature (Miller et al., 2018). Furthermore, the multi-dimensional nature of the ‘entrepreneurial university’ as an institutional phenomenon (Jacob, Lundqvist and Hellsmark, 2003) contributed to the emergence of a certain conceptual ambiguity on the level of the individual academic – particularly, it has caused an inconsistency in the usage of the terms ‘entrepreneurial academic’ and ‘academic entrepreneur’ in the literature (Nyeko and Sing, 2015; Miller et al., 2018).
2.3 Industry perspective towards UIC

Despite the relevance of the phenomena of the entrepreneurial academic and the academic entrepreneur for the actual development of the entrepreneurial university, there has been no holistic, state-of-the-art picture on this conceptual issue in the literature (Miller et al., 2018). One of the recent works by Nyeko and Sing (2015) undertakes the first attempt to shed a light on this issue. This dissertation uses a systematic literature review along the three dimensions (disciplines) of the related literature – entrepreneurship, innovation and higher education – to clarify the differences between academic entrepreneurs and entrepreneurial academics.

2.3 Industry perspective towards UIC

This subchapter outlines the industry (companies’) perspective towards university–industry collaboration, introduces the key theoretical concepts reflecting this perspective and points out the key research problems, which remain unsolved, in studying industry perspective towards UIC.

2.3.1 Knowledge-based view, open innovation and UIC

For companies operating in the knowledge-based economy, knowledge and innovation have become essential to firms’ competitiveness. On the landscape of strategic management research, this has led to the emergence of a knowledge-based view (KBV) of the firm (Conner and Prahalad, 1996; Grant, 1996) from the previously developed resource-based view (RBV) of the firm (Wernerfelt, 1984; Barney, 2001; Barney, Wright and Ketchen, 2001). In the KBV, knowledge appears as a vital strategic resource, and the company strategies of leveraging and capturing value from this resource become decisive in the company’s competitive position (Conner and Prahalad, 1996).

In this age of a turbulent environment, globalisation trends, growing competition, interdependences and shortening product lifecycles, the matter of timing in bringing innovation to the market becomes essential for company success. All those external pressures stimulate scientific debates on the applicability of such well-established theoretical views as Porter’s industry structure view (Porter, 1980), the resource-based view and the knowledge-based view (Jeffrey and Dyer, 1998; Acedo, Barroso and Galan, 2006; Kraijjenbrink, Spender and Groen, 2010). The transformations in inter-organisational relationships towards alliances have led to the emergence of a relational view (Jeffrey and Dyer, 1998), where the sources of inter-organisational competitive advantage and thus supernormal relational rents have been proposed. Dyer and Singh (1998) identify four high-level sources of inter-organisational competitive advantage: 1) investment in relation-specific assets; 2) substantial knowledge exchange and joint learning; 3) combining complementary but still scarce resources and capabilities and 4) lower transaction costs than competitor alliances owing to effective governance.

Subnormal relational rents, shortening product lifecycles, the growing importance of knowledge and the sharing of ‘know-how’ as well as inter-organisational relations as a
source of transaction costs cuts (Jeffrey and Dyer, 1998) appear among the reasons for companies to start opening up their knowledge search strategies (Laursen and Salter, 2006) as well as their business models (Chesbrough, 2006). The recent scientific works drawing upon RBV, KBV and the relational view increasingly emphasise the multi-stakeholder and multi-level nature of inter-organisational collaboration for innovation (Kazadi, Lievens and Mahr, 2016; Radziwon, 2017). Following a multi-level approach and drawing upon Santos and Eisenhardt’s (2005) view towards organisational boundaries, groundings of RBV, KBV as well as ecosystem approach towards value creation and capture (Ritala et al., 2013), Radziwon (2017. pp. 59-60) proposes an ‘Ecosystem Safe Net’ concept. Radziwon (2017) proposes the ‘elements’ or the mechanisms for facilitating (‘fostering’) an Ecosystem Safe Net for each of the levels in focus – the organisational, inter-organisational and ecosystem levels (see Figure 3). The organisational level includes six elements of ecosystem facilitation: (1) an organisation’s balance between core and side activities; (2) the presence and recognition of potential gain; (3) long-run contribution potential; (4) commitment to join and motivation to remain active; (5) internal financial resources and (6) drive to collaborate. The four inter-organisational level elements proposed are: (1) trust and familiarity between the partners; (2) shared business objectives; (3) similar cognitive frame and (4) power balance between partners. Finally, the two ecosystem level elements proposed by Radziwon (2017) are: (1) external financial support and (2) the external management, coordination and facilitation of activities. The work by Radziwon (2017) is taking a company (particularly an SME) perspective, but the multi-level and multi-stakeholder approach applied provides very relevant ground for this dissertation, and the company-perspective framework requires its reflection among the other stakeholder perspectives (e.g. university and government).

Particularly in relation to knowledge sourcing, from the firm perspective, universities appear as one of the vital channels for producing and sharing knowledge and ideas that may potentially create a basis for innovation (Laursen and Salter, 2006; Sherwood and Covin, 2008). Since the 2000s, the body of literature studying UIC from a corporate perspective has grown notably. Scholars are tending to increasingly explore the role of universities as external knowledge sources for firms (Laursen and Salter, 2006; Perkmann and Walsh, 2007), to study firms’ prospects towards knowledge exploitation (Bozeman and Boardman, 2014) – particularly, the commercialisation of universities’ R&D (D’Este and Patel, 2007; Perkmann et al., 2013) – and to study firms’ networking (Howells, Ramlogan and Cheng, 2012). From the perspective of the literature streams that study the company (or industry) viewpoint, these aspects of the company innovation strategy are framed by the concept of open innovation (Chesbrough, 2006). The open innovation paradigm assumes that companies ‘can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology’ (Chesbrough, 2003, p. xxiv). Chesbrough and Bogers, aiming to assist in unifying the understanding on OI, recently proposed a revised definition of OI: ‘open innovation is a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with each organization’s business model’ (Chesbrough and Bogers, 2014, p. 27).
Figure 3: Value creation and capture model (Radziwon 2017, p. 59)

The concepts of open innovation and university–industry collaboration thus far continue to exist rather independently in the literature, and only a limited number of studies attempt to combine them in the context of UIC (Perkmann and Walsh, 2007; Laursen, Reichstein and Salter, 2011; Kutvonen et al., 2013; Alexander, Miller and Fielding, 2015). There might be several reasons for this, one of which may be hidden behind and at the same time reflect the global problem that still exists in managerial science – a lack of a holistic, multi-level theoretical lens and cross-level linkages between the existing theories (Gupta, Tesluk and Taylor, 2007; Bogers et al., 2017). The consideration of a university as solely a knowledge source for companies may create an assumption that the open innovation concept is theoretically framing the entire phenomenon of university–industry relationships. However, if one attempts to take a holistic perspective towards university–industry collaboration, a variety of collaborative modes and links may be revealed in UIC (Meyer-Krahmer and Schmoeh, 1998; Perkmann and Walsh, 2007) (see the more detailed analysis of the links in subchapter 2.6). Not all of these collaborative links necessarily represent collaboration for innovation – such as collaboration in curriculum development and two-way students and staff mobility (Galán-Muros and Plewa, 2016) – these links may or may not lead to innovation development in the longer term. Hence, from a company perspective, university–industry collaborative innovation as a concept is at the intersection between (or a special instance of) open innovation and the university-industry collaboration phenomena.

Despite multiple efforts to clarify the definition of the OI concept, as a relatively early-stage, developing theoretical construct it unavoidably faces a problem of ‘conceptual ambiguity’ (Trott and Hartmann, 2009) – both within and between academic and business communities (Podmetina et al., 2016). In simple terms, the definition of ‘open innovation’
and its application varies greatly across different research works and managerial practices (Podmetina et al., 2016). On the academic side this is partly due to the multi-disciplinary origin of the researchers studying open innovation (Vrande, Jong and Vanhaverbeke, 2009). The breadth in the understanding of OI by the research community also leaves an even greater degree of freedom for the business community to interpret OI differently. Thus, companies’ interpretations of OI may vary from, for example, an open-minded type of culture, corporate social responsibility, solely pecuniary or solely non-pecuniary OI practices, solely inbound or outbound OI practices or a mixture of those (Chesbrough, 2006; Dahlander and Gann, 2010; Gassmann, Enkel and Chesbrough, 2010; Podmetina et al., 2016). Wikhamn (2013, p. 386) argues that the ‘multidisciplinary origin of the researchers’ dealing with open innovation ‘makes it far from easy to form one strong, unified research community which shares one workable, all-encompassing definition’. This, apart from the constructive debates assisting in the theoretical developments of the open innovation research field, creates a conceptual ambiguity (Trott and Hartmann, 2009) and dualism in perceptions of OI (‘libre’ vs. ‘control’) (Wikhamn, 2013) and stresses the issue of the relevance of the OI concept for practitioners and managerial research, respectively (Vrande, Jong and Vanhaverbeke, 2009; Groen and Linton, 2010).

Aiming at finding ways to facilitate UIC and establishing a common language between academia and business, this dissertation sets a goal to detect the differences in perceptions towards OI between academia and industry, to find where exactly the perceptions differ and how this conceptual ambiguity should be addressed to facilitate UIC.

2.3.2 The role of human capital in company-university innovation

Regardless of what particular type of external knowledge source is being used by a company (whether it is a university or e.g. a supplier), to implement open innovation and still carry the innovation through all the stages of the innovation process (Bessant and Tidd, 2015), the company needs to have organisational capabilities and capacities (Hosseini et al., 2017). Lichtenthaler and Lichtenthaler (2009) distinguish between these on the internal (intra-firm) and external (inter-firm) levels. For the intra-firm level, they outline inventive capacity (ability to generate knowledge within the firm), transformative capacity (ability to retain and reactivate knowledge over time) and innovative capacity (exploiting knowledge internally). On the inter-firm level they highlight absorptive capacity – recognising, assimilating and applying external knowledge (Cohen and Levinthal, 1989, 1990; Zahra and George, 2002); connective capacity (retaining knowledge in inter-firm relationships utilising relational capability) and desorptive capacity (external knowledge exploitation). Furthermore, given the dynamic nature of the environment surrounding any innovation-focused company, the ‘dynamic capabilities’ of sensing opportunities, seizing opportunities and reconfiguring company assets are also needed when aiming at sustainable competitive advantage (Teece, 2007).

Although a number of company-centric studies have enriched the current understanding of the organisational capabilities required for a company’s open innovation (Lichtenthaler and Lichtenthaler, 2009; Hughes and Wareham, 2010; Hosseini et al., 2017), the open
innovation research has appeared to ‘neglect the human side’ (Gassmann, Enkel and
Chesbrough, 2010; Hosseini et al., 2017). This requires studying company human capital
in a generally open innovation context (with a number of the recent studies heading
towards that direction, e.g. Mortara et al. 2009; Ahn et al. 2016). However, when it comes
to the human capital required particularly for company-university collaborative
innovation, this area remains understood to only a limited extent (Becker and Tomes,
1986; Bozeman and Boardman, 2014). Hence, this dissertation proceeds by analysing the
current understanding of a company human capital in university relations.

When studying generally inter-organisational relationships (where university–industry
collaboration is a special instance), the various theoretical lenses available thus far
demand studying these relationships at different levels of analysis. For instance,
researchers applying Stakeholder Theory (Freeman, 2010) as a theoretical lens tend to
study these relationships at the organisational or extra-organisational level. The Network
Theory (Wasserman and Faust, 1994) in turn, demands a higher level of analysis, such as
inter-organisational or multi-level analysis (Moliterno and Mahony, 2011). In studying
inter-organisational relationships, Marchington and Vincent (2004) argue that organisations
generally should not be perceived as homogeneous. Furthermore, following
Lane and Bachmann (1997), Marchington and Vincent (2004) developed a model from
Sako’s (1992) and propose that inter-organisational relations should be studied through
the interplay of interactions happening at the different levels – institutional, organisational
and interpersonal (Sako, 1992; Lane et al., 1995; Marchington and Vincent, 2004).

One of the ways to deal with the task of overseeing the interplay between the levels of
analysis is to approach organisational entities as nested arrangements, as illustrated in
Figure 4 (Hitt et al., 2007). The nested approach proposed by Hitt et al. (2007, p. 1387)
implies that ‘individuals are nested in work groups, which in turn are nested in larger
organizational units, such as departments or strategic business units (SBUs), which are
nested in national or multinational organizations’. As it can be seen from Figure 4, the
theoretical concept that assists in bridging different levels of organisations’ analysis is
organisational human capital.
From the open and collaborative innovation perspective, organisational human capital is similarly the research tunnel connecting individual-level characteristics with organisational-level relational capability (capability to operate on the inter-organisational level and higher levels) (Knudsen, 2008; Schillebeeckx et al., 2016). Following Hitt et al. (2007), this dissertation uses the concept of human capital as a cross-level bridge in studying the company perspective towards university relationships.

Human capital is one of the components of organisational intellectual capital, which in turn includes human capital (people that form (or are nested into (Hitt et al., 2007)) organisations), relational capital (the value of organisations’ relations with external stakeholders) and structural capital (assets remaining with organisations when individuals leave it) (Edvinsson and Malone, 1997). The concepts of organisational capital generally and organisational human capital particularly have their roots in economics, as represented by organisational resources. Human capital combines the individual characteristics, including skills, abilities, knowledge, education and experience (Schultz, 1962; Smith, 1976; Goldin, 2016), and personal characteristics (Becker and Tomes, 1986) – resources utilised within the inter-organisational transactions. In the context of technology- or science-based innovation Bozeman and Boardman (2014) propose labelling the relevant organisational capital components as scientific and technical human capital (STHC). STHC Theory (Bozeman and Boardman, 2014) suggests that organisational capacities and capabilities shape the effects of individual-level resource contributions (skills, abilities, knowledge, education, experience and personal characteristics) (Dietz and Bozeman, 2005).

The open innovation research landscape is gradually developing a better understanding of its human side (Gassmann, Enkel and Chesbrough, 2010; Hosseini et al., 2017; Bogers, Foss and Lyngsie, 2018). A few studies have contributed to this understanding in highlighting the different individual characteristics required for general open innovation.
function (Mortara et al., 2009; Chatenier et al., 2010; Dabrowska and Podmetina, 2014; Hafkesbrink and Schroll, 2014). The studies highlight such skills and capabilities as negotiation, conflict resolution, problem solving and multi-tasking (Mortara et al., 2009; Chatenier et al., 2010), knowledge brokerage, team management (Hafkesbrink and Schroll, 2014), entrepreneurial skills (Lindegard and Kawasaki, 2010), decision-making, risk-taking and cultural awareness (Dabrowska and Podmetina, 2014). Despite the initial studies helping to shape the general understanding of the open innovation manager profile, the knowledge of the human capital components required for general open innovation function and for particularly company-university innovation remains quite fragmented (Vanhaverbeke, Cheng and Chesbrough, 2017). This dissertation aims to contribute in addressing this research gap and particularly in developing a profile of a company manager responsible for university collaboration in innovation.

2.4 Intermediary perspective towards UIC

Given the importance of the academia-business interface for economic development and the number of challenges that emerge in the university–industry relationships (Galán-Muros and Plewa, 2016), innovation intermediaries of different natures continue to emerge to facilitate the knowledge exchange between the two (Howells, 2006). For particularly the university–industry interaction context, Yusuf (2008, p. 1170) defines the intermediary as an entity whose ‘“midwifery” assists knowledge exchange between universities and the business community through the creation of bridging ties and interfaces, by diagnosing needs and articulating the demand for certain kinds of innovation, by instituting a dynamic framework for change and working to achieve the change through financing and other means’.

The forms of intermediation and respective bodies in UIC vary a great deal depending on various contextual factors, such as the goals of the particular UI collaboration (whether it is about tacit or explicit knowledge (technology) transfer or collaboration in education), the modes or links of interaction, the organisational structures of collaborating parties, institutional settings and others. This is why the actual terms used to describe the intermediating entity also vary and could be termed ‘technology transfer office’, ‘innovation intermediary’ or just ‘intermediary’, ‘collaborative platform’, ‘research centre’, ‘development agency’, ‘knowledge brokers’ and others (Bercovitz et al., 2001; Howells, 2006; Wright et al., 2008; Schoen, van Pottelsberghde la Potterie and Henkel, 2014; Barlatier, Giannopoulou and Pénin, 2017). To avoid a rather difficult choice in labelling the intermediating bodies, the general term ‘knowledge transfer intermediary’ (KTI) is used in this dissertation. This term serves as a holistic concept reflecting the function of transferring knowledge regardless of the position of this knowledge on the spectrums of ‘explicit vs. tacit’ and ‘know-what vs. know-about’ and regardless of the stage of its actual transformation to innovation (from creation to exploitation).

As the KTIs, again, take different forms and serve in satisfying different needs in UIC, the scholars studying them also apply various theoretical lenses. One of the most widely
acknowledged works on innovation intermediation thus far is that by Jeremy Howells (2006). In this work, the four key streams of literature on innovation intermediation are outlined: ‘(a) literature on technology transfer and diffusion; (b) more general, innovation research on the role and management of such activities and the firms supplying them; (c) the systems of innovation literature; (d) research into service organizations and more specifically Knowledge Intensive Business Services (KIBS) firms’ (Howells 2006, p. 716). The later special issue of Research Policy (2008) analyses in-depth intermediation in the context of university–industry linkages (Kodama, Yusuf and Nabeshima, 2008). That special section invites us into a discussion of the knowledge market per se and the role of intermediaries in transferring tacit and explicit knowledge on that market (Yusuf, 2008). A number of works on innovation intermediation in the UIC context study the types of KTIs and their structures (Bercovitz et al., 2001; Howells, 2006; Wright et al., 2008; Schoen, van Pottelsberghe de la Poterie and Henkel, 2014; Barlatier, Giannopoulou and Pénin, 2017). Finally, one of the latest works on innovation intermediation studies the rapidly developing phenomena of online marketplaces for knowledge or technology (Dushnitsky and Klueter, 2017). Particularly, the emerging digital form of knowledge transfer intermediation remains the least studied (and the least common in practice) thus far in the context of university–industry collaboration (Søndergaard, Bergenholtz and Juhl, 2015; Dushnitsky and Klueter, 2017) despite its relevance for the academia-business interface. For this reason, this dissertation is devoted to studying in-depth the emerging phenomenon of digital KTIs in university–industry collaboration. However, to understand the nature and the role of digital KTIs, it is necessary to first review the existing works on the general role of KTIs (including their non-digital, physical forms). This is why the dissertation continues with a review of the literature on knowledge markets and the role of KTIs within them as well as of their existing typologies in, particularly, the UIC context.

2.4.1 Knowledge markets and the phenomenon of intermediation

Given the complexity of knowledge as a phenomenon which may take various forms – from ‘explicit’ (codified) to ‘tacit’ knowledge (Polanyi, 1966; Nonaka and Takeuchi, 1995) – the need for intermediaries on the knowledge market appears not less evident when compared to traditional markets of goods and services (Booker et al., 2008). The knowledge market ‘serves functions similar to the traditional market by matching buyers with sellers, facilitating the exchange of information, goods, services, and payments, and providing a regulatory framework’ (Bakos 1998; Booker et al. 2008, p. 243). In the particular context of knowledge exchange happening across the academia-business interface, intermediaries ‘serve familiar roles of matching, repackaging, and redistribution – making academic findings available to practitioners’ (Booker et al. 2008, p. 243). As an instance or an intersection of the knowledge market, the ‘market for technology’ is also being studied. It implies an ‘exchange of goods for money’, which may take various forms, such as technological alliances, joint ventures, acquisitions and human capital flows and in concrete terms may be an ‘ex-ante’ practice (such as R&D
contracts) or 'ex-post' (such as licensing deals, co-development or alliances based on the exchange of existing technology) (Arora & Gambardella 2010, p. 777).

The phenomenon of intermediation is studied rather in-depth in the context of financial services and is outlined by the economic theory of intermediation in regards to transaction costs theory and information asymmetry (Allen and Santomero, 1998). However, even in this quite largely explored context of financial intermediation, the classical theories appear insufficiently developed to explain the paradox of transaction costs and information asymmetries decreasing over time and a number of intermediaries continuously growing (Allen and Santomero, 1998).

In the UIC context, intermediaries are also going through evolutionary development processes and, along with the rather traditional forms of university–industry knowledge transfer intermediaries such as technology transfer offices (TTOs) (Alexander and Martin, 2013) and Research and Technology Organisations (RTOs) (Barlatier, Giannopoulou and Pénin, 2017), novel forms such as online knowledge marketplaces continuously emerge (Dushnitsky and Klueter, 2011). Again, similar to the financial sector (Allen and Santomero, 1998), despite the novel forms of information management and exchange being available and continuously advanced, the number of knowledge transfer intermediaries (KTIs) in UIC continues to grow (Barlatier, Giannopoulou and Pénin, 2017), and the barriers remaining in university–industry relationships may explain that growth at least partially (Galán-Muros and Plewa, 2016). This only extends the diversity of the KTIs’ forms (see the following subchapter) and consequently challenges our understanding of the phenomena as well as increases the complexity of the KTIs’ performance measurement and evaluation (Comacchio and Bonesso, 2012).

### 2.4.2 Typologies of the KTIs in UIC

A number of studies have contributed to building our understanding of the functions that innovation intermediaries play in knowledge and technology transfer as well as in the innovation management processes. Table 3 summarises a few examples of such studies – some focus generally on innovation management or knowledge transfer, and some take a closer look at the university–industry interface.

More than a decade ago, Howells (2006) provided us with one of the first holistic typologies of knowledge transfer intermediaries (KTIs). The study outlines 10 key functions of innovation intermediaries, which were also reflected in later works – including those done in the university–industry collaboration context (see Table 3). The first is foresight and diagnostics, referring to technology foresight and forecasting, which is also found as a function of research and technology organisations (RTOs) (Arnold et al., 2007; Agogu, Ystr and Masson, 2013) and the articulation of needs and requirements (Yusuf 2008 - for UIC). The second is scanning and information processing, or scanning and technology intelligence, which also found to be important in the UIC context as a function of ‘external’ intermediaries (such as regional development agencies and public research centres) (Wright et al., 2008) and appears among the key functions of online
knowledge marketplaces (Dushnitsky and Klueter, 2017). The third, knowledge processing and combination/recombination, helps to combine partners’ knowledge, generating in-house knowledge (Arnold et al., 2007; Agogu, Ystr and Masson, 2013). Fourth, gatekeeping and brokering, refers to matchmaking and brokering (Agogu, Ystr and Masson, 2013; Dushnitsky and Klueter, 2017) and contractual advice explicit in the UIC context (Wright et al., 2008; Alexander and Martin, 2013; Schoen, van Pottelsberghe de la Potterie and Henkel, 2014). Fifth, testing and validation, entails diagnostics, analysis and inspection, prototyping and pilot facilities, scaling-up and training – these functions are performed by universities but still remain particularly relevant in cases of projects with RTOs (Arnold et al., 2007; Agogu, Ystr and Masson, 2013). Sixth, accreditation, refers to specification setting and providing standards advice, which, again, is particularly relevant in cases of projects with RTOs (Arnold et al. 2007). Seventh is regulation and arbitration; these functions are also discussed in the UIC context in relation to KTI structures and autonomy (Markman et al., 2005; Schoen, van Pottelsberghe de la Potterie and Henkel, 2014). Eighth, protecting the results, refers to intellectual property (IP) rights (IPR) advice and management, which is relevant in cases of technology transfer offices (TTOs) in the UIC context (Wright et al., 2008; Alexander and Martin, 2013; Schoen, van Pottelsberghe de la Potterie and Henkel, 2014). Ninth, commercialisation, entails market research and business planning, sales network and selling, finding potential capital funding, venture capital and initial public offerings – functions related to technology- (or knowledge-) based entrepreneurship, which is acknowledged as one of the key competences of, for example, university TTOs (Alexander and Martin, 2013). Finally is evaluation of outcomes, referring to technology assessment and evaluation; although not commonly, this function is practiced by university in-house TTOs in the UIC context, such as in the case of Stanford University’s TTO (Barlatier, Giannopoulou and Pénin, 2017).

As can be seen, the functions of general innovation intermediaries are quite widely explored and understood by the existing literature. Regarding the university–industry collaboration context, a number of substantial research works have explored in-depth and explain the role and functions of knowledge transfer intermediaries – however, thus far mainly from the perspective of their organisational structures (or the structural dimension of the institutional theory approach) (Bercovitz et al., 2001; Markman et al., 2005; Schoen, van Pottelsberghe de la Potterie and Henkel, 2014). At the same time, the recent literature review on university technology transfer (Miller et al. 2016) suggests that there is a need to take a contextual approach towards studying the performance and effectiveness of intermediaries as contextual settings appear to vary greatly from one case of university knowledge/technology transfer to another. Furthermore, the literature also suggests that the emerging forms of online knowledge marketplaces, crowdsourcing platforms and digital knowledge transfer intermediaries – their functions and business models – remain largely unexplored, both in the business-to-business context (Dushnitsky and Klueter, 2017) and even more so in the university-to-industry context (Soendergaard, Bergenholtz and Juhl, 2015; Barlatier, Giannopoulou and Pénin, 2017). This dissertation aims to contribute in covering this research gap.
Table 3: The functional typologies of KTIs (examples of those developed in the last decade)

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KTI Functions

1. Foresight and diagnostics
2. Scanning and information processing
3. Knowledge processing and combination/rec combination
4. Gatekeeping and brokering
5. Testing and validation
6. Accreditation
7. Regulation and arbitration
8. Protecting the results
9. Commercialisation
10. Evaluation of outcomes
2.5 Assessment of UIC: Government and multi-stakeholder perspective

Given the number of challenges and barriers existing in university–industry collaboration processes (Galán-Muros and Plewa, 2016) as well as the polarity of the key actors’ goals and motives (Parker, 1992), the assessment of UIC becomes an extremely challenging task (Rossi and Rosli, 2015). Furthermore, the definition of UIC ‘success’ and ‘performance’ may vary greatly depending on who is intending to evaluate these – whether it is a university perspective assessment or takes a business-focused lens or whether it is an evaluation carried out by a third party – such as public agencies co-financing collaborative initiatives or state or regional communities intending to assess the impact of UIC on society (Link and Siegel, 2005; Leyden and Link, 2013; Albats, Fiegenbaum and Cunningham, 2018). Despite the importance of university–industry relationships for innovation development per se and, consequently, the importance of the assessment of such relationships (Nuutinen et al., 2017) being acknowledged (Seppo and Lilles, 2012; Rossi and Rosli, 2015), a universal set of key performance indicators (KPIs) for such does not exist (Perkmann, Neely and Walsh, 2011; Piva and Rossi-Lamastra, 2013). Among the key reasons for the absence of a universal evaluation instrument are, first, multi-stakeholder involvement – the polarity of their approaches and relativism in UIC assessment (Salimi and Rezaei, 2016) – and second, linked to the first, the high contextual dependency of the KPIs’ relevance for particular UIC cases (Albats, Fiegenbaum and Cunningham, 2018).

In Publication I, constituting this dissertation (Albats, Fiegenbaum and Cunningham, 2018), a process approach to systemising UIC KPIs is applied – particularly, taking Brown and Svensson’s (1998) collaboration lifecycle of inputs, in-process activities, outputs and impacts (this lifecycle was later used also by Perkmann et al. 2011 in the UIC context). The process approach enables the building of a relatively holistic picture of the UIC lifecycle and the KPIs relevant for each of the stakeholders at each of the UIC process stages. In the following subsections the stakeholders’ perspectives towards UIC success assessment (university, industry or multi-stakeholder perspectives: both academia and industry as well as all the Quadruple/Quintuple Helix stakeholders) are reflected based on the review of the existing scientific works. Table 4 summarises the selection of studies used in this dissertation by the stakeholder(s)’ perspectives that the studies take. The studies were classified predominantly based on the stakeholder groups’ approaches to validating the certain set of KPIs or evaluation criteria. Thus, although many of the KPIs developed in each of the studies could serve all the stakeholder groups’ perspectives to a certain extent, the basis for classification is the sample approached or the primary and secondary data used. For example, based on the data collected it is rather an academia perspective taken in the study by Kauppila et al. (2015), while rather a business/industry perspective is taken in case of the study by Perkmann et al. (2011). Both core actors’ perspectives are primarily explored, such as in the study by Barnes et al. (2002) or Mead et al. (1999). A third-party perspective is taken, for example, in the study by D’Este et al. (2012) in exploring the effects of geographical proximity. Finally, among the limited
2.5 Assessment of UIC: Government and multi-stakeholder perspective

number of studies, a rather Quintuple Helix stakeholder (or multiple-stakeholder) approach is applied in the study by Rossi and Rosli (2015).

Table 4: Summary of the KPIs of UIC success
Were reviewed and utilised in Publication I (Albats et al. 2017) – reorganised here per stakeholder perspective

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<th>Stakeholder/UIC stage</th>
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<th>In-process activities</th>
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2.5.1 University perspective towards UIC assessment

Given the scientific nature of university and research institutions, not surprisingly, one of the common indicators applied to evaluating UIC inputs from the academia side is the number of joint publications, citations, projects, reports, contracts or patents done in the past (Petruzzelli, 2011; Kauppila et al., 2015; Albats, Fiegenbaum and Cunningham, 2018). For the in-process activities, linked to the mentioned inputs, a clear publication policy and IPR agreements are highlighted by the literature addressing the academia
Theoretical background

perspective (Kauppila et al., 2015). Along with commitment to collaboration (Butcher and Jeffrey, 2007) and inter-organisational trust (Barbolla and Corredera, 2009; Kauppila et al., 2015), the literature highlights a need for clearly defined roles and working methods to support value creation on both sides (Barbolla and Corredera, 2009; Kauppila et al., 2015). Finally, the importance of strong project management capability is also highlighted by the university-focused literature dealing with UIC success assessment (Butcher and Jeffrey, 2007; Kauppila et al., 2015).

In terms of UIC outputs and outcomes, the university-perspective studies again put an emphasis on publications and their impact (including dissertations as UIC outcomes) (Salimi and Rezaei, 2016) and patents (Petruzzelli, 2011). Notably, impact measures are often neglected in the university-perspective type of studies (Perkmann et al., 2013) – especially in respect to UIC’s impact on university teaching (Lin and Bozeman, 2006). However, the general importance of such impacts, such as ‘return on investment’, is acknowledged (Santoro, 2000), and a recent study (Wang et al., 2016) has already detected an inverted U-shape relationship between academic commercialisation and teaching performance. Overall, the university-perspective type of studies tend to place more emphasis on the inputs, in-process activities and outputs of UIC along with the need for continuous and careful governance and monitoring of the entire UIC process (Kauppila et al., 2015). The impacts are more carefully considered when the other stakeholders are invited to examine the UIC success and/or performance.

2.5.2 Industry perspective towards UIC assessment

The industry-perspective studies among UIC inputs highlight such measurements as the R&D expenditures of both parties (Al-Ashaab et al., 2011) and the number of joint publications done in the past (Perkmann, Neely and Walsh, 2011). In terms of the in-process activities, the industry-focused literature, like the university-focused studies, puts an emphasis on such metrics as clearly defined roles (Rohrbeck and Arnold, 2007), jointly defined strategy (Rohrbeck and Arnold, 2007; Perkmann, Neely and Walsh, 2011) and clarity of publication and IPR management policies (Rohrbeck and Arnold, 2007; Bruneel, D’Este and Salter, 2010; Bstieler, Hemmert and Barczak, 2015). Such studies as those focusing on the perspective of one of the two key actors underscore the importance of trust and commitment (Bruneel, D’Este and Salter, 2010; Schubert and Bjør, 2012), the alignment of the working methods (Rohrbeck and Arnold, 2007; Schubert and Bjør, 2012) and strong project management (Rohrbeck and Arnold, 2007; Bstieler, Hemmert and Barczak, 2015). In addition to the KPIs shared with the university-focused studies, the firms-oriented literature also points out such metrics as the number of joint supervisions, the number of the university’ students working with the company (Al-Ashaab et al., 2011) and the number of social events, such as joint public lectures (Perkmann, Neely and Walsh, 2011).

Compared with the university-centric literature, the industry-focused works appear to place a slightly greater emphasis on the UIC outputs and impacts. The output KPIs, in addition to the number of joint publications, patent applications, patents granted and
2.5 Assessment of UIC: Government and multi-stakeholder perspective

Jointly supervised thesis works (Al-Ashaab et al., 2011; Perkmann, Neely and Walsh, 2011) include, depending on the context, such metrics as the number of new (improved) products/services/technologies/architectures or designs (Al-Ashaab et al., 2011; Perkmann, Neely and Walsh, 2011). Furthermore, the number of best business practices developed and adapted by the focal firm as a result of UIC is outlined as an outcome KPI of UIC (Al-Ashaab et al., 2011). The company-perspective impact metrics include financial KPIs (such as gross profit and cost savings thanks to UIC projects (Al-Ashaab et al., 2011)), the number of successfully completed business projects and the number of emerging follow-up projects (Al-Ashaab et al., 2011; Perkmann, Neely and Walsh, 2011). The sustainability-related metrics – in the technical/technological sense (such as recycling), from the social and strategy perspectives (such as number of new employees and the company’s network capital developed), (Al-Ashaab et al., 2011; Perkmann, Neely and Walsh, 2011) also outline the company perspective towards UIC assessment.

2.5.3 Multi-stakeholder perspectives towards UIC assessment

The literature on UIC assessment addressing the perspectives of multiple stakeholder groups (such as both university and industry at the same time or the perspectives of the third parties (such as governmental agencies, society) or those that tend to take all of these into account) mostly cover the KPIs that the solely university-focused or solely company-focused studies consider (Albats, Fiegenbaum and Cunningham, 2018). Furthermore, such multiple-stakeholder studies bring in a number of additional KPIs – those that are overlooked by single-stakeholder-focused studies (Albats, Fiegenbaum and Cunningham, 2018).

Particularly, the ‘additional’ input KPIs brought in by the multi-stakeholder literature include, first, the financial resources invested in collaboration – government and industry co-financing as well as industry in-kind contributions (Seppo and Lilles, 2012; Rossi and Rosli, 2015). Furthermore, the third-party lens applied to UIC outlines such input KPIs as the corporate strategies towards UIC and the amount of resources allocated to support such strategies along with both parties’ staff perception towards the benefits of UIC and the number of a company’s previous contacts or current involvements with universities (Seppo and Lilles, 2012). The company characteristics, such as company quality certificates (such as those granted by the International Organization for Standardisation – ISO) membership in relevant associations or research groups and the structure of the company’s employees by occupation and education, are also suggested for a closer look when assessing the inputs for UIC. As one of the recipes for diminishing the barriers arising often in UIC (Galán-Muros and Plewa, 2016), the multi-stakeholder literature also suggests tracking the acceptance of each other’s needs and benefits by both parties (further assigned in the partner agreement) as well as assuring effective communication channels and modes, as the input-stage KPIs.

Of the ‘additional’ in-process KPIs, the multi-stakeholder literature suggests a number of postdoctoral or doctoral positions offered within the UIC as well as secondment of researchers (Ramos-Vielba, Fernández-Esquinas and Espinosa-de-los-Monteros, 2009;
Seppo and Lilles, 2012). Among the added output KPIs, the Quintuple Helix perspective suggests tracking the number of UIC services (provided by the university/acquired by company) along with the university income from industry collaborations (per type of service), including the number of licenses and amount of licence revenue (Rossi and Rosli, 2015).

The unquestionable added-value of the multiple-stakeholder approach application to UIC assessment is its contribution to the assessment of the UIC impact, which was brought in per se by a number of policy studies and their ‘Impact’ agenda (Lambert, 2003; Witty, 2013; Allas, 2014). The concrete metrics on the impact level brought in by the multi-stakeholder studies include the number of UIC-originated start-ups, spin-offs and linked metrics of the employment growth and investments turnover as well as global impact metrics (knowledge intensity of production; export growth, etc.) (Seppo and Lilles, 2012; Rossi and Rosli, 2015; HEFCE, 2017).

2.6 UIC links and challenges

In studying UIC stakeholders scholars invest a lot of effort in studying how actually (through what links) the stakeholders are connected, what brings them together and what hinders their collaboration (Bruneel, D’Este and Salter, 2010; Galán-Muros and Plewa, 2016). Universities and industry happen to be involved in relationships via various collaborative links (Meyer-Krahmer and Schmoch, 1998; Perkmann and Walsh, 2007) although both parties face a number of challenges along each of the collaborative links (Bruneel, D’Este and Salter, 2010; Galán-Muros and Plewa, 2016). The work by Galán-Muros and Plewa (2010) is one of the most recent studies combining an in-depth literature review and empirical validation and providing an overarching outlook towards collaborative links (or activities) and barriers as well as drivers of UIC. Table 5 summarises the proposed types of activities, barriers and drivers of UIC.

In terms of UIC activities, Galán-Muros and Plewa (2010) suggest that there are three key streams – education, research and valorisation. The education set of UIC links includes such activities as curriculum design and delivery and joint supervision (Alexander and Martin, 2013). It also includes lifelong learning activities (seminars, workshops for industry, training of company employees and continuous professional development (Meyer-Krahmer and Schmoch, 1998; Alexander and Martin, 2013)) and student mobility (training of postgraduates and internships at the firm, student placements (Ramos-Vielba, Fernández-Esquinas and Espinosa-de-los-Monteros, 2009; Alexander and Martin, 2013)). The research type of UIC combines such activities as professional mobility (employee exchange, secondment, postgraduate training in the company) and R&D-related activities (contract, sponsored and collaborative research; shared facilities; publications; PhD theses (Meyer-Krahmer and Schmoch, 1998; Georgiou and Roessner, 2000; Cohen, Nelson and Walsh, 2002)). Finally, the valorisation type of activities entails entrepreneurship, including joint ventures, academic and student entrepreneurship, spin-offs and spin-outs (Cohen, Nelson and Walsh, 2002; Perkmann and Walsh, 2007; Ramos-
2.6 UIC links and challenges

Vielba, Fernández-Esquinas and Espinosa-de-los-Monteros, 2009; Alexander and Martin, 2013). It also includes commercialisation-related activities, such as consulting, patents and licencing (Meyer-Krahmer and Schmoch, 1998; Cohen, Nelson and Walsh, 2002; D’Este and Patel, 2007). Although the study by Galán-Muros and Plewa (2010) mentions the relevance of less formal activities, their proposed framework mainly combines rather tangible forms of knowledge transfer between universities and industry. However, if one looks at prior works (Meyer-Krahmer and Schmoch, 1998; Cohen, Nelson and Walsh, 2002; D’Este and Patel, 2007; Perkmann and Walsh, 2007; Ramos-Vielba, Fernández-Esquinas and Espinosa-de-los-Monteros, 2009; Alexander and Martin, 2013), less formal modes of engagements, such as participation in conferences and other events and networking between university and company employees, are also highlighted. These, less formal activities may take place along each of the collaborative streams (education, research, valorisation) and even across them (see Table 5).

Despite the variety of the known collaborative mechanisms, a number of barriers continue to exist in UIC. The study by Galán-Muros and Plewa (2010), being one of the most recent works on the topic, shares four key types of barriers in UIC (Table 5). The first barrier is a connection problem – the challenge of identifying and selecting the right academic/industry partner in terms of capabilities and strategic fit (Barnes, Pashby and Gibbons, 2002; Muscio and Pozzali, 2012; Plewa et al., 2013). The second common barrier identified is a lack of funding for collaboration on all the three ends – government, industry and academia (Etzkowitz, 1998; Lambert, 2003; Bercovitz and Feldman, 2007; Perkmann, Neely and Walsh, 2011; Muscio and Pozzali, 2012). The third principle barrier in UIC relates to the differences in organisational culture – differences in motivations (research and education vs. profit), communication (academic vs. business language), timeframes and different operational settings (Barnes, Pashby and Gibbons, 2002; Bruneel, D’Este and Salter, 2010; Muscio and Pozzali, 2012). The fourth barrier, closely linked with the previous one, relates to differences in internal characteristics, including publications on the university side vs. non-disclosure principles on the industry side and the limited absorptive capacity of companies (Perkmann and Walsh, 2009).

Although there are many barriers in UIC, there are also drivers of these inter-organisational relationships which bring the stakeholders together. According to Galán-Muros and Plewa (2010) there are two key types of drivers. The first implies the availability of complementary resources: for universities these are industrial challenges, knowledge of industrial needs, co-financing of university research and contribution to university educational activities; for companies this implies access to the advanced academic research results and access to the human capital and shared facilities (Etzkowitz and Leydesdorff, 2000; Bercovitz and Feldman, 2007; Ramos-Vielba, Fernández-Esquinas and Espinosa-de-los-Monteros, 2009). As in any inter-organisational relationships, such attributes as trust, commitment, experiences in prior relationships and shared goals also support UIC as a relationship driver (Barnes, Pashby and Gibbons, 2002; Siegel, Waldman and Link, 2003; Mora-Valentin, Montoro-Sanchez and Guerras-Martin, 2004; Muscio and Pozzali, 2012; Galán-Muros and Plewa, 2016).
Despite the barriers and drivers of UIC being well explored and understood by scholars, the ways to overcome the barriers, unlock the drivers and thus facilitate UIC remain to a large extent undefined (Siegel et al., 2004; Bruneel, D’Este and Salter, 2010; Galán-Muros and Plewa, 2016).
Table 5: UIC links, barriers and drivers
Based on Galán-Muros and Plewa (2010) and other previous works

<table>
<thead>
<tr>
<th>UIC Links/Activities</th>
<th>Barriers and Drivers of UIC</th>
</tr>
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<tbody>
<tr>
<td><strong>Informal interactions</strong>: conferences, networking (Meyer-Krahmer &amp; Schmoch 1998; Cohen et al. 2002; Perkmann &amp; Walsh 2007; D’Este &amp; Patel 2007; Ramos-Vielba et al. 2009; Alexander &amp; Martin 2013)</td>
<td><strong>Connections</strong> (identification and selection of partners) (Barnes et al., 2002; Muscio and Pozzali, 2012; Plewa et al., 2013)</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td><strong>Funding</strong> (lack of funding on all the three sides – government, university, industry) (Bercovitz and Feldman, 2007; Etzkowitz, 1998; Lambert, 2003; Muscio and Pozzali, 2012; Perkmann et al., 2011)</td>
</tr>
<tr>
<td>Curriculum design and delivery (joint supervision) (Alexander &amp; Martin 2013)</td>
<td><strong>Organisational culture</strong> (motivations, communication, timeframes and other operational settings) (Barnes et al., 2002; Bruneel et al., 2010; Muscio and Pozzali, 2012)</td>
</tr>
<tr>
<td>Lifelong learning (seminars, workshops for industry, training of company employees and CPD) (Meyer-Krahmer &amp; Schmoch 1998; Cohen et al. 2002; Perkmann &amp; Walsh 2007; D’Este &amp; Patel 2007; Ramos-Vielba et al. 2009; Alexander &amp; Martin 2013)</td>
<td><strong>Internal characteristics</strong> (publications vs. non-disclosure, companies absorptive capacity) (Hall et al., 2001; Perkmann and Walsh, 2009)</td>
</tr>
<tr>
<td>Student mobility (training of postgraduates and internships at the firm, student placements) (Ramos-Vielba et al. 2009; Alexander &amp; Martin 2013)</td>
<td><strong>Resource availability</strong> (complementary resources) (Ramos-Vielba et al., 2009; Bercovitz and Feldmann, 2006; Etzkowitz and Leydesdorff, 2000)</td>
</tr>
<tr>
<td><strong>Research</strong></td>
<td><strong>Drivers</strong></td>
</tr>
<tr>
<td>Professional mobility (employee exchange, secondment, postgraduate training in the company) (Roessner 1993; Meyer-Krahmer &amp; Schmoch 1998; Cohen et al. 2002; Perkmann &amp; Walsh 2007; D’Este &amp; Patel 2007; Ramos-Vielba et al. 2009; Alexander &amp; Martin 2013)</td>
<td><strong>Relationships</strong> (trust, commitment, prior relationships, shared goals) (Siegel et al., 2001; Barnes et al., 2002; Mora-Valentin et al., 2004; Muscio and Pozzali, 2012)</td>
</tr>
<tr>
<td>R&amp;D (contract, sponsored, collaborative research, shared facilities, publications, PhD theses) (Roessner 1993; Meyer-Krahmer &amp; Schmoch 1998; Cohen et al. 2002; Perkmann &amp; Walsh 2007; D’Este &amp; Patel 2007; Ramos-Vielba et al. 2009; Alexander &amp; Martin 2013)</td>
<td></td>
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</table>
2.7 Stakeholder theory and ‘Helix’ concepts in studying UIC

The stakeholder theory has been developed to cope with the problems which appear to a different extent relevant for the modern state of university–industry collaboration, where the core collaborative actors may have polar visions towards joint activities or conflicting interests (Parker, 1992; Mcadam et al., 2012). According to the originator of the stakeholder theory, Edward Freeman, it was developed to solve at least three specific problems (Freeman et al., 2010).

The first is ‘the problem of value creation and trade’ – or the understanding of how those two are possible in rapidly changing and context-dependent business relationships (Freeman et al. 2010, p. 4), which appears particularly relevant for the knowledge markets where UIC is primarily positioned. The second is ‘the problem of the ethics of capitalism’, which in the context of university-business collaboration, in addition to the ‘business vs. ethics’ discussion on the business side (Freeman et al. 2010’, p. 4-5), is enriched by the debates around ‘academic capitalism’ emerging from the developing phenomenon of the entrepreneurial university (Slaughter and Larry L., 1997; Renault, 2006). The third problem addressed by stakeholder theory is ‘a problem of managerial mindset’ (Freeman et al. 2010, p. 5), which again stresses the issues on both ends of the university-business links. On the business side, it is reflected as a challenge of combining business and ethics in the managerial mindset while facing the age of turbulence and globalisation. On the university side it is reflected first in the challenge for economics scientists to redefine economic theory to address ethical challenges and, second, in the challenge of developing business schools’ curricula that supports nurturing the dual (business plus ethics) managerial mindset (Freeman et al., 2010).

Classical stakeholder theory (Freeman, 1984) studies the strategic management of the organisation analysing the internal and external stakeholders – actors (individuals or groups of them) which ‘can affect or are affected by the achievement of the organisation’s objectives’ (Freeman 1984, p. 46). One of the critics of stakeholder theory argues that it applies solely to corporations (Donaldson and Preston, 1995). However, recent developments in stakeholder theory suggest that it can and, moreover, should also be applied to ‘small or family owned businesses, privately owned concerns of any size, partnerships, non-profit and governmental organizations’ (Phillips et al. 2003, p. 495; Freeman et al. 2010).

In this respect, the recent works on university–industry collaboration, knowledge and technology transfer tend to apply stakeholder theory increasingly more often and not just studying firms in their collaboration with universities (as Abidin et al. 2003). Scholars also apply it to studying the university as a focal actor (Mcadam, Miller and Mcadam, 2016b) as well as to collaborative projects with multiple stakeholders involved (Carlos et al., 2015). The relevance of stakeholder theory as one of the theoretical lenses for studying UIC has also been increasing due to the constantly growing empirical applicability of the ‘Helix’ concepts.
Following the main goal of this research of seeking ways to facilitate university–industry collaboration, this dissertation applies the stakeholder theory perspective as an umbrella approach. This work is an attempt to build a holistic picture and suggest measurements that take into account the perspective of each of the stakeholders in the Triple Helix (university, industry, government) while still reflecting the impacts of their actions on broader society (Quadruple Innovation Helix) taking place in environmental settings (Quintuple Innovation Helix). Thus, the author continues with reviewing the literature that studies the UIC links, challenges and perspectives of each of the three stakeholders of the Triple Helix, including intermediaries as the focal ones, the impacts made by their interactions and the contexts in which these stakeholders interact.

2.8 Summarising the literature insights and research problems

The dissertation is article-based and is formed of five research articles, each of which addresses the perspective of a particular actor in university–industry relations towards UIC at a particular level of analysis. Table 6 summarises the research problems addressed by this dissertation per groups of stakeholders in university–industry collaboration.

Specifically, the research papers contributing this dissertation are follows:


- **Publication V** takes a multi-actor perspective towards analysing UIC performance – all three actors of the Triple Helix – university, industry and government
Theoretical background


Figure 5 describes the theoretical framework of the dissertation and highlights the theoretical contribution of each publication. All the research publications included in the dissertation to a certain extent address issues of inter-organisational relationships and, thus, the theory of inter-organisational relationships frames the general theoretical background of the dissertation. Dashed lines in the figure highlight that the theoretical approaches cross-cut rather than limit the scope.

Figure 5: Theoretical framework of the dissertation

Concept level (circles): The key stakeholders and the key linked concepts (university and the concept of entrepreneurial university; industry approached with the knowledge-based view and open innovation concept; government and society linked via Quadruple-Helix concept; intermediary in university–industry relationships).

Theory level (rectangle): Stakeholder theory as an overarching framework for studying the relationships between stakeholder organisations in the context of university–industry relationships.

Publication level (Publications I-IV boxes): Article in this dissertation contributing a certain stakeholder perspective.
Table 6: Summary of the research problems per group of stakeholders in UIC

<table>
<thead>
<tr>
<th>#</th>
<th>UIC stakeholders</th>
<th>Research gaps addressed</th>
<th>Research sub-question(s) to be answered</th>
<th>Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Academia perspective</td>
<td>The distinction between ‘academic entrepreneurs’ and ‘entrepreneurial academics’ remains unclear.</td>
<td>RSQ1: What distinguishes academic entrepreneurs from entrepreneurial academics?</td>
<td>Publication I</td>
</tr>
<tr>
<td>2</td>
<td>Industry perspective</td>
<td>The components of organisational human capital required for successful university–industry collaboration remain unstudied.</td>
<td>RSQ2: What are the employees’ skills and knowledge required for companies’ collaboration for innovation with external partners? RSQ3: What are the skills required specifically for sustainable collaboration with universities, and how do they differ from those required for collaborating with other types of external partners?</td>
<td>Publication II</td>
</tr>
<tr>
<td>3</td>
<td>Academia and industry perspective</td>
<td>Ambiguity of ‘open innovation’ concept within and between academia and business communities remains.</td>
<td>RSQ4: How does factual open innovation adoption vary for companies that claim to be open innovation adopters and those that claim they do not adopt open innovation? RSQ5: What open innovation activities, identified as such by academic researchers, are not considered open by business practitioners?</td>
<td>Publication III</td>
</tr>
<tr>
<td>4</td>
<td>Intermediary perspective</td>
<td>The novel forms of online intermediation platforms in the UIC context, their roles, functions and revenue streams remain unexplored.</td>
<td>RSQ6: What are the emerging types of online intermediaries in UIC? RSQ7: What are the roles and functions these different types of intermediaries have in UIC?</td>
<td>Publication IV</td>
</tr>
<tr>
<td>5</td>
<td>Multi-stakeholder perspective: academia, industry, government, society</td>
<td>It is unclear which UIC KPIs are common and which are context-specific.</td>
<td>RSQ8: What are (1) the common and (2) context-specific key performance indicators of UIC at the micro level?</td>
<td>Publication V</td>
</tr>
</tbody>
</table>
3 Methodology

3.1 Defining the research paradigm

This dissertation is devoted to exploring the phenomenon of *inter-organisational relationships* in the context of *university–industry collaboration*. It focuses particularly on university–industry collaboration for innovation, where ‘knowledge’ is an essential asset. The concept of *knowledge* itself is quite *elusive*, and its definition or the perception thereof depends highly on contextual settings (Cormican & O’Sullivan, 2003, p. 3). Following the *Theaetetus* of Plato (Everson, 1990; Fine, 1992) and understanding of knowledge as a *‘justified true belief’* Ladyman (2002) frame the traditional view towards knowledge: *‘knowledge can only be claimed when we have an adequate justification for our beliefs’* (Ladyman 2002, p. 6). Cormican and O’Sullivan (2003, p. 3) reframe it as *‘an opinion, idea or theory that has been verified empirically and agreed upon by a community’*. Thus, the first important notion about knowledge is its relativism – to become knowledge, the information, idea or opinion needs to be *agreed* upon or accepted by a community. Therefore, in relation to the ontological debates of the Four Paradigms (Burrell and Morgan, 1979), one can conclude that whatever knowledge is produced, acquired or shared – it all goes through humans’ subjective evaluation – is a product of the human mind – in combination with the case-specific characteristics of the environment – see Figure 6 for the position of this research in the Four Paradigms. Furthermore, in terms of the epistemological debate as knowledge is being agreed upon by a community, it is always a collective effort of the social actors involved within the knowledge creation process. In terms of human nature, the author acknowledges both that the environment affects humans’ behaviour and that humans themselves do as well as those building the environment (rather than being prisoners thereof). Furthermore, Markusen (1994) suggests that knowledge is complex, is hard to package, is often intrinsically embedded in the *knower* and cannot be *commoditised* or *traded* as a part of a transaction between two parties. However, to make the knowledge transfer between two actors happen, the knowledge embedded within one actor needs to be acquired by (embedded into) the other (Cutler, 1989). Such an approach on knowledge being embedded within knower reflects the tacit knowledge which is a target for the interpretive view in epistemological debates.
Individuals involved in collaborations are supposed to be building knowledge collectively – in a collaborative group and also within one’s own working environment. Looking at the reality through the prism of the interaction between individuals and following the approach of Alexander (2012), the author positions herself as a social constructivist. The author’s research orientation as a social constructivist is based on two reasons. The first is the nature of the phenomenon in focus – continuous (dynamic) flows of knowledge (tacit and explicit) happening between individuals (social actors) and being embedded within those actors. Second is an assumption that university–industry collaboration should be considered in the first place as a social interaction as it implies a transfer of knowledge, which in turn is embedded into actors and, due to its embeddedness, is supposed to be jointly (or socially) constructed.

3.2 Research methodology

3.2.1 Research approach

The methodological choices made for this PhD dissertation follow the philosophical considerations described above and the focus of this research – university–industry collaboration for innovation – as well as its goals and research questions.

Two of the central concepts in the studied phenomenon are knowledge, which takes both explicit and tacit forms as one of the core reasons or assets for these relationships, and its transfer happening between individuals or social actors having their own internal perceptions and interpretations of the world. These perceptions of the world as subjective constructions and knowledge as a tacit asset call for capturing the qualitative rather than quantitative factors of the knowledge transfer process (Nonaka and Takeuchi, 1995). This is one of the two key reasons for taking an exploratory rather than an explanatory approach to this study. Another reason for the research approach chosen lies in the
rationale of this research. As the primary aim of this research is to find ways to facilitate university–industry collaboration, or, in other words, to find out how the UIC could be facilitated keeping in mind the perspectives of all the actors of the Helixes, the study needs to take an exploratory approach rather than a descriptive or explanatory one. This is particularly because an exploratory approach assists in capturing a holistic view towards various perceptions (D'Iribarne, 1996) as it deals with the ‘...”soft” inter-relationships between core factors...’ (Marschank-Piekari and Welch, 2004).

In terms of the overall logic or research strategy, the dissertation follows an abductive approach (Bryman and Bell, 2015) for a combination of reasons. On one hand, the theoretical developments in the field of university–industry collaboration have an established agenda (Perkmann and Walsh, 2007; Perkmann et al., 2013), which may be used for further theory testing as per a deductive approach (Bryman and Bell, 2015). On the other hand, a great variety of issues in the field remain unsolved along with a number of novel theoretical developments (such as the open innovation concept) (Perkmann et al., 2014; Geoghegan, 2017). Mantere and Ketokivi (2013) propose that in such a case of some degree of theory development with certain conceptual issues remaining unsolved, a balance between computational and cognitive reasoning is needed. That drives this dissertation to simultaneously grasp the perceptions of the actual participants of the UIC process, test whenever possible and discuss those against the linked theories rather than merely examine the existing theory, as a deductive approach would suggest, or rely primarily on the data, as inductive reasoning implies (Bryman and Bell, 2015).

Taking a multi-stakeholder approach in the context of UIC requires carrying out research at different levels of analysis – the individual level (as individuals are involved in collaborations); the organisational/institutional level (as these set up the rules for those collaborations); the inter-organisational level (the actual collaboration level) and the extra-organisational and industrial/regional/social levels (as these form the environment) (Bogers et al., 2017). This dissertation addresses the three levels of analysis (see Table 7) following the classification of Bogers et al. (2017), which distinguishes between different levels of analysis particularly for the context of collaboration for innovation. Specifically, Paper I studies the phenomenon of entrepreneurial academic entrepreneurs mainly on the intra-organisational or individual level, although it refers back to the institutional (organisational) level. Papers II–IV stay on the organisational level as the focus is particularly from the company (Papers II, III) or intermediary (Paper IV) perspective. Paper V has collaborative projects in focus and grasps the perspectives across participating organisations and decision-making levels.
Table 7: Research object, subject, context and level of analysis
(using the categorisation proposed by Bogers et al., 2017) applied in each research paper constituting the dissertation

<table>
<thead>
<tr>
<th>Research Paper #</th>
<th>Research Object</th>
<th>Research Subject</th>
<th>Research Context</th>
<th>Level of Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publication I</td>
<td>Literature on academic entrepreneurs and entrepreneurial academics</td>
<td>Entrepreneurship function of university researchers and perception of it</td>
<td>University mission including the third one</td>
<td>Vary, but mainly intra-organisational – individual</td>
</tr>
<tr>
<td>Publication II</td>
<td>Companies’ human capital</td>
<td>Companies’ collaboration for innovation</td>
<td>Companies’ collaboration for innovation with universities</td>
<td>Organisational</td>
</tr>
<tr>
<td>Publication III</td>
<td>Perception of open innovation practices and concept by scientific and business communities</td>
<td>Open innovation phenomenon</td>
<td>Europe-based companies</td>
<td>Organisational</td>
</tr>
<tr>
<td>Publication IV</td>
<td>Knowledge transfer intermediaries</td>
<td>Knowledge transfer intermediation</td>
<td>University–industry collaboration and knowledge transfer</td>
<td>Organisational</td>
</tr>
<tr>
<td>Publication V</td>
<td>KPIs of the UIC process</td>
<td>UIC collaboration process</td>
<td>Cross-boundary collaborations – collaborative projects across disciplines and organisational and country borders</td>
<td>Inter-organisational</td>
</tr>
</tbody>
</table>
3.2.2 Research methods

To set up a robust theoretical ground, the research process began with a literature review. Given the conceptual ambiguity around the terms ‘entrepreneurial academic’ and ‘academic entrepreneur’, the corresponding research problem in particular required a systematic literature analysis. This is why a systematic literature review was chosen as a strategy for Publication I. This strategy allows the researcher to critically examine a large volume of disparate literature in a structured way (Publication I) – using standardised pro forma, which assist in assuring research rigour (Tranfield, Denyer and Smart, 2003). Following the goals of validating the current theory developments against business practices and solving the issue of conceptual ambiguity around open innovation – analysing the differences in academia and industry perceptions – a survey strategy was utilised (Publication III). This strategy is helpful in this case as it assists in ‘gathering comparable information across a wide range of different social groups’ (Aldridge & Levine 2001, p. 28).

Further research sub-questions set up in this dissertation required a deeper dive into the context of the studied phenomenon. The human side of university–industry innovation (Publication II) requires a close look into the personalities and contextual settings forming the requirements for the human capital (Chatenier et al., 2010). The phenomenon of online knowledge transfer intermediaries (Publication IV), partly due to its novelty, suffers from a lack of theory development (Hagiu and Yoffie, 2013; Dushnitsky and Klueter, 2017) and thus also requires an exploratory outlook before being able to generate testable results (Bryman and Bell, 2015). Finally, the different stakeholders’ perspectives towards UIC evaluation appear extremely context-specific (Hong, Heikkinen and Blomqvist, 2010; Albats, Fiegenbaum and Cunningham, 2018), thus the comparison of these (Publication V) requires a close look at UIC contexts.

To achieve the required context richness in answering the later research sub-questions, a multiple case study approach was chosen as the research method. The main benefit of this research strategy is that it supplies the researcher with individuals’ perspectives – reasons and motivations, beliefs, values and links between different social actions or individuals placed in various contexts – which also enables cross-case and cross-context comparison (Yin, 2009, 2011). These kinds of data cannot be gathered using solely quantitative data collection technics (such as surveys) also because the context of each collaboration becomes particularly important as ‘the surroundings associated with phenomena’ (Cappelli & Sherer 1991, p. 56; Welch & Piekkari 2011). Table 8 summarises the research methods used in each of the publications that constitute the dissertation as well as describes the data collected and data analysis procedures used.

3.2.3 Data collection and analysis

The data collection and analysis carried out for this dissertation involved a combination of various data collection techniques (quantitative and qualitative), different data types
(primary and secondary) collected and several data analysis techniques (see Table 8). Such a mixed-method approach enabled a holistic vision towards the studied phenomenon of UIC through triangulation, the facilitation of the research process and the complementarity of the various types of data and methods as well as aided the interpretation of the received results (Saunders, Lewis and Thornhill, 2009).

Particularly, the dissertation research began with a systematic literature review on the academia perspective towards entrepreneurial academic entrepreneurs – to solve conceptual issues and identify core themes and future research agendas – where the dataset was formed by research publications carefully selected and analysed through five stages. The five stages included a key words search; setting up the delimitations in terms of the timeframe (25 years), journals and research areas (17 leading journals in the field of entrepreneurship, education and innovation were pre-selected); developing the pro forma (Tranfield, Denyer and Smart, 2003); initial screening and further in-depth analysis and coding the data gathered from the selected 114 articles. To ensure the validity and reliability of the coding process, two members of the research team conducted open coding on each article independently, and any variances were discussed amongst the whole research team. This allowed the development of open codes into first and second order themes (O’Kane et al., 2015).

To proceed further with solving the conceptual issue around the open innovation concept (following the prior research findings of Trott & Hartmann 2009; Dabrowska et al. 2013), the data were collected using a survey strategy – as the literature provides open innovation activities (scales) for further testing (Chesbrough and Brunswicker, 2014). The survey questionnaire (see Appendix A) was deployed as a part of the European project OI-Net (European Academic Network for Open Innovation: www.oi-net.eu) based on an in-depth analysis of the academic literature and relevant reports, such as the Community Innovation Survey. The questionnaire included a number of closed questions as well as a set of open-ended questions – including one asking for a definition of open innovation. The survey respondents were employed in innovation, R&D, HR or were top managers of European companies; 525 respondents from 38 countries answered the survey, with an average response rate of 10%. These data were collected by the European Academic Network for Open Innovation (OI-Net project) – the research group of the author of this dissertation (including the author herself) – which was responsible for the data collection processes as the leader of the OI-Net project consortium and the corresponding work package. Further data cleaning of incomplete questionnaires resulted in a sample of 251 firms; this sample was used in further statistical analysis for Publication III. A group of two researchers – Roman Teplov and the author of this dissertation – carried out the initial data analysis and interpretation for Publication III, which led to the further development of the publication together with the third co-author, Daria Podmetina. The self-assessed construct of open innovation coded as a binary variable was used as a dependent variable, and 13 open innovation activities (developed based on Chesbrough & Brunswicker 2014)
were used as independent variables. For controls, company size, region, manufacturing/service and high-low tech industry were selected. To test the research proposition (*There are certain open innovation activities perceived open innovation by academia but not by business/practitioners*) a binary logistic regression was applied as an estimation method. Instead of a linear regression, a logistic regression was used as it helps to predict not the actual values of the dependent variable but the probability that the dependent variable belongs to a specific group (Hair *et al.*, 1998). Given the importance of the firm size for open innovation practices (Spithoven, Vanhaverbeke and Roijakkers, 2012; Vanhaverbeke, 2017) three models were analysed: Model 1 is based on the full sample, Model 2 consists of large firms and Model 3 contains SMEs and micro-sized enterprises. The qualitative data collected via the survey (definitions of open innovation) were analysed using manual text mining in a search for contradictions with the theoretical developments in the field of open innovation research, and the author of this dissertation was the key member responsible for this part of the data analysis and interpretation.

Moving towards solving more context-specific problems and related research questions (company human capital components for university collaborations – Publication II; emerging forms of online innovation intermediaries in the UIC context – Publication IV and the KPIs of UIC – Publication V) the multiple case study method used assured the collection and analysis of various sorts of primary and secondary data from a number of sources (Yin, 2009). In total 18 case studies of university–industry collaboration were analysed from one of three core angles: human capital, intermediation or UIC KPIs (see Table 8). Given the quite narrow scope of the research goals, analysis on a micro-level was required (Cunningham, Menter and Young, 2017). Specifically, a purposive sampling strategy was used to select cases that are particularly informative (Saunders, Lewis and Thornhill, 2009) and heterogeneous in terms of the case region, size and industry/field of the involved parties – again to assure context richness (Yin, 2011; Cunningham, Menter and Young, 2017).

The key sources of the primary data for all the case studies were 27 personal interviews with individuals of different affiliations and positions involved in UIC processes and/or projects – company managers; university managers and researchers; policy makers; and owners, managers and users of online intermediary platforms – based in Europe and the US. The focus towards Europe is explained by the author being based there and having the access to the data region, while the selection of several cases from the US is explained by this country having the longest history of intensive UIC developments (since the introduction of the Bayh-Dole Act in 1980). Interviews were carried out in person or via Skype/phone, were recorded and were then transcribed and analysed using categorisation, manual text-mining and coding in NVivo software. For one of the online platforms a participant observation was arranged by the platform owner and was successfully used for collecting feedback on the platform.

A broad set of secondary sources was utilised to enrich the studied cases, including company managers’ work profiles on corporate websites and in professional networks such as LinkedIn; information on companies’ collaborative activities from company
websites and the press; company reports; scientific publications relevant for the cases studied; platform user feedback; collaborative projects’ documentation and governmental legislation; and reports from funding organisations and policy makers. The secondary data were also analysed using categorisation, manual text-mining and coding. Secondary data were used as complementary, confirmatory or contradictory data to additionally challenge the findings and reasoning behind the analysis of the primary data.

Finally, to test the interpretation of the results, a member-check technique was applied. To decrease the chances of misrepresentation and to increase the validity of the study (Krefting, 1991; Saunders, Lewis and Thornhill, 2009), the interviewees were asked to read and comment on the results of the analysis, and the research findings were revised in accordance with the comments received. This contributes to the trustworthiness of the dissertation findings, analysis and interpretations. A more detailed discussion follows.

3.2.4 Trustworthiness of the thesis

Aiming for high validity, trustworthiness, reliability and strong evidence, this dissertation applies three kinds of triangulation (Patton, 2002; Saunders, Lewis and Thornhill, 2009; Bryman and Bell, 2015).

The triangulation of the data sources and methods is reflected in combining primary sources (survey; interviews; participant observation) and secondary sources as well as quantitative and qualitative data collection and analysis techniques, respectively. Analyst triangulation is achieved through several researchers (co-authors) being involved in the analysis to avoid observer bias and to find the ‘white spots’ in the data interpretation, supported by a member-check technique applied (Krefting, 1991; Saunders, Lewis and Thornhill, 2009). Theory triangulation implies using several theoretical perspectives to interpret the data (Patton, 2002). Theory triangulation is reflected in this dissertation in the usage of multiple theoretical lenses, such as institutional theory, a knowledge-based view of the firm and the open innovation concept, Triple-to-Quintuple Helixes and Human Capital Theory applied towards studying the phenomenon of UIC through the overarching prism of stakeholder theory.
<table>
<thead>
<tr>
<th>Research Paper #</th>
<th>Goal(s)</th>
<th>Research Sub-question(s)</th>
<th>Research Method</th>
<th>Data Sources and Data Collection Technique(s)</th>
<th>Data Analysis Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publication I</td>
<td>To critically review literature on academic entrepreneurs and entrepreneurial academics, identify the key patterns and research gaps</td>
<td>RSQ1: What distinguishes academic entrepreneurs from entrepreneurial academics?</td>
<td>Systematic literature review</td>
<td>Peer-reviewed articles published over the past 25 years in 17 journals leading in the fields of higher education, entrepreneurship and innovation. 5-stage process: key words search; journal search; scanning and selecting; data extraction according to pro forma developed; papers analysis.</td>
<td>Open coding and template analysis</td>
</tr>
<tr>
<td>Publication II</td>
<td>To identify the components of organisational human capital required for successful university–industry collaboration.</td>
<td>RSQ2: What are the employees’ skills and knowledge required for companies’ collaboration for innovation with external partners? RSQ3: What are the skills required specifically for sustainable collaboration with universities, and how do they differ from those required for collaborating with other types of external partners?</td>
<td>Survey followed by a multiple case study (10 case studies)</td>
<td>Secondary data: managers’ profiles, information on companies’ collaborative activities from companies’ websites and press releases available online. Primary data: Survey of over 500 Europe-based companies; 11 interviews with company managers responsible for university collaborations.</td>
<td>Quantitative: analysis of means Qualitative: Open coding and member check technique</td>
</tr>
<tr>
<td>Publication III</td>
<td>To compare business and academic perspective towards open innovation concept</td>
<td>RSQ4: How does factual open innovation adoption vary for companies that claim to be open innovation adopters and those that claim they do</td>
<td>Survey</td>
<td>Survey of 251 European companies.</td>
<td>Binary logistic regression</td>
</tr>
<tr>
<td>Publication IV</td>
<td>To identify the novel forms of online intermediation platforms in the UIC sphere; to analyse the role they fulfil and to identify what functions they offer for UIC.</td>
<td>RSQ5: What open innovation activities, identified as such by academic researchers, are not considered open by business practitioners?</td>
<td>Multiple case study (5 case studies) and participant observation</td>
<td>Secondary data: press releases, websites and platform users’ public feedback on 15 UIC online platforms. Primary data: 7 interviews on 5 distinct types of platforms with platform owners and users, taking field notes during the client presentation.</td>
<td>Open coding and member check technique</td>
</tr>
<tr>
<td>Publication V</td>
<td>To identify the UIC KPIs already applied by external UIC evaluators and generally relevant for different collaboration contexts. To understand, which of the KPIs known by external evaluators are only applicable for certain specific context of collaboration. To identify the indicators perceived relevant by collaborating actors, but not yet applied by respective evaluation bodies.</td>
<td>RSQ6: What are the emerging types of online intermediaries in UIC? RSQ7: What are the roles and functions these different types of intermediaries have in UIC?</td>
<td>Multiple case study (3 case studies)</td>
<td>Secondary data: documentation of the collaborative projects, governmental legislation, projects’ and companies’ information on the Web. Primary data: 9 interviews with university researchers and managers, company managers and policy makers.</td>
<td>Interpretative content analysis and member check technique</td>
</tr>
</tbody>
</table>
4 Publications’ results and discussion

This chapter outlines and discusses the results of each of the five publications constituting this dissertation and describes the contributions to solving the research problems addressed. The final subsection provides a summary of the contributions across the publications. It also discusses the overall contribution of the thesis as whole against the existing literature – particularly, its contribution to solving the research problem in focus: identifying the ways to facilitate university–industry collaboration taking into account the perspectives of the stakeholders involved at multiple levels via building a supportive theoretical lens.

4.1 Publication I: Entrepreneurial academics and academic entrepreneurs


Paper I has four key findings to contribute to this doctoral dissertation, as described below. Based on a systematic literature review, Paper I also has a number of suggestions for future research, which are incorporated into section 5.4 of this dissertation.

First, the paper contributes to clarifying the definitions of ‘academic entrepreneur’ and ‘entrepreneurial academic’ as phenomena and as concepts which appear to play an important role in forming the entrepreneurial university as an institution (Guerrero, J. a. Cunningham and Urbano, 2015). The term ‘academic entrepreneur’ appeared to have been used more commonly in the literature compared to ‘entrepreneurial academic’ – until recently (Miller et al., 2018). The former term is related to more formal industry engagements leading to commercialisation (e.g. patents, licences and new venture start-ups), and the latter one is linked to less formal engagements (such as networking or consultancy) (Rothaermel, Agung and Jiang, 2007; Wright, 2014; Miller et al., 2018). Through the systematic literature review, the following definitions of the studied concepts and phenomena have been developed. Academic entrepreneur is defined as an individual who ‘undertakes technology commercialisation, <zusing formal modes of engagement, which capitalise on specific market opportunities ’ (based on a number of research works, including Grimaldi et al. 2011; Rothaermel et al. 2007; Schumpeter 1965; Miller et al. n.d., p. 8). Entrepreneurial academic in turn is an individual who ‘adopts an entrepreneurial outlook and who readily seeks engagement with industrial partners, often through the less formal modes of engagement, to further their research objectives ’ (based on the recent work by Alexander et al. 2015; Miller et al. n.d., p. 8).

Second, following the clarified definitions revealing entrepreneurial academics as being involved in less formal modes of engagements (Fini, Lacetera and Shane, 2010), Paper I
also looks closer into the particular channels of knowledge transfer (Alexander and Childe, 2013) in which each type of academic tends to be involved. Following the existing literature (Agrawal and Henderson, 2002; Cohen, Nelson and Walsh, 2002; D’Este and Patel, 2007; Link, Siegel and Bozeman, 2007; Fini, Lacetera and Shane, 2010; Ding and Choi, 2011), Paper I interprets the continuum of knowledge transfer channels (from informal to formal ones) as per Alexander et al. (2015). The findings of Paper I accordingly suggest the applicability of the respective channels to the two different types of academics. Particularly, academic entrepreneurs were found to be involved in spin-offs, patenting and licensing, joint ventures and sharing facilities with industry as activities that lead to the commercialisation of their research results (Miller et al., 2018). Entrepreneurial academics, in turn, appear to be engaged with a wider spectrum of knowledge transfer activities (from relatively formal to informal ones), including contracted research and consultancy, collaborative research, executive education, secondments, graduate and student placements, joint supervision, joint publications, joint industry conferences and networking (Miller et al., 2018).

Third, Publication I also compares academic entrepreneurs and entrepreneurial academics in terms of the key motives for their engagements with industry and outlines the supplementary factors and determinants of these engagements. Despite the key role of academics in university–industry knowledge transfer, the paper was able to confirm only a number of motivational factors for each academic type, while some gaps in the literature were still spotted (see Table 1 in Miller et al. n.d.). Entrepreneurial academics are keen to engage with industry to further their research objectives, validate their approaches and results and contribute to their research field and thus to acquire peer recognition and esteem but to also contribute solving global challenges (Rothaermel, Agung and Jiang, 2007; D’Este and Perkmann, 2011; Wright, 2014). In terms of monetary drivers, income also motivates entrepreneurial academics, but in contrast with academic entrepreneurs, who are motivated by understanding the commercial lifecycle of their research results, by public recognition and by private income (Meyer, 2003; Perkmann et al., 2013), entrepreneurial academics engage to gain income for their home institution (Alexander, Miller and Fielding, 2015).

Fourth, despite the motivations in place, both types of academics face challenges on the individual level, institutional and policy levels. On the policy as well as organisational levels, the challenge is common for both types of academics: the demand for a greater impact of the academic’s work, but the outputs of the activities performed by academic entrepreneurs appear easier to measure (through e.g. patents and spin-out activity) and thus reward (Bercovitz and Feldman, 2007). This is despite proof found of a greater impact created by informal activities (Abreu and Grinevich, 2013). This paradox requires further investigation under the interplay between Stakeholder Theory (as the issue requires balancing the views of academics and policy makers as the key stakeholders) and Institutional Theory (as the issue faces the classical debate of structure (institution) and agency (individual academics) (Archer, 2004)). At the university level, in addition to the performance measurement issue, there exist linked issues of promotion, career progression and a need to combine the ‘traditional’ responsibilities of teaching and
research with industry engagements, which stress the greater issue of the legitimacy of both academic entrepreneurs and entrepreneurial academics (Jong, 2008; Haeussler and Colyvas, 2011; Abreu and Grinevich, 2013; Perkmann et al., 2013). This in turn creates a ‘symbiotic interdependency’ between the two types of academics (Silva, 2015).

Overall, Paper I helps in serving the conceptual issue of defining ‘entrepreneurial academic entrepreneur’. Furthermore, the paper addresses the issue of finding a balance between the formal institutional structures of universities, policy norms lagging behind in terms of introducing required measurements (playing the role of ‘structure’) and flexible individuals (academics as ‘agents’) spanning the boundaries with industry (Archer, 2004; Janowicz-Panjaitan and Noorderhaven, 2008) – contributing to the ongoing ‘structure versus agency’ debate in Institutional Theory (Archer, 2004). Figure 7 below outlines the theoretical framework standing behind Paper I in particular, which explores and explains the role of different types of individual academics in building an entrepreneurial university and studies the ambidexterity of the academics’ role in this process (Miller et al., 2018).

**Figure 7: Theoretical framework of the academia perspective towards UIC**
(Publication I)

### 4.2 Publication II: Companies’ human capital in university collaboration

The findings of Paper II contribute to our understanding of the human capital components required for companies collaborative innovation with universities and distinguish between these components for the open innovation function generally and university innovation in particular. Thus, applying the knowledge-based view of the firm in the open innovation context, Paper II analyses the UIC phenomenon through the prism of company human capital (Human Capital Theory) – see Figure 8. The paper has five key findings to contribute to this dissertation.

Figure 8: Company human capital in university relations
(Publication II)

First, the findings highlight the significant importance of context when approaching multiple stakeholders’ views towards UIC (each of the stakeholders’ goals, mission, particular types of partners, etc.). Furthermore, the findings support the proposition offered by Carayannis et al. (2000): although there are many components of company human capital that appear equally relevant generally for the open innovation manager and specifically for the UIC manager (e.g. communication, networking, team-work, problem solving, ability to share knowledge internally and externally, creativity, technology and business mindset), there are particular human capital components that become vital when companies are dealing with university-type partners. The particular human capital components found by Publication II, such as those required for companies’ collaboration with universities are summarised in Table 7 of the publication. Publication II’s results also illustrate that the need for such specific human capital characteristics arises to a large extent from differences in basic rationale between these two types of stakeholders: invention-oriented universities versus profit-oriented businesses – respectively long-term operational planning in universities versus normally shorter-term company prospects towards financial returns from research results (Galán-Muros and Plewa, 2016).

Second, according to the results, among the most crucial human capital characteristics required from the company side for university relations in particular is knowledge of IP, the linked ability to deal with bureaucratic procedures and publishing-related issues. These problems are widely acknowledged by the literature (Hall, Link and Scott, 2001;
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Bruneel, D’Este and Salter, 2010), but the prior literature does not address it through the prism of human capital (Galán-Muros and Plewa, 2016).

Third, the awareness and acknowledgement of university organisational structures and operational procedures are also critically needed for the UIC manager at a company. Furthermore, technical knowledge and a good understanding of the scientific field at the focus of the collaboration is a particularly important human capital characteristic in company-university relations. In terms of the organisational functioning and resources of the university, knowledge of available funding opportunities for UIC and research and experience in applying for various sorts of funding are valuable assets in the portfolio of a UIC manager as these assist in finding the resources for collaboration and activating the resource driver (Santoro, 2000; D’Este and Perkmann, 2011; Galán-Muros and Plewa, 2016).

Fourth, regarding personal characteristics, the UIC manager as an individual needs to be tactful with university academics, respect the academic personality (which according to the results received may seem ego-centric from the perspective of the corporate world) and be politically astute in communication with academia as well as when using these characteristics carefully manage expectations on both sides. Other personal characteristics which according to the results would make work in this position easier include being open-minded, being curious by nature and being an influencer-type of person.

Finally, the results of Publication II show that the human capital characteristics found particularly relevant for company co-innovation with universities are developed through experience with collaboration rather than taught (although many pieces of knowledge, such as IPR management expertise, may be acquired through education). Furthermore, for the context of UIC as a special instance of inter-organisational relations, the practice of continuous interpersonal attrition needs to be experienced by the company team to nurture a strong capability in university relations. The practice of interpersonal attrition is explored by the psychology literature (Schneider, 1987) yet not acknowledged widely by the management literature (Ployhart, Weekley and Baughman, 2006).

4.3 Publication III: What does open innovation mean?


Publication III achieved its goal of clarifying the gap in perceptions towards open innovation between academia and the business community. The interpretation of open innovation within and between academia and the business community appears to vary greatly, and Publication III, relying on a survey of 250 Europe-based companies, sheds light on this conceptual issue.
According to the results of Publication III, out of 17 activities perceived as ‘open innovation’ practices by the academic literature (Chesbrough and Brunswicker, 2014), only five (namely, free revealing, scanning for external technologies, subcontracting R&D, customer co-creation in R&D projects and idea & start-up competitions) were acknowledged by the surveyed companies as ‘open innovation’. At the same time, such practices as IP out-licensing and the commercialisation of unused technologies, which are perceived by the scientific literature as ‘outbound open innovation’ (Dahlander and Gann, 2010; Chesbrough and Brunswicker, 2013), showed the least difference in the means of activity adoption between companies counting themselves as OI adopters and those perceiving themselves as OI non-adopters. This clearly indicates that these two activities fall outside of companies’ perception of the pool of OI practices. The results suggest that the adoption of the remaining ‘open innovation activities’ (academically perceived as open) by companies does not show a significant impact on companies’ self-perception as OI adopters. This also supports the hypothesis tested in Publication III: There is at least one open innovation activity perceived as open innovation by academia but not by business/practitioners. Hence, it appears that one of the novel theoretical constructs widely used by researchers to study companies’ collaborative innovation (where UIC for innovation is a special instance) is still going through the process of conceptualisation. If one attempts to illustrate this conceptual issue graphically (Figure 9), it appears that the overlap of the perceptions (or the shared common understanding) towards OI between academia and the business community is thus far smaller than the varieties of interpretations existing within each of the communities.

Figure 9: Clarifying each side’s perspective towards open innovation concept (Publication III)

Hence, the results of Publication III contribute to the ongoing debates around the OI construct and particularly point out the concrete components of the open innovation paradigm (particular practices), which thus far are not perceived as ‘open’ by the business and industry communities. This contribution is useful not only for management research as it supports the process of OI conceptualisation (Vrande, Jong and Vanhaverbeke, 2009; Groen and Linton, 2010), but it may also help practitioners and policy makers in using the open innovation concept. Overall, in practical terms Publication III assists in creating a common language between academia and industry, which thus far remains insufficiently developed yet critically needed to facilitate UIC processes (Hong and Su, 2013). That also reveals Paper III’s contribution towards increasing the relevance of managerial research for the business community (Vrande, Jong and Vanhaverbeke, 2009).
4.4 Publication IV: Online intermediaries in UIC


Publication IV is one of the first research attempts to analyse the emerging phenomenon of the online platforms that facilitate UIC. It draws upon the theory of inter-organisational relationships, where relationships seem dynamic and dependent on the interaction intensity (Geisler, 1995; Rossignoli and Ricciardi, 2015). Although the online knowledge transfer intermediaries (KTIs) (or knowledge market places) have existed on the knowledge market for some time now, little is known about this novel form of innovation intermediation generally and even less in the UIC context (Howells, 2006; Dushnitsky and Klueter, 2011, 2017). Publication IV analyses 15 examples of UIC KTIs at the organisational level, and, upon defining the five key types of these by their functions, it analyses five example cases (one of each type) more in-depth. The five key types of UIC online platforms according to their functions as defined in Publication IV, and their examples include the following:

(1) **Education-focused platforms** – Digital tools supporting practice-based learning for university students. These get students to solve real industrial challenges while providing supportive infrastructure – project management tools, communication between students, teachers and industrial supervisors and monitoring and assessment tools. EduSourced ([www.edusourced.com](http://www.edusourced.com)) and Coursera ([www.coursera.org](http://www.coursera.org)) represent examples of such platforms. EduSourced, studied as a focal case in Publication IV, is particularly designed for experiential learning and supports its users in handling project submissions, monitoring and assessing progress and securely managing student-client communications.

(2) **Knowledge, technology and IP transfer-focused platforms** – Digital instruments that enable the continuous monitoring and analysis of the universities’ capabilities on one side and the companies’ needs on the other. Such intermediary also assists in creating a digital introduction to the client university’s innovations and puts the parties into direct contact based on matching their interests. Examples of such platforms are [www.in-part.com](http://www.in-part.com), [www.easyaccessip.com](http://www.easyaccessip.com), [www.praxisunico.org.uk](http://www.praxisunico.org.uk) and [www.globalipexchange.co.uk](http://www.globalipexchange.co.uk). The In-part platform has been studied closely in Publication IV. This platform, developing digital introductions for universities’ innovations, achieved a milestone of over 1,000 university–industry interactions facilitated in 2017 (IN-PART.com, 2018).

(3) **Crowdsourcing platforms** – Platforms built to support online student competition in solving industrial challenges as a part of a curriculum structure. Such platforms assist in sourcing ideas and solutions from students and university researchers to solve business challenges (e.g. [www.marblar.com](http://www.marblar.com) or [www.nimblebee.eu](http://www.nimblebee.eu), studied in-
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depth in Publication IV) or follow crowd-sourcing principles to jointly solve scientific challenges (e.g. [link to web page](www.challengeacademy.eu) (Rakitina-Qureshi, 2015; Ventura, Alexandre and Rosli, 2015)).

(4) Network building platforms – Match-making online platforms that enable mapping stakeholders based on matching interests, existing networks and relationships using the stakeholders’ provided data and globally available data. Examples of such match-making platforms include the University–industry Interaction Network ([www.uiin.org](http://www.uiin.org)), which in addition to online connections arranges networking events to complement its online match-making service with face-to-face interactions. Similarly, the University–industry Demonstration Partnership organisation (UIDP.org) uses a dedicated community on LinkedIn to bridge communication between academics and practitioners and facilitate their collaboration (UIDP, 2018) and also arranges dedicated conferences offline. The Bridgelight platform ([http://bridgelight.co.uk/](http://bridgelight.co.uk/)), studied particularly in-depth in Publication IV, in addition to offering a match-making instrument provides its users with the functionality of network visualisation – mapping the stakeholders’ network against the expert field or a geographical map based on a key words query.

(5) Innovation marketing platforms – Digital market places for university research results and innovation. These publish digital profiles of university innovations, thus making the university research results more open; announce industrial challenges; report on the marketing progress to both sides and put the parties into direct contact upon interest expressed by at least one side of a potential collaboration. Friesike et al. (2015) overview the initiatives which support the open science philosophy. Among these, there are such online tools as the Atlas Twiki Portal (platform that provides access to the results of the CERN lab); Sciworthy (publishes easy-to-understand scientific news) and research networks connecting scientists and disseminating their research results, such as ResearcherID and ResearchGate. The platform called Leading Edge Only ([www.leadingedgeonly.com](http://www.leadingedgeonly.com)), studied in-depth in Publication IV, was launched in 2014 and is devoted specifically to the marketing of university research results. This platform provides a space for university discoveries within a network of innovation seekers, and it tracks and analyses statistics of interest in particular technologies or ideas.

All of the platforms analysed particularly in-depth in Publication IV represent commercial companies, and despite all of them being relatively young, each of the companies’ owners reported a continuously growing demand for their intermediation function on both sides (companies and universities) and, respectively, a continuous growth and scaling up process of their platform business. This illustrates well the growing need for such intermediate stakeholders due to information asymmetries, a growing need for multi-disciplinary innovations and a rapidly shortening product lifecycle (Hagiu and Yoffie, 2013; Dushnitsky and Klueter, 2017). However, all of the platforms, except the case under the crowdsourcing type, keep the university–industry interaction online only until the connection is established. In other words, although the analysed platforms appear supportive in solving the connection problem of UIC (Galán-Muros and Plewa, 2016), on a large scale, so far, these cannot be substituted face-to-face negotiations and hand-in-
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hand collaboration. Thus, from the theory of inter-organisational relationships perspective, such online KTIs appear thus far as essential enablers of the initial connection between universities and companies globally (Figure 10). The phenomenon of economic intermediation, which thus far has been studied mostly in a financial context (Allen and Santomero, 1998), in the context of knowledge-based economy and particularly in the UIC context thus becomes crucially important although still quite poorly explored (Soendergaard, Bergenholtz and Juhl, 2015; Dushnitsky and Klüter, 2017).

Figure 10: Intermediation in UIC Publication IV

4.5 Publication V: UIC lifecycle KPIs: Micro-level perspective


Publication V is devoted to identifying the common and context-specific key performance indicators of UIC at the joint project level (inter-organisational level) addressing the perspectives of all of the Triple Helix stakeholders (university, industry, government) as well paying attention to the KPIs representing impact for society (the fourth actor of the Quadruple Helix) – see Figure 11. Publication V has two key findings to contribute this dissertation.
First, Publication V addresses the key criticism made of the previous studies about UIC assessment – particularly, the problem of the existing KPIs being primarily focused towards UIC outputs. Based on Brown et al. (1998) and Perkmann et al. (2011) the paper applies a process-view towards UIC assessment (inputs, in-process activities, outputs and impact) and, using a multiple case study approach, it identifies the common KPIs across the cases but stakeholder-specific KPIs for each of the UIC process stages. Table 7 in Publication V summarises the common, context-specific and additional micro-level KPIs identified across the UIC lifecycle. Particularly, the paper results identified an impact KPI suggested solely by a governmental body – ‘company revenue structure renewal’. While such in-process KPIs as ‘efficiency of collaboration management’ and ‘clearly defined roles’ appeared particularly important as per university and industry partners, the governmental stakeholders disregard these KPIs in their assessment systems (Albats, Fiegenbaum and Cunningham, 2018).

Second, Publication V also addresses the proposition made by Rossi and Rosli (2015) on the need for context-specific KPIs for UIC assessment via identifying the context-specific KPIs for each of the UIC process stages. Particularly for the input stage in the context of a demographical crisis those include ‘a number of young employees’ involved and for the in-process phase that is ‘a fit between organisational strategies and collaboration goals’. As the collaborating company may not always desire ‘publications’ as an output of UIC for different reasons, such an output-stage KPI also appears to depend on contextual settings. Finally, ‘enterprise image improvement’, depending on the context, may serve as an impact KPI. Furthermore, the results of Publication V illustrate that certain KPIs may or may not be applied at a certain UIC process stage depending on the particular contextual settings (Albats, Fiegenbaum and Cunningham, 2018).
Overall, Publication V addresses the issue of UIC assessment from the perspective of all UIC stakeholders (university, industry, government and society) in their contextual settings at the inter-organisational (joint project) level. It also assists in advancing the currently existing UIC systems towards an unbiased, more universal and context-adaptable system for evaluating UIC – addressing the criticism brought in by previous studies (Perkmann, Neely and Walsh, 2011; Rossi and Rosli, 2015). Thus, in addition to supporting the ongoing UIC assessment research, the results of Publication V provide numerous insights for practitioners, including business people and policy makers, which are shared in section 5.3 of this dissertation.

4.6 Summary of the main findings

The review of the literature on university–industry collaboration (Chapter 2) outlines the complexity as well as multi-stakeholder and multi-level nature of the phenomenon. Different schools of thoughts apply various approaches and look from different stakeholder perspectives, those of university/academia; industry/business; government and the Triple, Quadruple and Quintuple Helixes (Etzkowitz and Leydesdorff, 2000; Carayannis and Campbell, 2010; Carayannis and Rakhmatullin, 2014) as well as intermediaries in university–industry collaboration (Yusuf, 2008). This thesis not only captures these different angles and identifies the related research gaps but also addresses the research gaps behind each of the literature streams and, thus, has a number of findings and contributions to share. Table 9 summarises the answers to the research sub-questions of this dissertation and outlines the corresponding contributions.

First, the results of the research carried out in this dissertation affirm the polar nature of the stakeholders involved in the Helixes (Parker, 1992), and the publications constituting the paper illuminate these. Publications I and V, applying intra-organisational and inter-organisational levels of analysis, respectively, outline that less formal modes of academics’ engagement with industry are less recognised by university performance evaluation systems despite that they often provide a greater impact and thus value for industry and society (Abreu and Grinevich, 2013). Publication III, running the analysis on the organisational level, detects and describes in detail the gap between academia vs. business perceptions towards the open innovation approach. Following the open innovation approach, Publication II, seeking to develop company human capital components for university collaboration, also identifies a number of principle differences between academia and industry – both as institutions and as groups of interacting individuals (Sako, 1992; Lane et al., 1995; Marchington and Vincent, 2004) – which find their footprint in the final human capital composition proposed. Publication IV illustrates the paradox of UIC as a special instance of inter-organisational relationships: transaction costs and information asymmetries (Nooteboom, 2000; Abramo et al., 2011) are decreased over time, and the number of intermediaries is only growing (Allen and Santomero, 1998).
Table 9: Summary of the publications: Answers to the research sub-questions

<table>
<thead>
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<th>Research Sub-questions</th>
<th>Publications</th>
<th>Key Findings</th>
<th>Key Contribution</th>
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| **RSQ1: What distinguishes academic entrepreneurs from entrepreneurial academics?** | I            | Clarified definitions of *academic entrepreneur* vs. *entrepreneurial academic*, key respective knowledge transfer (KT) channels, motives to engage with industry and key challenges:  
  *ACADEMIC ENTREPRENEUR (AE)*: an individual who undertakes technology commercialisation, using formal modes of engagement, that capitalise on specific market opportunities.  
  *AE – KT channels*: contract research and consultancy, shared facilities, joint ventures, patents and licences, spin-outs and start-ups.  
  *AE – Motives*: understanding the lifecycle/adoption of research, public recognition, private income.  
  *AE – Challenges*: lack of opportunities and resources, ‘symbiotic interdependency’ between various activities.  
  *ENTREPRENEURIAL ACADEMIC (EA)*: an individual who adopts an entrepreneurial outlook and who readily seeks engagement with industrial partners, often through less formal modes of engagement, to further their research objectives.  
  *EA – KT channels*: networking, joint conferences and publications, joint supervision, graduate/student projects, secondment, executive education, collaborative research.  
  *EA – Motives*: furthering research objectives, gaining feedback, academic contribution, esteem, contribution to society, institutional income.  
  *EA – Challenges*: lack of institutional, micro- and macro-policy-level support for less formal activities and thus lack of their legitimacy, lack of reward and recognition, debated role of the TTOs in stimulating entrepreneurship, lack of opportunities and resources, ‘symbiotic interdependency’ between various activities. | Clarification of the conceptual ambiguity around the terms of entrepreneurial academic and academic entrepreneur; Reflection of motives and challenges of UIC from a university perspective on intra-organisational level (individual level) and its links to organisational level (structure vs. agency debate of the Institutional Theory (Archer, 2004)). |
| **RSQ2: What are the employees’ skills and knowledge required for companies’ collaboration?** | II           | The need for *specific human capital characteristics in university relations* arises from *differences in the basic rationale between these two types of stakeholders*: invention-oriented universities versus profit-oriented business. The most crucial human capital characteristics required from the company side for university | Linking the open innovation and UIC literature and organisational and intra- |
for innovation with external partners?
RSQ3: What are the skills required specifically for sustainable collaboration with universities, and how do they differ from those required for collaborating with other types of external partners?

RSQ4: How does factual open innovation adoption vary for companies that claim to be open innovation adopters and those that claim they do not adopt open innovation?
RSQ5: What open innovation activities, identified as such by academic researchers, are not considered open by business practitioners?

RSQ6: What are the emerging types of online intermediaries in UIC?
RSQ7: What are the roles and functions these different types of intermediaries have in UIC?

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<tr>
<th>RSQ3</th>
<th>RSQ4</th>
<th>RSQ5</th>
<th>RSQ6</th>
<th>RSQ7</th>
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<td>for innovation with external partners?</td>
<td>How does factual open innovation adoption vary for companies that claim to be open innovation adopters and those that claim they do not adopt open innovation?</td>
<td>What open innovation activities, identified as such by academic researchers, are not considered open by business practitioners?</td>
<td>What are the emerging types of online intermediaries in UIC?</td>
<td>What are the roles and functions these different types of intermediaries have in UIC?</td>
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Publications’ results and discussion

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<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
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| relations: knowledge of IP, ability to deal with bureaucratic procedures and publishing related issues; awareness of the university structure, technical knowledge, awareness of funding opportunities, being tactful, politically astute with academics, being curious and an open-minded influencer. The human capital characteristics which the university relations manager shares with the manager of any partner relations include: communication, networking, team-work, problem solving, the ability to share knowledge internally and externally, creativity, technology and a business mindset. The specific human capital components required particularly for university relations (mentioned above) arise from the context of university relations – particular barriers and drivers of UIC (such as commonly arising IPR-related issues). | Out of 17 activities perceived as ‘open innovation’ practices by the academic literature (Chesbrough & Brunswicker 2014) only 5 are acknowledged by the surveyed companies as ‘open innovation’: free revealing, scanning for external technologies, subcontracting R&D, customer co-creation in R&D projects and idea & start-up competitions. IP out-licensing and the commercialisation of unused technologies, perceived by the scientific literature as ‘outbound open innovation’ (Chesbrough & Brunswicker 2013; Dahlander & Gann 2010), showed the least difference between companies counting themselves as OI adopters and those perceiving themselves as non-adopting OI. | Identifies 5 types of online knowledge transfer intermediaries (KTIs) in UIC according to their roles and functions:
1. Education-focused platforms – digital tools supporting practice-based learning for university students (e.g. www.edusourced.com).
2. Knowledge, technology and IP transfer focused platforms – via developing digital introductions enable a continuous monitoring of the universities’ capabilities and companies’ needs (e.g. www.in-part.com). | Outlines the growing role of online knowledge transfer intermediaries in UIC for overcoming information asymmetries and solving the connection problem (Galán-Muros and Plewa, 2016) at inter-
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<th>Publications’ results and discussion</th>
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3. **Crowdsourcing platforms** – built to support online student competition on solving industrial challenges as a part of a curriculum structure (e.g. [www.nimblebee.eu](http://www.nimblebee.eu)).

4. **Network building platforms** – platforms that enable mapping the stakeholders based on matching interests and networks using the stakeholders’ provided and globally available data (e.g. [http://bridgelight.co.uk/](http://bridgelight.co.uk/)).

5. **Innovation marketing platforms** – digital market places for university research results and innovation publishing digital profiles of university innovations (e.g. [www.leadingedgeonly.com](http://www.leadingedgeonly.com)).

The demand for digital intermediation grows on both sides (companies and universities). All of the platforms except the crowdsourcing one enable only the initial connection digitally, while further collaboration happens mostly offline.

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<th>RSQ8: What are (1) the common and (2) context-specific key performance indicators of UIC at the micro level?</th>
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<td><strong>V</strong></td>
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<tr>
<td>INPUT: resources investment</td>
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<tr>
<td>IN-PROCESS: project management; roles defined</td>
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<tr>
<td>OUTPUTS: number of innovations thanks to UIC</td>
</tr>
<tr>
<td>IMPACT: number of new R&amp;D projects thanks to UIC; renewal of the business revenue structure</td>
</tr>
<tr>
<td><strong>Context-specific KPIs:</strong></td>
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<tr>
<td>INPUT: choice of partners; tech. talent availability; fit between the project plan and partners’ strategy</td>
</tr>
<tr>
<td>IN-PROCESS: jointly defined strategy and mission; use of the national infrastructure;</td>
</tr>
<tr>
<td>OUTPUTS: number of joint publications; knowledge acquired; proof of unpromising R&amp;D direction</td>
</tr>
<tr>
<td>IMPACT: sustainability and global impact metrics (e.g. CO2 emissions or export rate); development of the innovation pipeline; enterprise image improvements</td>
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A multi-stakeholder and process view applied towards UIC assessment (based on Brown et al., 1998 and Perkmann et al., 2011) allows the advancement of the existing evaluation systems towards less biased and more universal assessment instruments.
Publication IV explains this according to the differences in organisational nature between universities and firms and the differences between the individuals working on both sides. Finally, Publication V outlines where the views of the different stakeholders towards assessing university–industry collaboration align and where they differ (Albats, Fiegenbaum and Cunningham, 2018).

Second, although this dissertation deals with very practical issues of bridging academia and industry, it also advances the theoretical understanding of the phenomenon. Particularly, it contributes to conceptualising the relevant and still quite novel concepts of entrepreneurial academic, academic entrepreneur (Miller et al., 2018) and open innovation (Podmetina et al., 2018). All three concepts share a common issue appearing often in the theory development process: they attempt to combine or build upon multiple streams of literature (Gulati, 2007). For the entrepreneurial academic and academic entrepreneur concepts these streams include the entrepreneurial university, the knowledge and technology transfer literature, the entrepreneurship literature and the literature on institutional policies stimulating entrepreneurship (Etzkowitz, 2003; Goldfarb and Henrekson, 2003; Mazloomi Khamseh and Jolly, 2008; Knockaert et al., 2011; Audretsch, Lehmann and Paleari, 2014; Miller, McAdam and McAdam, 2016). For open innovation they combine organisational theory and issues of corporate strategy and business models (Chesbrough, 2007; Chesbrough and Appleyard, 2007), and sometimes they even mix in the concept of ‘open science’ if considered in the university–industry collaboration context (Perkmann and Walsh, 2007). Such a mixture of concepts and theoretical grounds inevitably creates conceptual ambiguity (Trott and Hartmann, 2009) and forms a gap between management research (academia) and real-life problems (business) (Gulati, 2007; Vrande and Man, 2011). Thus, clarifying the definitions of the above-mentioned concepts (Publications I and III) along with defining where the academia-business perceptions differ (Publication III), this dissertation contributes to the processes of conceptual development taking both of the key research angles in university–industry collaboration (academia and industry).

Third, following the recent studies that highlight the role of individuals’ skills and organisational capabilities in open innovation (Mortara et al., 2009; Chatenier et al., 2010; Ahn et al., 2016; Vanhaverbeke, Cheng and Chesbrough, 2017), Publication II uses the concept of human capital as a cross-level bridge (as proposed by Hitt et al., 2007) in studying the company perspective towards university relationships. Through developing a framework, Publication II proposes the components of the company human capital required particularly for the university–industry innovation. The framework and findings contribute to the theoretical landscape first by clarifying the actual human capital components and second by outlining the linkage between individual-level characteristics and organisational-level relational capability (Knudsen, 2008; Schillebeeckx et al., 2016). The results of Publication V in turn, highlight the importance of human capital for the success of university–industry innovation on the university end – and through the prism of the assessment criteria applied by the third actor of the Triple Helix, government (Albats, Fiegenbaum and Cunningham, 2018).
Fourth, Publication IV (on university–industry online intermediaries) simultaneously contributes to the findings of Publication III (on perceptions of open innovation) and Publication II (on company human capital) in a different manner. It enriches Publication III’s results by illustrating the limits of the open innovation concept in explaining the novel phenomenon of digital intermediation in university–industry collaboration. For Publication II, the results of Publication IV affirm the critical need for specialised human capital components required for university collaborations by specifically outlining how many additional efforts (commonly invested by intermediaries) are required to create a bridge for the parties and a common language for the ‘messages’.

Fifth, Publication I (on entrepreneurial academic entrepreneurs) aligns with the findings of Publication V (on the evaluation of UIC) as it outlines the need for additional KPIs of university–industry collaboration that are linked to less formal engagements with industry for academics and that go beyond the tangible academic spin-offs (Albats, Fiegenbaum and Cunningham, 2018; Miller et al., 2018). The duality or paradox of less formal activities having a greater value for the stakeholders in UIC but being less recognised by formal university structures and institutional evaluation systems (Abreu et al., no date; Miller et al., 2018) reflects the classical ‘structure vs. agency’ debates arising from institutional theory (Archer, 1995). Particularly, the paradox questions simultaneously whether the industry engagements are driven more by informal, interpersonal relationships between agents or by formal, institution-driven incentives (Paper I) and, respectively, how the success of these engagements is measured (Paper V).

Finally, although all the five publications constituting this dissertation search for answers to quite distant research questions and apply various theoretical lenses, levels of analysis and research methods, all of them serve to achieve a single goal – finding ways to facilitate university–industry collaboration by taking the perspective of each individual stakeholder as well as multiple stakeholders in the collaborative process. Thus, the answers to this research question are found from several angles, and, respectively, the contributions serve several target groups – researchers, practitioners and policy makers. Moreover, despite the stakeholder theory serving perfectly as an overarching theoretical framework for this research, each of the stakeholder perspectives studied in this dissertation required its own theoretical ground – see sections 4.1–4.5.

Figure 12 below combines the overarching theoretical framework of this dissertation, with the lower-level contributions brought in by the Publications I–V. The figure also frames the theoretical landscape for studying university–industry collaboration across different levels of analysis. Consequently, in addition to contributing to Stakeholder Theory development, this dissertation contributes to a number of the theoretical streams – Institutional Theory, Human Capital Theory and the Theory of Inter-organisational relations – as well as offers a synthesis between these in the context of university–industry relationships. The dashed lines in Figure 12 additionally illustrate that the proposed framework is the subjective vision of the author of this dissertation, which not only excludes but even outlines the possibility for a variety of forms of intersections between the highlighted theories to emerge in other contexts.
4.7 Discussion

Turning back to the research landscape, the university–industry collaboration (UIC) phenomenon has been studied particularly closely over the last 40 years (Mahdad, 2016). The related theoretical streams, including the resource- and knowledge-based views of the firm (Wernerfelt, 1984; Conner and Prahalad, 1996; Grant, 1996; Barney, Wright and Ketchen, 2001), the relational view (Jeffrey and Dyer, 1998), open innovation (Chesbrough, 2006) and stakeholder theory (Freeman, 1984), have also been intensively developed throughout these four decades. However, as studying any collective action, UIC research requires consideration of multiple levels of analysis – of intra-organisational, organisational, inter-organisational and industrial/regional/social or ecosystem levels (Bogers et al., 2017) – as well as a multi-stakeholder approach (Mcadam, Miller and Mcadam, 2016a; Reypens, Lievens and Blazevic, 2016). However,
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the current research landscape is still reported to lack a holistic multi-level theoretical lens and the cross-level linkages between the theories (Gupta, Tesluk and Taylor, 2007; Bogers et al., 2017) and researchers are called to contribute to filling this research gap.

The recent research work by Radziwon (2017), drawing upon such theoretical streams as complex evolutionary systems theory, organisational boundaries and the resource- and knowledge-based view of the firm as well as strategic management theory, aimed to understand how SME collaboration with other stakeholders in the regional ecosystem contributes to such an ecosystem. Radziwon (2017) proposes a ‘model of value creation and capture’ for SME-focused regional innovation ecosystems – across different levels of analysis (Radziwon 2017, p. 59, see also Figure 3 in this dissertation). This dissertation, in applying a different theoretical framework (with stakeholder theory as the overarching framework), complements the findings of Radziwon (2017) by improving the understanding of how university–industry collaboration, being a multi-stakeholder phenomenon, could be facilitated across different levels of analysis. Figure 13 extends the preceding framework by Radziwon (2017) by adding the results of this dissertation research and particularly the multi-stakeholder perspective towards UIC across different levels of analysis. The resulting framework primarily addresses the key collaborating parties (university and industry) with the mechanisms for UIC facilitation, but on the highest (ecosystem) level, the proposed elements also address government as a Triple Helix (Etzkowitz and Leydesdorff, 1995) stakeholder.

To begin with, drawing on Brown and Svenson (1998) and Perkmann et al. (2011), the results of this dissertation suggest that UIC should be approached not only from the perspective of joint value creation and capture, but also through the prism of a process view – taking into account its inputs and impacts (figure 13). Because of the distinct natures of the core stakeholders (university and industry) (Parker, 1992), the U–I relations appear complicated even before they are started – already at the stage of the partner search and selection stages (the ‘connection’ problem – Galán-Muros & Plewa 2016). This is why the interaction entry point also needs to be taken into consideration. The ‘impact agenda’ (PACEC, 2012; Eggington, Osborn and Kaplan, 2013) along with sustainable business and science principles (Orecchini, Valitutti and Vitali, 2012), on their end, demand approaching the UIC value capture beyond its outputs and outcomes towards its impact – including the global ones, such as CO2 emissions or employment rate (Albats, Fiegenbaum and Cunningham, 2018).

The following subchapters discuss each level of analysis tackled by this dissertation in detail and explain the mechanisms for facilitating inter–organisational relations in UIC context for each level of analysis. Figure 13 outlines the particular elements affirmed and developed by this dissertation in the UIC context referring to the constituting publications.
4.7.1 Intra-organisational level of analysis

In further developing the model of Radziwon (2017), this dissertation expands the exploration by adding in the lowest level of analysis – intra-organisational, or the individual level (Bogers et al., 2017) – see Figure 13. Drawing on Hitt (2007), the results of this dissertation highlight the importance of individuals responsible for managing the university–industry interface either on the university side, on the company side or on the intermediary side. This dissertation has particularly taken a company perspective, given the prior works investing their effort into studying the university (Haywood, Pennington and Warrington, 2000) and intermediary perspective (Alexander and Martin, 2013). The company-focused perspective has, first, enriched the UIC manager profile with particular individual characteristics (particular skills and abilities, knowledge, education, experience and personal characteristics) required for successful university–industry collaboration management (Publication II – Albats et al. 2016).

The developed profile suggests that such a characteristic as ‘drive to collaborate’, found by Rarziwon (2017), in the UIC context belongs rather to the group of personal characteristics at the individual level than to the organisational level. Such a level shift also relates to the context of the works. Particularly, Radziwon’s (2017) research focus is towards SMEs, where the drive to collaborate shared between the core team members may appear to immediately constitute the entire organisation’s drive – given the small size of the entire organisation. A focus towards larger size organisations – such as large companies and universities – highlights the human’s and particularly the individual’s role in inter-organisational relations (Miller, Alexander, et al. 2016; Miller et al. n.d.; Albats et al. 2016).

Similarly, a facilitating element such as commitment to join and motivation to remain active (Radziwon, 2017) in the UIC context gets positioned between the organisational and individual levels. Although both commitment and motivation arise on the interpersonal level, as the ‘structure’ side of the ‘structure versus agency’ debate of the Institutional Theory suggests (Archer, 1995, 2004), they still require acceptance and approval on the organisational level – especially in the context of a large organisation – either company or university (Albats et al. 2016; Miller et al. n.d.).

Furthermore, when studying the human side of open innovation in the UIC context the Institutional Theory grounds particularly arise in relation to the nature of academics’ motivation to collaborate with industry. As the research results suggest, in addition to institutional (organisational) measures towards facilitating academic engagement, the role models of academics involved in both more formal (academic entrepreneur) and less formal (entrepreneurial academics) activities are needed to enhance motivation for and peer-to-peer learning of academic engagement with industry (Miller, Alexander and Albats, 2016; Miller et al., 2018).

Finally, as was found (Albats et al. 2016; Albats et al. 2017) in the UIC context, the language spoken by parties differs significantly – not only in regard to terminology used
but also in terms of perception towards science and business and communication styles (Albats et al. 2016; Teplov et al. 2018).

4.7.2 Organisational level of analysis

In line with Hitt’s (2007) proposal of human capital serving as a conceptual bridge between the levels of analysis, in the UIC context, organisational human capital for UIC is formed through several elements of the intra-organisational (individual and team) level (Bogers et al., 2017). These particular elements of the intra-organisational level constituting human capital on the organisational level include such elements as ‘commitment to join and motivation to remain active’, ‘drive to collaborate’ and

individual characteristics (skills and abilities, knowledge, experience, education and personal characteristics) (Radziwon 2017; Albats et al. 2016).

The motivation issue is closely linked with the other important element of the innovation ecosystem at the organisational level – balancing between the core activities of the focal organisation (Radziwon 2017 – found for the company focus). As engagement in university–industry relations is not a goal in itself, universities perceive it as a ‘third mission’ (Shore and Mclauchlan, 2012; Wang et al., 2013). Thus, both types of academics (entrepreneurial academics and academic entrepreneurs) struggle in securing the time resources for these activities and also with the remaining issue of the limited legitimacy of industry engagement – the absence or limited presence of related indicators at the institutional level (Albats et al. 2017; Miller et al. n.d.; Miller et al. 2016).

Similar to the evidence found for the SME open innovation context (Radziwon, 2017), the presence and recognition of potential gain as well as of a long-term impact at the organisational level appear important for university–industry collaboration success and thus are suggested among its key performance indicators (Publication V - Albats et al. 2017). This is particularly important at the organisational/institutional level since, as Institutional Theory suggests, if an individual in an organisation understands the potential gain and its impact, the action (collaboration) to be taken is still required to be accepted by the governing organisation (Lam, 2010).

Finally, in addition to human resources, the financial resource investment into collaboration upfront and along the collaboration process is required in UIC (Albats, Fiegenbaum and Cunningham, 2018) as generally in any OI process (Howells, Ramlogan and Cheng, 2012; Radziwon, 2017). Furthermore, the share of co-financing invested into collaborative activities could be used as an indicator of the interest in collaboration on both sides – companies and universities (Albats, Fiegenbaum and Cunningham, 2018).

4.7.3 Inter-organisational level of analysis

At the inter-organisational level, the relational view (Jeffrey and Dyer, 1998) of an organisation (rather than of solely a ‘firm’) supports studying the phenomenon of university–industry open innovation. First, partners in such relations do invest in relation-
specific assets (Jeffrey and Dyer, 1998) – whether they are technology, product or human capital (e.g. students as potential company employees; current company’s staff taking part in the joint research projects). Those investments along with constant knowledge sharing routines (Jeffrey and Dyer, 1998) similarly to open innovation in SMEs context (Radziwon, 2017) do require trust and familiarity between partners, which deals both with geographical and organisational proximity (D’Este, Guy and Lammarino, 2012). In building trust and familiarity, the distinct types of organisations as universities and companies would first need to accept the differences in their fundamental goals, strategies, organisational structures and practices (Albats et al. 2016). Furthermore, the differences in organisational culture need to be acknowledged and accepted, which compared with SMEs’ open innovation context (Radziwon, 2017) requires not an alignment, but often an adjustment of the cognitive frames by each of the organizations types (Albats et al. 2016).

Second, the parties in UIC do combine their resources in a unique way: universities provide their research expertise, human resources and facilities (Alexander and Martin, 2013), while companies complement that with their knowledge on the market, potential innovation users and customers, industry trends and requirements (Galán-Muros and Plewa, 2016). A unique combination of those resources along with a shared knowledge base (Hamel, 1991) does provide a source for competitive advantage of the innovation resulting from collaboration and furthermore for each of the parties individually. For the company those sources of competitive advantage include a knowledge base shared and sharing a risk of science-intensive developments (Ankrah et al., 2013; Galán-Muros and Plewa, 2016). In the age of increasing competition on the education and technology markets (Goldfarb and Henrekson, 2003), the competitive advantage of a university arising from UIC is particularly important to mention. The sources for university’s competitive advantage in addition to possible licencing revenue streams may include the practice-based learning for students and staff, and as a result, a gain towards university reputation in terms of industry collaboration references and students employment rates (Guan, Yam and Mok, 2005; Galán-Muros and Plewa, 2016). However, to reach the point of creating at least two distinct streams of competitive advantage (one for company, one for university), an overlap in the interests and goals – the shared objectives need to be identified (Albats, Fiegenbaum and Cunningham, 2018).

Third, for the effective governance of UIC, which is a prerequisite for alliances to stay competitive against other alliances alike (Jeffrey and Dyer, 1998), the power balance between partners is critically important. Depending on the context (regional one or large company- vs. SME-university partnership) it may appear even more fragile in the UIC context compared with inter-firm relations due to the nature of public-private partnerships and linked threats of conflicts of interest (Kuhlman, 1996; Albats, Fiegenbaum and Cunningham, 2018). The ‘structure vs. agency’ debate of institutional theory (Archer, 2004) outshines here if moving the scope from the individual level of analysis towards organisational level – the motives and interests of individuals involved are bound up with their institutions’ power.
4.7.4 Ecosystem level of analysis

The results of this dissertation suggest that availability of an infrastructure for partner search and selection at the ecosystem level is a critical enabler of university–industry collaboration (Albats et al. 2016) for solving particularly a ‘connection problem’ in university–industry relations (Galán-Muros and Plewa, 2016). Development of a digital infrastructure (e.g. a platform) for connecting universities and companies opens an opportunity for the entire ecosystem to stay connected and thus be rather flexible in re-arranging itself – via using matchmaking and digital network instruments based on artificial intelligence and machine learning (Publication IV - Albats et al. 2016). In line with Dushnitsky & Klueter (2017) the results suggest that given the differences between companies and universities, the platforms commonly used in the inter-firm relations or crowdsourcing (as e.g. www.yet2.com, www.inncentive.com) does not fit well enough the digital interaction on the university–industry interface. Thus, a specific type of digital intermediaries is being currently developed (as e.g. www.in-part.com, www.leadingedgeonly.com and others – see Albats et al. 2016).

Furthermore, like in the SMEs’ open innovation context (Radziwon, 2017), external co-financing as well as external management, coordination and facilitation along the entire UIC process also stay among the key enablers of university–industry collaborative innovation (Publication V – Albats et al. 2017). The external co-financing is important in mitigating the risks related to science-intensive developments, which is commonly implied by UIC collaboration for innovation. Moreover, external co-financing of UIC supports the collaborating parties in the actual collaboration management, which itself may appear very resource-demanding (Galán-Muros and Plewa, 2016; Albats, Fiegenbaum and Cunningham, 2018).

Finally, along with external co-financing and management the university–industry collaboration needs to be evaluated externally – in addition to any evaluation carried by particular participating organization. As the research results show (Albats, Fiegenbaum and Cunningham, 2018), the evaluation criteria applied vary a lot depending on perception of a particular stakeholder type and context. Exactly for the sake of the context-dependency, the external evaluation is called to take into account the goals, roles and strategies of the focal UIC stakeholders (Albats, Fiegenbaum and Cunningham, 2018). That is offered to be achieved via either developing an extensive list of evaluation criteria and offering the option to choose the ones most suitable for particular context or inviting the collaborating parties to bring their own success metrics (Rossi and Rosli, 2015; Albats, Fiegenbaum and Cunningham, 2018).

The following and final chapter, Chapter 5, shares the paper’s conclusions, explains in detail the implications for scholars and practitioners, outlines the research limitations and suggests directions for further research.
Figure 13: Mechanisms for facilitating multi-stakeholder UIC
(Across levels of analysis – development of a framework proposed by Radziwon (2017, p. 59); green blocks indicate contributions made by this dissertation, P I – P V: contribution by particular publication in this dissertation)
5 CONCLUSIONS

This dissertation is devoted to finding ways to facilitate university–industry collaboration while taking into account the perspectives of the stakeholders involved in/influencing the collaboration (university, industry, government) at multiple levels (individual; organisational; inter-organisational). As a research work studying the relationships between the heterogeneous stakeholders (Corsaro, Cantù and Tunisini, 2012), the dissertation also had to apply a multi-theoretical lens to further contribute the development of a holistic multi-level theoretical lens and cross-level linkages between the existing theories (Bogers et al., 2017; Gupta et al., 2007). The different theory streams and concepts used in this dissertation include Stakeholder Theory, Institutional Theory, the Knowledge-based View of the Firm, Open Innovation, the Theory of Inter-organisational Relationships and the Triple, Quadruple and Quintuple Helixes.

The application of Stakeholder Theory (Freeman, 1984) to studying UIC enables the consideration of each of the key heterogeneous actors in UIC, including their values, beliefs, priorities, problems and approaches to the collaboration process and its assessment. First considering each stakeholder individually (as done in Publication I for university, in Publication II for industry and in Publication IV for intermediary) and then comparing their perceptions (Publications III and V) assisted in identifying ways to facilitate UIC. The facilitation strategies proposed would require efforts by each of the stakeholder types. Given the multi-stakeholder approach applied, the strategies would be compatible with the needs and priorities of each of the stakeholders and are supposed to assist in bridging the polar views of stakeholders in UIC (Parker, 1992).

5.1 Synthesis: Mechanisms for facilitating UIC

This chapter provides an answer to the main research question by sharing the mechanisms for facilitating university–industry collaboration by each stakeholder type analysed at a particular level – as covered by the scope of this dissertation. Table 10 summarises the facilitation mechanisms developed.

First, from the university perspective, analysing industry engagements on the intra-organisational (individual) level and UIC assessment principles on the inter-organisational level, this dissertation revealed an important facilitation mechanism of UIC for the organisational (institutional) level. Particularly, this dissertation makes a distinction between the entrepreneurial academic type and academic entrepreneur type of university researchers and clarifies this distinction through analysing individual motives and challenges as well as institutional evaluation mechanisms. The results of this analysis suggest that on the institutional (university policy making and performance assessment) level this distinction is commonly neglected: the less formal knowledge transfer mechanisms used by entrepreneurial academics often provide a valuable impact for industry and society but thus far are not acknowledged by the university performance evaluation systems. The set of mechanisms to address this drawback and thus facilitate UIC would refer to the university management (university policy and strategy
If a certain university’s management team aims to facilitate UIC, they would need to:

- first, acknowledge the diversity among the research staff in regard to their industry engagement channels and motivations;
- second, develop incentives and time management and performance evaluation systems which acknowledge the less formal knowledge transfer channels used by the research staff in industry engagements as well as the impact achieved; and
- third, support the emergence of (or purposively hire) the role-model individuals of both types – entrepreneurial academic and academic entrepreneur.

This strategy according to the research findings is supposed to support the portfolio principle in developing university human capital for industry engagements and contribute to the transformation of the traditional education and research institution towards an entrepreneurial university.

Second, from the industry perspective, the research results suggest that company human capital appears as one of the most vital assets in managing university relations. Thus, the development of the specific components of company human capital (either in a single manager, in a team or across the organisation) required for university collaboration becomes itself a mechanism to facilitate the existing university relationships and encourage future ones to emerge as these help in overcoming the UIC barriers and activating its drivers. The components of human capital required specifically for university relationships constitute five dimensions: skills, abilities, knowledge, experience and personal characteristics. Particularly, to deal with the distinct rationale of the university as an open innovation partner, the company manager would require strategic thinking, a long-term perspective, communication skills and agility. To deal with the commonly arising issues related to IPR and publishing, the company manager needs negotiation skills and knowledge of IPR management. To address the differences in organisational structures and processes, the university relations manager would require not only strong technical knowledge but also an understanding of the supportive funding schemes, mission and performance metrics applied by universities as well as the ability to be politically astute in communicating with academia. Finally, to succeed on the interpersonal level, the company employee responsible for university relations needs to be an open-minded, curious influencer, who is able to be tactful with often over-ambitious and ego-centric academics. Furthermore, most of the required characteristics bring the biggest value when they are acquired through the individual’s experience rather than through studying as, due to the gaps between perceptions, university collaboration may require even more interpersonal attrition than any company-to-company relationship.

Thus, for the company seeking to acquire or develop the capability of university relations, even small-scale engagements with a university partner would become a valuable investment into the facilitation of university relations. Such thinking resonates with the new theory of the firm, where organisations appear as human-capital intensive – especially in the innovation development context (Zingales, 2000).

Third, when comparing university (academia) and industry (business) perceptions of the open innovation concept, used widely by management scholars to study the company’s external relationships for innovation, a significant mismatch has been
identified. This issue calls for careful considerations from the side of theory developers when disseminating the theoretical implications and constructs to the business community. From the side of management researchers it also requires a continuous validation of their research results with the studied groups – to reassure them of the relevance of managerial research for practitioners (Vrande, Jong and Vanhaverbeke, 2009). The way to minimise conceptual ambiguities and advance common language building between the academia and business communities is to organise and take part in joint thematic events (e.g. conferences, seminars, workshops, joint teaching and supervision).

Fourth, if taking the perspective of an intermediary is itself a facilitator of UIC, the results of this research indicate a growing demand for online intermediation. However, although the usage of online intermediaries in company-to-company relationships appears to be a globally recognised phenomenon, in the company-to-university context, these tools remain less known (Dushnitsky and Klueter, 2017), although they provide great value in addressing information asymmetries and solving the connection problem of UIC (Galán-Muros and Plewa, 2016). The way to enhance the online facilitation of UIC would be efforts towards disseminating these types of instruments on the organisational, industrial and policy levels as a secure and efficient connector, knowledge (IPR) transfer tool or education supporter. The dissemination of such online instruments and maintenance of a continuous feedback loop are crucial due to ‘network effects’ and the so-called ‘chicken-and-egg problem’ (Katz and Shapiro, 1994; Parker and Van Alstyne, 2005) – platforms and market places value being dependent on the number of contributors and the mutual value created and shared. In the age of global, multi-sided knowledge markets and inter-organisational systems (Gupta, 1995), the approach of a business stakeholder analyser (Chung, Chen and Reid, 2009) needs to take steps beyond a firm-level analysis towards stakeholder networks and ecosystems to increase value creation and capture (Gupta, 1995; Freeman et al., 2010; Dushnitsky and Klueter, 2017). The emerging forms of online knowledge transfer intermediaries dedicated to serve the university–industry interface take one of those steps in spanning organisational boundaries.

Finally, also important in facilitating UIC is the evaluation of UIC success from a multi-stakeholder perspective (university, industry, government, society) at the inter-organisational level. Here two aspects appear particularly important. First, the collaboration needs to be carefully monitored by all the stakeholders beyond solely the outputs of the collaboration – from the initiation stage across the entire process towards outputs and impacts – exactly because ‘what gets measured gets managed’ (Drucker 1954, p. 70). This also implies the inputs and in-process metrics, which appear crucial in solving the issue of resource balancing for entrepreneurial academics and academic entrepreneurs (Miller et al., 2018). Furthermore, as contextual settings significantly change the importance of particular assessment metrics, the evaluation system must be adaptable to these contextual settings – involving expert evaluations whenever relevant and providing freedom in selecting the relevant metrics (as prospected by Rossi & Rosli 2015) and suggesting additional ones.
Apart from facilitation mechanisms, this dissertation has a number of theoretical and practical implications as well as suggestions for further research, which follow this section.
Table 10: Mechanisms for facilitating UIC per stakeholder
(Answer to the main research question)

<table>
<thead>
<tr>
<th>Stakeholder perspective/interface</th>
<th>Level of analysis</th>
<th>Facilitation mechanisms</th>
</tr>
</thead>
</table>
| University                        | Organisational level | University management team should:  
1. Acknowledge the diversity among research staff in their industry engagement channels and motivations (entrepreneurial academic vs. academic entrepreneur).  
2. Develop incentive, time management and performance evaluation systems, which would acknowledge the less formal knowledge transfer channels used by the research staff in industry engagements as well as the impact achieved.  
3. Support the emergence of (or purposively hire) role model individuals of both types – entrepreneurial academic and academic entrepreneur. |
| Industry                          | Organisational level and intra-organisational (individual) level | Company human capital composition (employees’ skills & abilities, knowledge, education, experiences and personal characteristics) itself represents a mechanism for facilitating university collaboration as particular components may help in overcoming the UIC barriers:  
1. To address the **differences in basic rationale**: strategic thinking, long-term perspective, communication skills and agility are required.  
2. To deal with **IPR- and publishing-related issues**: negotiation skills, knowledge of IP.  
3. **Differences in org. structures and processes**: should be addressed with strong tech. knowledge, knowledge of the funding schemes, mission and performance metrics applied, being politically astute in communicating with academia.  
4. **To succeed on interpersonal level**: being tactful with academics, open-minded, curious influencer. |
| University–industry interface     | Organisational level and intra-organisational (individual) level | The **language** (terms, jargon) and perception towards particular collaborative activities may differ generally among individuals, but these are particularly different between academia and business representatives. This is why when university and company partners engage, it is particularly crucial to achieve a maximum possible clarity in:  
1. The joint goals, mission, strategy, interests, priorities (still taking into account the perspective of each collaborating party). |
## CONCLUSIONS

| Intermediary | Inter-organisational level | 1. Further development of the online platforms serving university–industry interface (such as commercial businesses; global, national, regional or organisational initiatives) would inevitably accelerate the joint value creation and particularly value capture, which in turn would contribute to the impact growth.  
2. The wider dissemination of such online instruments and continuous feedback loop are crucial due to ‘network effects’ and ‘chicken-and-egg’ problem. |
|--------------|----------------------------|---|
| Government and Society perspective towards assessment of UIC success and impact | Inter-organisational level | 1. The collaborations needs to be carefully monitored by all the stakeholders beyond solely outputs of collaboration – from the initiation stage across the entire process towards outputs and impacts.  
2. The evaluation system is required to be adaptable to the contextual settings of collaboration – involve expert evaluations whenever relevant, provide freedom in picking the relevant metrics and suggesting additional ones. |
5.2 Theoretical implications

Each of the levels of analysis addressed by this dissertation has certain implications regarding particular theoretical streams. Some of the theoretical streams in turn found to assist in bridging the different levels of analysis. Figure 14 illustrates those along the model, which is introduced in the chapter 4 and is based on the framework initially proposed by Radziwon (2017). This subchapter outlines the key theoretical implications coming out of this dissertation research.

First, Human Capital Theory in studying university–industry collaboration serves not only as a bridge across different levels of analysis (Hitt et al., 2007), but also across the related theoretical streams. The ‘structure versus agency’ debate arising from the Institutional Theory (Archer, 2004) found its reflection on intra-organisational and inter-organisational levels of UIC. Particularly, academic entrepreneurs and entrepreneurial academics face the boundaries of institutional regulations towards UIC and the limited legitimacy of industry engagements (Miller et al. n.d.; Miller, et al. 2016). Companies’ employees engaged in university relations face the challenge of aligning these relations with the company strategy (again, organisational constrains). Both types of parties face a need of adjusting their cognitive frames to enable the collaboration and knowledge exchange (Albats et al. 2016). The results of this dissertation affirm that organisational human capital (with its specific components for UIC – Albats et al. 2016) is in charge of smoothing down the structure-agency tension both within each organisation type (university and industry) and on inter-organisational level. Thus, the ‘human side of open innovation’, which currently remains somewhat neglected by the literature (Gassmann, Enkel and Chesbrough, 2010; Vanhaverbeke, Cheng and Chesbrough, 2017; Bogers, Foss and Lyngsie, 2018) needs further exploration and advanced understanding in order to clarify and potentially operationalize the bridges between Institutional Theory and Human Capital Theory in the open innovation context.

The relational view (Jeffrey and Dyer, 1998) further bridges the inter-organisational level of analysis with an ecosystem one. The resources, knowledge and capabilities of universities and companies collaborating complement each other, are invested in relation-specific assets and utilised to create a competitive advantage. However, the specifics of university–industry innovation context (the differences in the partners’ nature) complicate the process and linked understanding of the joint creation of a competitive advantage. The universities and companies remain to be heterogeneous stakeholders (Corsaro, Cantù and Tunisini, 2012; Gattringer et al., 2014) with a distinct nature of their competitive advantage. For the company those include potential gains from the joint developments in terms of profit, new markets and customers as well as a potential for strategic shifts and growth (Ankrah et al., 2013; Galán-Muros and Plewa, 2016). The university competitive advantage from UIC despite its ‘third mission’ is still distinct in nature from companies and may include the practice-based learning for students and staff and as a result, a gain towards university reputation in terms of industry collaboration references, students employment rates and overall social impact (Guan, Yam and Mok,
However, to reach the point of creating at least two streams of competitive advantage distinct in their nature (one for company, one for university), an overlap in the interests and goals – the shared objectives – needs to be identified (Albats, Fiegenbaum and Cunningham, 2018). Thus, the relational view of the firm to be applied in the UIC context requires exploring further the nature of competitive advantage of both types of partners in university–industry collaboration.

If climbing higher up in the level of analysis – towards the ecosystem level – the role of the third stakeholder in the Triple Helix (government) (Etzkowitz and Leydesdorff, 2000) becomes particularly visible in terms of regulating, facilitating and assessing the university–industry relations, their outcomes and impacts (Albats, Fiegenbaum and Cunningham, 2018). Despite all the facilitation efforts in bridging universities and companies, the ‘connection problem’ of partner search, selection, aggregation and analysing the relevant information remain high for both companies and universities (Galán-Muros and Plewa, 2016). That is also despite the relatively developed forms of intermediary institutions called to help in solving the ‘connection problem’ as for instance technology transfer offices (Barlatier, Giannopoulou and Pénin, 2017). Thus, the novel, digital forms of innovation intermediation specifically for the UIC context arise in response to the demands of reducing internal organisational costs for partner search, selection and collaboration management. This phenomenon illustrates the Transaction Cost Theory application (Coase, 1934; Williamson, 1981) – although the information on potential partners has become more available with such technologies as Internet, the costs for processing, aggregating and analysing this information internally remain too high to perform this function within organization and digital intermediaries come to reduce these transaction costs. The results of this dissertation suggest that state- and university-governed intermediaries appear to be not agile enough to address the issue of information asymmetries and connection problem of UIC (Albats et al. 2016), which creates a demand for digital UIC intermediary business. When considering UIC with the participation of a digital intermediary in a long-term perspective, the universities and companies are supposed to update their profiles and enrich the platforms space with more of their new data. Given these data enrichments similarly to the logic of transaction value theory (Zajac and Olsen, 1993; Vanhaverbeke and Clooedt, 2014) the parties if observed in a long run not only minimise their transaction costs, but also maximise the joint value – also through the presence of network effects (Katz and Shapiro, 1994; Love and Roper, 2001; Parker and Van Alstyne, 2005).
Overall, the results of the research carried out in this dissertation confirm an assumption of importance of the multiple stakeholder perspective and particularly application of Stakeholder Theory principles towards studying university-industry collaboration phenomenon. The limits of the classical Stakeholder Theory have already been acknowledged (Freeman *et al.*, 2010) and the valued works in the fields of Network Theory and Inter-Organizational relations (Cook, 1977; Rowley, 1997) have themselves proven a significance of dynamic and simultaneous influence of interdependent external stakeholders across levels. However, usage of the advanced developments of the Stakeholder Theory in the context of university-industry collaboration – beyond the company-centred approach – has been started just recently (Abidin *et al.*, 2003; Gould, 2012; Mcadam *et al.*, 2012; Mcadam, Miller and Mcadam, 2016a). This dissertation illustrates the applicability of a Stakeholder Theory approach as an overarching framework and invites the scholars studying university-industry collaboration if not to use it as a focal theory, but at least apply it for outlining the delimitations and limitations of a particular (e.g. a single-stakeholder) approach.

The originator of the stakeholder theory, Edward Freeman with their co-authors argue that although the “*stakeholder theory has been applied to a variety of topics in the business disciplines... discipline research has not contributed much to the core theory*” (Freeman *et al.* 2010, p. 161). They also specifically emphasise that “*In spite of the conceptual similarities of stakeholder theory to institutional theory, institutional theorists ignored it*” (Freeman *et al.* 2010, p. 151). This dissertation and the theoretical framework developed by this dissertation not only acknowledge the conceptual tightness of stakeholder theory with institutional theory as well as with the human capital theory, the relational view and transaction cost theory. This research also explains how particularly these theoretical streams are linked within the context of university-industry relationships. Application of the stakeholder theory in this still relatively new (for the stakeholder theory) context and discovery of the mechanisms for stakeholder relationship management contributes the stakeholder theory as a core one.
Figure 14: Theoretical streams contributed
(Across levels of analysis – development of a framework proposed by Radziwon (2017, p. 59); green stripes indicate theoretical streams contributed by this dissertation)
5.3 Implications for practitioners

This dissertation also has a few implications for practitioners, including university managers, company managers and policy makers.

For university managers, the results of this dissertation suggest, first, making a distinction between the types of university research staff (entrepreneurial academics and academic entrepreneurs) and implementing incentives and evaluation systems acknowledging the contributions of each type as well as introducing role models of both types to support the assimilation of different types of entrepreneurial culture within university. Second, university managers should not underestimate the cumulative power of the digital (information) revolution and intensive growth of knowledge markets and the knowledge-based economy (Carayannis et al., 2006). Similar to companies, universities are competing on the same markets and to stay competitive need to utilise information and communication technologies to facilitate networking and knowledge and technology transfer deals and enhance educational processes as well as internal and external knowledge management processes.

One of the messages for company managers is the notion that in the knowledge-based economy, collaboration with universities has become vital for company competitiveness due to several reasons. First, universities, as knowledge developers, represent an important source for innovation-driving knowledge (Laursen and Salter, 2006). Second, universities’ alumni represent the next generation of company employees, and companies’ ability to contribute the education processes supports nurturing the generation of talents demanded by the current and future economic environment. Such approaches towards the potential benefits of collaboration with universities may become a wise investment into the future – the future of the company and the future of the entire society. However, the results of this dissertation suggest that the experience of collaborating with universities may appear dramatically different compared with other innovation partners (e.g. clients or suppliers) due to differences in basic rationale, goals and operational processes applied by business and universities. One of the key enablers of a rather smooth collaboration with universities is company human capital (a combination of characteristics along such dimensions as skills, abilities, knowledge, experience and personality), which is capable of acknowledging these principal differences and assisting in bridging the mentalities.

Finally, there are also a few messages for policy makers. First, in terms of the evaluation of university–industry collaboration, there is a need to develop instruments for collaborating parties’ evaluations on a systematic basis and across the entire process: from partner selection through all the in-process activities towards outputs and impact assessment. The provision of such instruments tailored to the needs and perspectives of each of the key stakeholders (universities and companies) would not only enhance the evaluation process per se but also assist in stakeholder reflections on their collaborative experience and make the evaluation practice more proactive than reactive. Furthermore,
following the critiques shared by Rossi and Rosli (2015) and the results of this dissertation, the evaluation system should include context-specific metrics (depending on the region, sector, type of collaboration, parties’ goals, etc.) and the possibility to express case-specific UIC results by each of the collaborating parties. This may not only assist in current evaluations but also help in the future development of KPIs. Lastly, to assist in bridging the differing mentalities, more events joining universities and companies would need to be developed and organised in a way that the parties can come prepared (e.g. using digital match-making instruments) and, thus, motivated for engagement, and every participant may benefit from the face-to-face interaction.

5.4 Research limitations and further research directions

This research has a number of limitations, and each of these leaves avenues for future research.

First, despite the multi-stakeholder and multi-level approaches being applied, this dissertation carries out the analysis at the particular levels of each of the stakeholders: for the university, at the individual level, and for the company and intermediary, at the organisational level; only for the UIC evaluation does it apply at the inter-organisational level of analysis. Thus, additional efforts are needed in developing a multi-level lens for studying UIC – approaching each and every level and doing a cross-level comparison. Furthermore, additional emphasis towards society as a stakeholder group in UIC is required.

Second, although multiple cross-theory bridges have been built in this dissertation, the holistic theoretical lens proposed here also requires a consideration of other relevant theories and strengthening the ties between them. The additional literature streams to bring into such a framework would be, for instance, the entrepreneurship literature, strategic management literature, social and relational capital streams, literature on economic intermediation and literature on ethics and policy-making. The links to be built between and across these literature streams would further enhance the multi-disciplinary approach towards analysing UIC and generally developing management research (Gupta, Tesluk and Taylor, 2007; Bogers et al., 2017).

Third, due to exploratory research focus, the scope of this work also has its limitations. Except of a survey-based publication III devoted to a relatively niche conceptual problem, most of the findings of this dissertation are based on multiple cases. Those assure the contextual richness of this dissertation, but at the same time limit its generalisability. Hence, future research may further advance this research field, via validating the received results in a larger-scale and particularly quantitative studies.

Finally, in terms of empirical evidence, this thesis is primarily focused on analysing UIC in Europe as well as benchmarking it with best practices in the US – a pioneer in stimulating UIC on the policy level (Bayh-Dole Act of 1980). However, as was also affirmed by this dissertation research – contextual settings appear critically important in
studying UIC. Thus, further exploration and analysis of UIC in other regions, including best practices, challenges and facilitation mechanisms, is particularly important in building a holistic understanding of the UIC phenomenon and the further development of its facilitation mechanisms.
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Appendix A: OI-Net Questionnaire

The questionnaire was developed by an international team of researchers as a part of activities of European Academic Network for Open Innovation (OI-Net project), which received funding from the European Union Lifelong Learning Programme under the Grant Agreement Number 2013-3830 (http://oi-net.eu).

Survey: Identification of Industrial Needs for Open Innovation Education in Europe

Part of deliverable of WP 2: Identification of Industrial Needs for Open Innovation Education in Europe
Survey “Identification of Industrial Needs for Open innovation Education in Europe” 2014

Dear Survey Participant,

Thank you very much for helping us with the research on Industrial Needs for Open Innovation Education conducted within ERASMUS Academic Network project, OI-Net. We aim to interview companies in 35 European countries in order to collect the information on real companies’ needs for specialists working under open innovation approach.

Open Innovation concept was introduced by Henry Chesbrough in 2003 and it “assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology. Open Innovation combines internal and external ideas into architectures and systems whose requirements are defined by a business model” (Chesbrough, 2003: p. 43).

In order to enable teaching open innovation on the basis of actual industry needs, we, first, study the level of open innovation adoption in companies in Europe, then, the level of open innovation knowledge and skills of employees in the companies. We try to develop open innovation manager profiles and specify the skills and knowledge that these specialists need in different EU countries and different industries. This research will help us to give recommendation to higher education in Europe on the development of open innovation curricula.

In return for your time and help, you will have an opportunity to participate in workshops, conferences, round tables etc. organized by OI-Net community. Additionally, we will organize a lottery among the survey participants with several prizes, including 10 upcoming books on Open innovation by Henry Chesbrough, which will be published in October, 2014.

Thank you very much for your time and insights!

Yours sincerely,

OI-Net Team
## Identification of Industrial Needs for Open innovation Education in Europe, 2014

### 1. COMPANY PROFILE

Name of the company: ___________________________  Web address: ___________________________

Country: ___________________________ Company was established in (Year): ___________________________

The main markets for our goods and services are Industrial (B2B) ____ % Consumer (B2C) ____ %.

Industry: Please select the industry. Tick the one which provides the main source of revenue.

<table>
<thead>
<tr>
<th>Industry</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Energy</td>
<td></td>
</tr>
<tr>
<td>Materials</td>
<td></td>
</tr>
<tr>
<td>Capital Goods</td>
<td></td>
</tr>
<tr>
<td>Commercial &amp; Professional Services</td>
<td></td>
</tr>
<tr>
<td>Transportation</td>
<td></td>
</tr>
<tr>
<td>Automobiles &amp; Components</td>
<td></td>
</tr>
<tr>
<td>Consumer Durables &amp; Apparel</td>
<td></td>
</tr>
<tr>
<td>Hotels Restaurants &amp; Leisure</td>
<td></td>
</tr>
<tr>
<td>Other, what?</td>
<td></td>
</tr>
<tr>
<td>Diversified Financials</td>
<td></td>
</tr>
<tr>
<td>Retailing</td>
<td></td>
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<tr>
<td>Food &amp; Staples Retailing</td>
<td></td>
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<tr>
<td>Food, Beverage &amp; Tobacco</td>
<td></td>
</tr>
<tr>
<td>Household &amp; Personal Products</td>
<td></td>
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<tr>
<td>Technology Hardware &amp; Equipment</td>
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<tr>
<td>Semiconductors &amp; Semiconductor Equipment</td>
<td></td>
</tr>
<tr>
<td>Health Care Equipment &amp; Services</td>
<td></td>
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<tr>
<td>Pharmaceuticals &amp; Biotechnology</td>
<td></td>
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<tr>
<td>Telecommunication Services</td>
<td></td>
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<tr>
<td>Banks</td>
<td></td>
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<tr>
<td>Utilities</td>
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<tr>
<td>Technology Hardware &amp; Equipment</td>
<td></td>
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<tr>
<td>Semiconductors &amp; Semiconductor Equipment</td>
<td></td>
</tr>
<tr>
<td>Other, what?</td>
<td></td>
</tr>
</tbody>
</table>

Size of the firm

- Large, >250
- Medium-sized, 50 - 249
- Small, 10 - 49
- Micro, 1 - 9

*Optional questions, due to social data collection ethics and requirement for anonymous data collection

### 2. OPEN INNOVATION ACTIVITIES

#### Current State of Open Innovation Adoption

<table>
<thead>
<tr>
<th>Do you adopt the following activities in your company?</th>
<th>Which of the following should be used more often and which should be used less in your company?</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>-2 decrease significantly, -1 slightly decrease, 0 keep as it is, 1 slightly increase, 2 increase significantly, 9 - 1 don't know</td>
</tr>
</tbody>
</table>

1. Customer and consumer co-creation in R&D projects
2. Crowdsourcing
3. Scanning for external ideas
4. Collaborative innovation with external partners (i.e. suppliers, universities, competitors)
5. Subcontracting R&D
6. Idea & start up competitions
7. Using external networks (e.g. associations, intermediaries, knowledge brokers)
8. Participation in standardization (public standards) / influencing industry standards
9. Free Revealing (e.g. Ideas, IP) to external parties
10. IP in-licensing
11. IP out-licensing
12. External technologies acquisition
13. Selling unutilized / unused technologies
### Appendix A: OI-Net Questionnaire

#### Open Innovation Competences

<table>
<thead>
<tr>
<th>Statement</th>
<th>1 strongly disagree</th>
<th>7 strongly agree</th>
<th>9 - I don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. We provide education and training on open innovation for our employees</td>
<td></td>
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<tr>
<td>2. Open innovation skills and awareness are fostered within our organization</td>
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<tr>
<td>3. The borders of our company are open for knowledge flow from outside-in and from inside-out</td>
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<tr>
<td>4. New external ideas are easily accepted and disseminated in our organization</td>
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<tr>
<td>5. Relevant departments are actively participating in knowledge sourcing and knowledge exchange</td>
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<tr>
<td>6. We accept the possibility of mistakes in external knowledge sourcing</td>
<td></td>
<td></td>
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<tr>
<td>7. Our employees have positive attitudes for applying ideas and technologies from outside the company</td>
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<tr>
<td>8. Our employees have positive attitudes to having other companies receiving and using our knowledge and technologies</td>
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</tr>
<tr>
<td>9. Open innovation activities of our employees are rewarded</td>
<td></td>
<td></td>
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<tr>
<td>10. Organizational structure in our company is designed according to our needs to be open</td>
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<tr>
<td>11. We apply interactive collaboration tools and methods to facilitate open innovation</td>
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<tr>
<td>12. Externally obtained knowledge is integrated into our products, processes and services</td>
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<tr>
<td>13. Our competitive advantage lies in collaborating with external partners</td>
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<tr>
<td>14. We have sufficient knowledge in our organization to compete in our marketplace</td>
<td></td>
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</tr>
<tr>
<td>15. (Top) management strongly supports open innovation activities (by allocating enough resources)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 3. SKILLS AND COMPETENCES IN OPEN INNOVATION CONTEXT

<table>
<thead>
<tr>
<th>What skills and knowledge should open innovation specialist have? Please evaluate the importance of the following items</th>
<th>1 not important</th>
<th>7 strongly important</th>
<th>9 - I don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. IP management skills</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2. Negotiation skills</td>
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<tr>
<td>3. Entrepreneurial skills</td>
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<tr>
<td>4. Leadership skills</td>
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<tr>
<td>5. Teamworking skills</td>
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<tr>
<td>6. Multi-tasking skills</td>
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<td>7. Problem solving skills</td>
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<tr>
<td>8. Virtual collaboration skills</td>
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<tr>
<td>9. Internal collaboration skills</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>10. External collaboration skills</td>
<td></td>
<td></td>
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<tr>
<td>11. Trust skills</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>12. Communication skills</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>13. Networking skills</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Other:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What abilities should open innovation specialist have? Please evaluate the importance of the following items</th>
<th>1 not important</th>
<th>7 strongly important</th>
<th>9 - I don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Technology and business mindset</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Project management</td>
<td></td>
<td></td>
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<tr>
<td>3. Adaptability and flexibility</td>
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<tr>
<td>4. Managing inter-organizational collaboration process</td>
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<tr>
<td>5. Ability to work in interdisciplinary environment</td>
<td></td>
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<tr>
<td>6. Ability to work in internal cross-functional teams</td>
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<tr>
<td>7. Strategic thinking</td>
<td></td>
<td></td>
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<tr>
<td>8. Creativity</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>9. New media literacy</td>
<td></td>
<td></td>
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<tr>
<td>10. Cultural awareness</td>
<td></td>
<td></td>
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<tr>
<td>11. Ability to work with different professional communities</td>
<td></td>
<td></td>
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<tr>
<td>12. Ability to share knowledge and ideas internally / within organization</td>
<td></td>
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<tr>
<td>13. Ability to share knowledge and ideas externally</td>
<td></td>
<td></td>
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<tr>
<td>14. Risk awareness</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>15. Failure tolerance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Other:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 4. OPEN INNOVATION PERFORMANCE

<table>
<thead>
<tr>
<th>Please evaluate the innovation performance of your company over the last 3 years</th>
<th>-2 decrease significantly, -1 slightly decrease, 0 keep as it is, 1 slightly increase, 2 increase significantly, 9 - I don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Success of radically new or significantly improved products and services development</td>
<td></td>
</tr>
<tr>
<td>2 Risks of innovation activities (financial, technological and market based risks)</td>
<td></td>
</tr>
<tr>
<td>3 New product and service development time</td>
<td></td>
</tr>
<tr>
<td>4 Market acceptance of innovative products and services</td>
<td></td>
</tr>
<tr>
<td>5 Return on investment rate (ROI) of innovation activities</td>
<td></td>
</tr>
</tbody>
</table>

### Please evaluate your current open innovation status. Choose one option.

| 1 We are not adopting and not planning to adopt open innovation | |
| 2 We are not currently adopting open innovation, but plan to implement OI in the nearest future | |
| 3 Early stages of implementing OI activities | |
| 4 In the process of refining OI activities and shaping programs to help establish best practices of OI | |
| 5 Experienced adopters of OI (processes, procedures and best practices are in place) | |
| 6 We had OI activities, but decided to discontinue | |

### How do you define open innovation? Please provide your own definition (optional)

### 5. RESPONDENT INFO AND FEEDBACK

#### What is your opinion about the survey?

- This survey is of current importance
- We consider the research on this topic to be pointless

#### Are you interested in the results of the survey? If yes, in what form?

- No
- Yes, Brief report
- Yes, Full report

#### Are you interested in participating in in-depth Interview on Industrial Needs for Open Innovation Education?

- Yes
- No

#### Are you interested in the future cooperation on the topics covered in the survey? If yes, in what form.

- Writing business cases
- Participation in round tables, workshops and conferences
- Evaluating and giving feedback on the curricula on open innovation
- Participation in research seminars
- Individual consultations
- Other, please specify

#### If you are interested in receiving the report, participating in the Open innovation book lottery or being contacted in the future, please provide your details *

- Name, Surname
- Email

* Optional question, due to social data collection ethics and requirement for anonymous data collection

#### Other Feedback you wish to provide?
Appendix A: OI-Net Questionnaire

52 partners from 35 countries

Leader: Finland
Lappeenranta University of Technology

Albania
“Marin Barleti” University

Austria
WF Institute for Economic Promotion of the Austrian Federal Economic Chamber;
FIW Wien University of Applied Sciences

Bosnia and Herzegovina
University of East Sarajevo

Belgium
University of Namur;
MAC-Team a.i.d.n.
European Foundation for Management Development (EFMD)

Bulgaria
New Bulgarian University

Croatia
University of Zagreb

Cyprus
University of Cyprus;
European Association of Erasmus Coordinators

Czech Republic
University of Economics

Denmark
Aarhus University

Estonia
University of Tartu;
Tallinn University of Technology

France
France Business School;
AcIF Europe

Germany
University of Erlangen-Nuremberg;
INNOFIS;
RWTH Aachen University

Greece
Athens University of Economics and Business-Research Center

Hungary
IMOC University of Miskolc;
University of West Hungary

Ireland
WIT Institute for Innovation and Societal Change, National University of Ireland

Italy
Scuola Superiore Sant’Anna;
TTP Lab, Technology Transfer Program & Laboratory/Studio Ing. Giordani;
PoliMiotec di Milano

Latvia
Riga International School of Economics and Business Administration

Lithuania
Kaunas University of Technology

Luxembourg
Public Research Centre Henri Tudor

Macedonia
Ss. Cyril and Methodius University in Skopje

Malta
University of Malta

Netherlands
Strategie en Organisatie;
University of Applied Sciences

Norway
Norwegian School of Economics;
NTNU Social Research AS

Poland
Technology Partners;
University of Economics In Katowice

Portugal
University of Porto, Faculty of Engineering

Romania
Transilvania University of Brașov

Serbia
University of Belgrade

Slovenia
Technical University of Koper

Slovakia
University of Žilina;
University of Zilina

Spain
EADA Business School;
IE Business School

Sweden
Linköping University

Switzerland
Geneva School of Business Administration

Turkey
Middle East Technical University

United Kingdom
IPSM;
University of Exeter

This project has been funded with support from the European Commission. This publication reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.
Appendix B: Other research contributions during doctoral studies

During my PhD studies in addition to working on this dissertation I was given a chance to work in a number of research projects, which have had different types of partners involved – both companies and universities. This experience was particularly valuable for me as I got a chance to sense, observe, manage and understand the phenomenon of university–industry collaboration in action. The related research projects, that I have been involved in during my PhD studies include:

2. *DOIT*, 2017-2020: Entrepreneurial skills for young social innovators in an open digital world. A European Initiative (European Union’s Horizon 2020 research and innovation programme under grant agreement No 770063 [www.doit-europe.net](http://www.doit-europe.net)).
3. *INSPIRE*, 2016-2019: INtegrated Support of oPen Innovation pRoфессионаlization initiative. (European Union’s Horizon 2020 research and innovation programme under grant agreement grant agreement No 691440 – INSPIRE, [www.inspire-smes.eu](http://www.inspire-smes.eu)).
4. *C3PO*, 2015-2018: Collaborative City Co-design PlatfOrm ([www.itea3.org/project/c3po.html](http://www.itea3.org/project/c3po.html)). Co-funded by ITEA and TEKES.
5. *Accelerate*, 2013-2016: A Platform for the Acceleration of go-to market in the ICT Industry ([www.itea3.org/project/accelerate.html](http://www.itea3.org/project/accelerate.html)). Co-funded by ITEA and TEKES.

These projects supported my work on a number of research papers, which enriched my understanding and research expertise in the field:


Appendix B: Other research contributions during doctoral studies

3. Albats, E., Alexander A. and Miller, K. SMEs’ open innovation: A simplified cross-case analysis. 2017 University-Industry Interaction Conference, Dublin, Ireland, 7-9 June 2017. ***This Paper has received a Best Scientific Paper Award***


Publication I

Miller, K., Alexander, A., Cunningham, J. and Albats E.
Entrepreneurial Academics and Academic Entrepreneurs: A Systematic Literature Review

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International Journal of Technology Management
Vol. 77, Nos. 1/2/3, pp. 9–37
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Companies’ human capital required for collaboration: toward a focus on university relations

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Companies’ human capital required for collaboration: toward a focus on university relations
Ekaterina Albats1, Marcel Bogers2, Daria Podmetina1

1 Lappeenranta University of Technology, School of Business and Management
2 University of Copenhagen, Department of Food and Resource Economics, Unit for Innovation, Entrepreneurship and Management

Abstract
Universities are widely acknowledged as an important source of knowledge for corporate innovation, and collaboration with universities plays an important role in companies’ open innovation strategy. However, little is known about the human capital components required for collaboration with universities. Analysing the results of the survey among over 500 company managers we define the universal employees’ skills required for company’ successful collaborations with external stakeholders. Then through analysing qualitative interviews data we distinguish between these skills and capabilities required specifically for sustainable and successful collaboration with universities. We have identified and validated 28 skills and abilities required for collaboration with external partners and defined the key of them. We have also defined the key peculiarities of such skills as communication, trust building, relationship building, IPR management and negotiation for the context of collaboration with universities. Our research has revealed an importance of expectation management skills for university-industry collaboration (UIC) context. We found that human capital for UIC is to be continuously developed and contracted by engagement in various relationships with academia. Our research helps in filling the research gap on human capital components required from the company specifically for collaboration with academia. It also serves practitioners with a profile of a general (archetype) UIC manager.

Keywords
university-industry collaboration, skills, abilities, human capital, open innovation

1 Introduction

Universities are widely acknowledged as an important source of knowledge for corporate innovation (Howells, et al., 2012) and mean for facilitating innovation (Perkmann & Walsh, 2007). However, human capital characteristics, associated with the establishment of successful university-industry relations are understudied. Even though the literature on university-industry collaboration (UIC) is rather established, most scholars focus on motivations and barriers in UIC (Hall et al., 2001; Bruneel et al., 2010), or modes or links of interaction (D’Este & Patel, 2007; Perkmann & Walsh, 2007) addressing the social capital and not yet the human capital theory (Chakrabarti & Santoro, 2004; Thune, 2007).

A number of researchers approach UIC as a type of open innovation activity beneficial for both parties (Perkmann & Walsh, 2007; Howells, et al., 2012). As a “distributed innovation process based on purposively managed knowledge flows across organizational boundaries” (Chesbrough & Bogers, 2014: 17), open innovation puts a focus on the knowledge that can flow into or out of the organization. The university-industry interface becomes an important boundary, which needs to be managed as a part of a company’s search strategy (Laursen & Salter, 2004). In terms of organizational intellectual capital,
studies on UIC mostly focus on social capital (Chakrabarti & Santoro, 2004; Thune, 2007), and even though a number of studies tackle the problem of human capital required for general open innovation professional (Shockley-Zalabak, 2008; Lindegaard & Kawasaki, 2010), the existing research does not explore yet deeply enough the role of human capital in UIC. Also the literature on open innovation “neglects the human side” (Gassmann, et al., 2010: 218). Accordingly, there is a research gap to study the characteristics of company human capital required for UIC.

Our paper contributes to the literature on university-industry collaborations by specifically highlighting how human capital facilitates the relationship between universities and companies. Moreover, we contribute to the literature on human capital by studying to what extent established concepts and mechanisms can be applied to university-industry context as a particular type of collaboration for innovation. Finally, we help managers working with university partners to understand the difference between industry and academia from the perspective of skills and knowledge required to collaborate with this type of partners.

The difference in basic rationale between universities and industries (Parker, 1992) differences in their focus and structure (Quinn & Rohrbaugh, 1983) distinguishes universities from industrial partners and requires specific skills from the company employee and specific organizational capabilities to ensure successful and sustainable collaboration with universities (Bruneel et al., 2010).

Thus, the two research questions that we are addressing in this study are:

**RQ1:** What are the employees’ skills and knowledge required for companies’ collaboration for innovation with external partners?

**RQ2:** What are the skills required specifically for sustainable collaboration with universities and how do they differ from those required for collaborating with other types of external partners?

## 2 Background

*Open innovation and university-industry collaboration*

University and industry complement each other, e.g. by such assets as educated students (potential employees), scientific discoveries - from university side (Chesbrough, 2006); additional funding, equipment, industrial experience, field-testing opportunities – from industry side (Perkmann, et al., 2013). Nowadays many researchers tend to consider UIC not just as a mutual collaboration, but also more from a perspective of growing importance of external knowledge sources (Perkmann & Walsh, 2007; Chesbrough, 2006) and knowledge exploitation (Bozeman & Dietz, 1999). Others consider UIC the context of networking (Howells, et al., 2012; Van der Steen & Enders, 2008) and commercialization of internal R&D (Perkmann, et al., 2013; D’Este & Patel, 2007; Markman, et al.,
All of these contexts are covered by the concept of Open Innovation (OI) introduced by Henry Chesbrough in 2003 (Chesbrough, 2003).

Some authors are already discussing UIC using the term open innovation (Perkmann & Walsh, 2007; Howells, et al., 2012; Lucia, et al., 2012) and some are studying this phenomenon without even mentioning OI concept (Lin & Bozeman, 2006; Siegel, et al., 2004; Ramos-Vielba, et al., 2009). In this study, we focus on the external collaboration for innovation (as one of the open innovation modes) and through the human capital perspective, we compare it to university-industry collaboration that aims at innovation (as a subtype of open innovation).

The role of human capital in inter-organizational relationships and open innovation

Human and social capital are linked with inter-organizational relationships, since any inter-organizational contact is shaped by personal interactions and connections between humans involved from each side (individual level) (Seabright et al., 1992; Ring & Van de Ven 1994). Moreover, inter-organizational engagements and social interactions contribute to development of organizational intellectual capital (structural, human and social capital) (Agndal & Nilsson, 2006). Compare to social capital concept which has roots in sociology and is focused on intangible human relations, human capital concept comes from economics and it frames the nature of human labour as a resource within inter-organizational transactions represented by individual characteristics as skills, education and proficiency (Schultz, 1961; Cornelius et al., 2002). Limiting our research devoted to university-industry relationships only to exploring a one side input (industry representatives’ skills, knowledge and competences) we bound our theoretical framework with human capital theory and do not focus explicitly on social capital theory even though we do address human interactions and relationships issues.

Goldin (2016) tackles the roots of human capital in economics coming from Adam Smiths: ‘talents, education, apprenticeship …, which is a capital in person’ (Smith, 1776). Bueno et al., (2003) suggests assessing the value of this asset by modelling the situation, when an individual is leaving the organization:

‘Human capital is defined as the knowledge that employees take with them when they leave the firm. It includes the knowledge, skills, experiences and abilities of people. Some of this knowledge is unique to the individual, some may be generic’. (Bueno et al., 2003, p.10)

To enable measuring the human capital we break it down to the concepts of skills, knowledge and competences and further try to distinguish between those, which are generic for particularly collaboration with external partners and which are more specific, individual and important for company collaboration with university.

Many researchers use terms skills and competences with some degree of freedom, and substitute one with another. Individual’ skills are often considered as element of competencies, compiled also by motivation, character traits, knowledge and behaviour (Podmetina et al., 2015). Proctor and Dutta (1995, p.18) describe skill as ’goal-directed, well-
organized behaviour that is acquired through practice and performed with economy of effort”. The term “competence” discuss mostly core knowledge, attitude, skills characterising relation between human and organization (Chatenier, 2010; Sandberg, 2000) or, in a more structured way – combination of knowledge, attitudes and individual skills (Mulder, 2007).

Open innovation skills and competences

A wide range of human resources practitioners and researchers discuss the role of education, training, motivation (Podmetina et al., 2013) and organizational culture (Chesbrough, 2003; West and Bogers, 2013; Mortara et al. 2009) in open innovati. The companies adopting open innovation have a new vision towards recruiting policy and employees’ skills (Mortara & Minshall, 2014), and the training and education positively affect cooperation with external partners (Teirlinck and Spithoven, 2013).

Mortara et al. (2009) discuss the individual skills e.g. techno-business mind-set, leadership, an entrepreneurial mind-set (Di Minin, et al, 2010, Cloyd and Euchner, 2012), adaptability and flexibility. The study of Sartori and colleagues (2013) compiles some of the required characteristics for individuals working in open innovation teams: entrepreneurial mindset (Sloane, 2011, Lindegaard & Kawasaki, 2010), communication skills (Shockley-Zalabak, 2008), skills for relationship building and maintenance in order to facilitate collaboration across various departments or external partners (Kanter, 2006; Sloane, 2011; Lindegaard & Kawasaki, 2010).

The list of skills developed based on the literature review is reflected in the list of variables in the later conducted survey (see Appendix 1).

Skills and competences required for university-industry collaboration

The authors addressing the issue of individual skills in university-industry collaboration mainly focus on university side and propose a theoretical basis for academics’ human capital development in this domain (D’Este P., Patel P., 2007; Siegel et al., 2003). A practical tool on developing the skills on the academic side is provided by Haywood et al., (2000). The authors create a skills matrix matching the key roles of university staff in UIC with the skills required (see Appendix 2).

However, the authors still recognise a lack of knowledge on the skills and capabilities required from the industry side (Bjerregaard, 2010), especially taking into account the changing role of universities towards entrepreneurial organizations, which is still under debates (Meyer, 2005; Duberley et al., 2007).

3 Research Design and Methodology

We design the research using multiple methods (Saunders, 2009) (the research choice) based on two data sources, data collection techniques, and analysis methods helping us to answer the research questions, what receives a lot of support in business and management
studies (Curran & Blackburn, 2001). It is also argued, that multiple methods are useful when they provide better opportunity to answer research questions, and help to evaluate the reliability of research findings (Tashakkori and Teddlie, 2003).

The mixed method approach is applied aiming to combine the sequential quantitative and qualitative data collection techniques in the research design (first quantitative, then qualitative). Qualitative techniques predominate in this study.

We build the research design of this study as combination of, first quantitative survey collecting data on general approaches to skills required for open innovation. Then, we address the specific research question on human capital in university industry collaboration in the qualitative analysis of the interview data.

3.1 **Survey of skills and organizational capabilities required for open innovation adoption**

The questionnaire for the study was developed within the work on OI-Net project (Open Innovation Academic Network, see www.oi-net.eu) and aimed to specify industrial needs in skills and capabilities required for adopting open innovation practices, and more specifically, for interaction with different external stakeholders. The online survey was distributed in 2014-2015 among Europe-based companies operating in various industries, in the end we received over 500 responses. The respondents indicated also the specific role of collaboration with universities in the open-end questions. Hence, we did not have the variable on university industry collaboration per se in our questionnaire. Universities as stakeholders were included into the variable analysing collaborative innovation with external partners (see variable list in Appendix 1 for reference). This fact motivated us to proceed with second stage of this research and conduct interviews with companies (see chapter 3.2.). However, our survey data can provide us a valuable insight on skills required for successful UIC.

After analysing the literature, for the purposes of this study, we focused specifically on those collaborative activities, which are common in university-industry collaboration. In particular that are: collaborative innovations with external partners (i.e. suppliers, universities, competitors); subcontracting R&D; IP in-licensing; external technologies acquisition (based on review of Roessner, 1993; Meyer-Krahmer & Schmoch, 1998; Cohen et al., 2002; Schartinger et al., 2002, Perkmann & Walsh, 2007, D’Este & Patel, 2007, Ramos-Vielba et al. 2009).

3.2 **Qualitative stage**

At the second stage, using the data on generally most important skills and competences for collaborative activities, we aimed to address the specific questions of skills and competences important for collaboration with universities. We conducted semi-structured interviews with companies’ employees - people actually involved in collaboration with universities (knowing in practice what skills are required). We follow the snowball-sampling strategy and interviewed people, who when answering the survey indicated their interest
in the personal interview. We also searched for target managers group among the members of LinkedIn community called University Industry Demonstration Partnership (UIDP, 2016).

In total 9 interviews with company’ managers responsible for collaboration with universities were conducted. Interviews lasted from 25 to 75 minutes. It has resulted in about 65 pages of transcripts and the data were analysed using categorization, manual text-mining and coding in NVivo software.

Table 1 – Summary of the interviews conducted

<table>
<thead>
<tr>
<th>№</th>
<th>Position in the company</th>
<th>Years of experience on this position / in this role</th>
<th>Company size¹</th>
<th>Industry</th>
<th>Country</th>
<th>Collaborative link(s) with university(ies)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Consultant</td>
<td>6</td>
<td>Small</td>
<td>Consultancy in Media and ICT</td>
<td>Finland</td>
<td>Mainly collaborative R&amp;D and forming university industry projects consortiums</td>
</tr>
<tr>
<td>2.</td>
<td>Consultant</td>
<td>4 / 12</td>
<td>Large</td>
<td>Finance, Consultancy</td>
<td>Denmark</td>
<td>Students’ business mentor-ship</td>
</tr>
<tr>
<td>3.</td>
<td>Head of –collaboration with Universities</td>
<td>1,3 / 5</td>
<td>Large</td>
<td>Dairy</td>
<td>Denmark</td>
<td>Mainly collaborative R&amp;D</td>
</tr>
<tr>
<td>4.</td>
<td>Owner, Innovation Consultant</td>
<td>1 / 16</td>
<td>Micro</td>
<td>Management Consulting</td>
<td>Netherlands</td>
<td>Both way business and innovation management consultancy</td>
</tr>
<tr>
<td>5.</td>
<td>Senior Vice President, Head of Innovation</td>
<td>2 / 26</td>
<td>Large</td>
<td>Building Materials</td>
<td>Switzerland</td>
<td>Mainly collaborative R&amp;D</td>
</tr>
<tr>
<td>6.</td>
<td>Program Manager - University Relations (Open innovation)</td>
<td>5</td>
<td>Large</td>
<td>Chemicals</td>
<td>USA</td>
<td>Collaborative R&amp;D, collaboration in education</td>
</tr>
<tr>
<td>7.</td>
<td>Technology Scouting &amp; University Collaborations</td>
<td>5/10</td>
<td>Large</td>
<td>Chemicals</td>
<td>USA</td>
<td>Collaborative R&amp;D, start-ups investments</td>
</tr>
<tr>
<td>8.</td>
<td>Managing director</td>
<td>10</td>
<td>Medium</td>
<td>IT and services</td>
<td>Hungary</td>
<td>Collaborative R&amp;D</td>
</tr>
<tr>
<td>9.</td>
<td>External Research - leader</td>
<td>2,5/10</td>
<td>Large</td>
<td>ICT</td>
<td>USA</td>
<td>Collaborative R&amp;D and education</td>
</tr>
</tbody>
</table>

¹ Using EU classification: micro enterprises - fewer than 10 persons employed; small enterprises - 10 to 49 persons employed; medium-sized enterprises - 50 to 249 persons employed; large enterprises - 250 or more persons employed (Eurostat, 2016)
4 Results

4.1 Universal skills and knowledge required for collaboration with external partners

Results of the quantitative data analysis

Conducting the survey, we have collected the data on 28 skills and competences required for OI specialist (see Appendix 1). The respondents were asked to evaluate the importance of these skills and abilities for OI manager using a scale of 1-7, where 1 means not important and 7 – strongly important.

Analysis of means of skills and abilities importance (see Appendix 3 and 4) for active adopters of certain OI activity revealed the most important skills for each of activity. Overall, all the skills and abilities appear important for OI manager, which additionally supports the set of skills and abilities we have constructed for the survey questionnaire.

On sample average the most important skills for OI manager according to our respondents are: team-working skills, problem-solving skills, external collaboration skills, communication and networking skills. The most important abilities are: to share knowledge and ideas internally, creativity, technology and business mind-set.

This quantitative analysis showing quite high importance of all the identified skills and abilities does not allow us yet to identify specific skills required for collaborating with different partners. However, it confirms the importance of universal skills needed for OI specialist.

Results of the qualitative data analysis

The majority of our interviewees see the difference in skills, abilities and knowledge required from general collaboration manager compare to one responsible for interaction with the university. For instance, one of our interviewees says:

“That’s a very good question. I think the straight answer should be NO. There is no way that you can use a general rule that you can apply to all types of partners. I guess there are principles that are standard, and that principles of course are building trust, and after you building trust getting to the right arrangement depending on the type of partners, depending on their objectives and depending on our objective of these for the relationship.” (Interviewee 3).

At the same time, one of our interviewees rather believe that it there are many universal mechanisms in collaboration:

‘In general, I think, the way to collaborate is the same whoever you collaborate with. I mean it’s being open minded and being ... sharp in terms what is that you are trying to achieve. I think, once you agree on that goal then everything else becomes much easier. Then of course, depending on the situation you might have more intellectual property related issues ... or sometimes with customers more on the commercial side. Then, there are technically something, that are very dependent on the type of project,
but in terms of attitude and way of handling it that’s kind of a universal system’ (Interviewee 5).

A number of skills was mentioned as universal skills required for collaboration with any type of partner. We have asked our interviews to list the three most important skills and most important type of knowledge required for any type of collaboration regardless the kind of partner. A summary is given in the table 5. Almost every respondent as fundamental mentioned a skill of building trust among partners. The skills very closely linked with a skill of building trust of mentioned during interviews are communication skills, being clear in goals and bridge the goals of various types of partners, openness towards other approaches, and ability to listen.

An importance of networking and diplomatic skills was also highlighted. The interviewee representing pharma industry pays attention to internal networking and understanding of what is happening inside the company:

“I think the basic skills are going to be the same. You have to be diplomatic, be able to network both externally as well as internally, and have a good overview or good knowledge of the company itself and have a personal network to be able to share the needs and technologies.” (Interviewee 7)

A separate attention was paid by several interviewees to the ability to create and communicate the value that the company has to offer to a partner and thus, being a credible partner for external party.

In terms of communication skills, a need to be able to communicate at the different levels both in terms of organizational structure and in terms of degree of technical and scientific knowledge was highlighted:

“You really need to be able to communicate effectively, but also be able to communicate as I said different levels: the level of science, the level of management, organizational communication, etc. So, those things should be in the arsenal of whoever wants to get into open innovation.” (Interviewee 3).

Again, in respect to communication, language skills were mentioned with a note that it is not only about grammar and language speaking skills, but also about awareness of special terminology that the company partner is using. These skills are closely linked with a need in knowledge and understanding of scientific field approached by collaboration, as well as knowledge on the industry and complete value chain (understanding of all the actors in the value chain). In terms of knowledge required the general knowledge on finance, marketing and economics were mentioned as a valuable assets as well. One of our interviewees mention a strong need in knowledge on collaborative business models and understanding of strategic value of each collaboration. The other important knowledge highlighted by several interviewees is a knowledge of business law.

Table 5 – Sets of skills, abilities and knowledge required for establishing and running collaborations with external partners
### Skills and abilities set (mentioned by № of interviewees)

1. Communication skills (7)
2. Building trust (6)
3. Being clear in goals and bridge the goals of various types of partners (6)
4. Openness towards other approaches, ability to listen (5)
5. Organizational and project management skills (being able to organize collaboration on the practical level) (3)
6. Being curious (2)
7. Being a credible partner (2)
8. Creative idea generation and idea management skills (2)
9. Language skills (2)
10. Skill of testing and failure tolerance (2)
11. Being ambitious in approaching collaboration (1)

### Knowledge set (mentioned by № of interviewees)

1. Knowledge and understanding of science and language of particular field partners are coming from (7)
2. Knowledge of the industry and complete value chain (5)
3. Legal knowledge: business law - IP and contracts (3)
4. Finance, marketing, economics (2)
5. Expertise and knowledge of collaborative business models (1)

---

#### 4.2 Skills and knowledge required specifically for collaboration with universities

**Results of the quantitative data analysis**

The analysis of the survey results helps us to highlight the skills required for activities that are common as collaborative links with the universities. The skills, which are commonly important for all the four activities are: *team-working skills, external collaboration skills, networking and communication skills* (see table 6).

Table 6 - Most important skills for firms with the highest intensity of OI practice adoption (based on analysis of the survey results)

<table>
<thead>
<tr>
<th>OI activity</th>
<th>Most important Skills and Abilities</th>
</tr>
</thead>
</table>
| Collaborative innovation with external partners (i.e. suppliers, universities, competitors…) | Skills 5. Team-working skills  
Skills 7. Problem-solving skills  
Skills 10. External collaboration skills  
Skills 12. Communication skills  
Skills 13. Networking skills  
Abilities 1. Technology and business mind-set  
Abilities 3. Adaptability and flexibility  
Abilities 5. Ability to work in an interdisciplinary environment  
Abilities 8. Creativity  
Abilities 12. Ability to share knowledge and ideas internally |
| Subcontracting R&D                  | Skills 2. Negotiation skills  
Skills 5. Team-working skills  
Skills 7. Problem-solving skills  
Skills 9. Internal collaboration skills  
Skills 10. External collaboration skills  
Skills 11. Trust skills  
Skills 12. Communication skills |
**Results of the qualitative data analysis**

The qualitative data analysis allows us to broaden the understanding of the human capital required for collaboration with the universities, to explore the abilities, which are specifically important for such a role compared to a general collaboration manager and check if the set of skills developed by us based on the literature is complete. Most of the interviewees (company managers responsible for collaboration with companies) have noted that there are certain specific skills needed in collaboration with universities. For instance, a manager responsible specifically for collaboration with universities and with SMEs says:

"The tools and the ways that you have to use to collaborate with universities are different from the ones that you use for SMEs and for Suppliers.” (Interviewee 3).

Below we go through the key differences in rationale between universities and industry covered during our interviews and analyse the skills needed for the company professional to overcome them. At the end of this section, in Table 7, we provide a summary of the results received from the data analysis. After a free discussion and open-ended questions, we gave our interviewees a list of 28 skills and abilities from the survey questionnaire. We asked them in a form of a closed-ended question to evaluate if these skills are more, less or equally important for establishing and running successful collaboration with universities than with other partners (we provided them a freedom to interpret success according to their own understanding and benefits for company). This closed-ended question revealed four skills and abilities that are specifically important for UIC: *Adaptability and flexibility*, *Ability to work in an interdisciplinary environment*, *Strategic thinking*, *Ability to work with different professional communities* (see Table 7).
Different timeframes: skills required to deal with

Answering the open-ended questions all of the interviewees mention an issue of different timeframes or dynamics of operations in business and in academia widely acknowledged in the literature (Bruneel et al., 2010; Hall et al., 2001). A manager responsible for external research turns it into skill:

“I think to work with universities, it is very critical to understand that universities work on different timelines than businesses work on. So, it is a skill to be able to balance the long-term vision of the university ... versus the timeline that the company is looking for...”. (Interviewee 9)

One of our interviewees, an owner of small consulting company highlights how big this time-orientation difference is between universities and particularly SMEs:

“One of the specific skills needed in order to establish collaboration between businesses (especially SMEs) and universities is that you need to understand the dynamics, and the language and motivation of people working on both sides of the collaboration gap. ... In many cases, people working in industry are looking for solutions that they can implement tomorrow. That especially counts for SMEs. When you have to deal from the business perspective with the culture and dynamics of university research you have to accept that the timeframe is completely different from SME perspective’ (Interviewee 4).

In order to balance this difference in time orientation, a specific skill or vision should be developed. Strategic view or mind-set helps to overcome this issue by looking at a longer-term plan for the research collaboration. As our interviewee says:

“It is about identifying your long-term needs for research, and what are the strategic areas that you want to develop in your business. Sometimes it is a difficulty to move from traditional contract research into more strategic.” (Interviewee 3).

Radical vs incremental innovation: skills required to deal with

A basic orientation of universities towards advanced, fundamental research does not always meet the company needs – as one of our interviewees says:

“In many cases, industry is satisfied with a solution that’s good enough. From a research perspective, you want to come up with new ... knowledge, innovative technology, and you always want to pursue the idea of the technology a little bit further than a solution suitable in practice.” (Interviewee 4).

Understanding of the great scientific value of research discoveries makes academics ambitious about its financial value, sometimes too ambitious as noted this university relations manager working in chemical engineering and biotech sectors:

“Another problem ... we face with the universities is that universities unfortunately equate invention with innovation. That are not the same things. ... At the university, I believe, you need to be paid for the invention, not for the product. Sometimes, the
universities expect that they are going to be paid as for commercial product although it was an invention.” (Interviewee 6)

According to our interviewees these issue are to be overpassed by a combination of such skills as *communication, agility* (or adaptability and flexibility), *being involved, and continuously engaged in interaction*, clear in setting up the collaboration goals.

**IPR related issues and publishing: how to deal with**

A problem, closely linked with scientific discoveries is IPR related issues. Seven out of nine interviewees mentioned it as a problem faced particularly often in collaboration with academia. One interviewee complains:

“*The big problem we face with the universities is IP. Negotiation of IP terms, negotiation of NDAs and BDAs it just takes too much time. ... it can literally take 3 months to set up agreement with a university even before you are able to talk. ... It needs to be shortened a lot.*” (Interviewee 6).

Interviewees had to admit that there is no other recipe to overcome this kind of issues than just being very **patient and diplomatic**.

However, the IPR related issues are quite industry and area specific. For instance, an interviewee representing an ICT sector puts hopes upon open source licensing, even though acknowledges that IP is a biggest detach in between industry and universities:

“*With an open source licensing and a proper way to set up the project, it’s a very different model of collaboration. It’s a cooperation that everyone gets benefit from. I think it is definitely the right direction and it enables companies and universities to work together more effectively.*” (Interviewee 9).

Another dramatic difference in university and industry mission is publishing. Universities needs to publish, while companies are not interested in disclosing the results of collaboration – as per one of our interviewees:

‘*Universities, they need to publish, of course industry doesn’t really like publishing that much. Especially about technology that presents the company. The result is negotiations on how long should the university wait to publish results from work that is done in collaboration with industry. ... ’* (Interviewee 7)

Here the **negotiation skills** come to the scene. However, there are certain basic goals or milestones that are dramatically different (e.g. publishing versus not disclosing). Such **milestones or success measures need to be acknowledged** by each side – university team and company managers and need to get aligned – as according to our interview:

“*Both partners have to understand what are the success factors of each individual. ... For them, university, it might be to publish as much as they can and for us it’s to innovate for commercial success. ... We need to find an alignment... to match the milestones.*” (Interviewee 7)
**Knowledge and understanding of the scientific area and industry**

All of the interviewees pointed out at importance of certain level of *scientific or technical knowledge* required for collaboration. Sometimes it needs to be an advanced knowledge to be able to speak a common language with scientists – as according to one interview:

“One of the key skills sets that I look for in someone for working with universities is a technical level of expertise. It’s very important, that our technical experts have the level of expertise and appreciation for what else is available in the particular technology field, so that they can work and collaborate on an equal level with the university team.” (Interviewee 9).

Six of the interviewed people have noted a crucial importance of knowledge and understanding of the industry, in which collaboration is happening. Moreover, many of them pointed out that it has to be an understanding on a strategic level. For example, one of the interviewees explains it that way:

“You have to have quite extensive understanding of the industry and changing... the future studies and scenario studies...” (Interviewee 1).

**Structural differences: respective knowledge and skills required**

Universities and industry are different not only by its basic rationale, but also by organizational structure. That is why to be able to collaborate with universities company manager needs to be familiar with the structure of the organization – see, what our interviewee thinks about it:

“Company manager will need to understand how university works... how are universities internally structured in terms of what is the role of TTOs [Technology Transfer Offices], how are they measured, what are their objectives, how to interact with faculty, how to interact with TTOs. ...” (Interviewee 7)

According to our findings not least important is a knowledge of funding schemes, understanding of how the two types of institutions are running. Four interviewees mentioned this aspect in various domains: importance of this understanding in terms of joint applications for funding as well as personal experience in applying for funding, which would be valuable for the position of university-industry collaboration manager.

**Differences in mind-set and personality: skills and abilities required**

Discussing the skills required from the managers one of the interviewees note an importance of not only understanding the structure and being able to approach right people, but also to be tactful with academics:

“Such a manager needs to understand how to build a relationship with universities... How do I approach university, how do I manage expectations... and how do I make sure that people don’t get frustrated, because most of the time when the proposal
A skill to manage expectations was mentioned by three company managers – all based in the USA. By this skill, they mean ability to explain to universities what should be and should not be expected by them. Moreover, by this skill they mean an ability to balance the polar needs of collaborative actors and communicate within the company any change in its own internal expectations. This skill was not used in our original set of skills and abilities, but we found that it has to be taken into account. Exactly the comment on one missing skill very closely linked with expectations management was given by one of the interviewees:

“Regarding the skills and abilities that you mentioned in the survey, I was missing one important point, that I consider vital for such collaboration - how to propose a “win-win” type of collaboration? There is a possibility for collaboration only in the case, when both partners have their interests in the collaboration. The manager should be able to identify what is the interest that offers benefits to all partners.” (Interviewee 8)

Every single interviewee mentioned a human relation skill and ability to build trust among the most important ones. They all have noted that there are peculiarities of these skills in university-industry collaboration context. These peculiarities lie in the differences between the mind-sets of academics and practitioners.

The role of collaboration manager in here is to not only acknowledge these differences in the mind-sets, but also again be diplomatic in communicating it, understand the personality of the people representing academia and make them believe in mutually beneficial collaboration. One of the interviewees shares his observation on academics’ personality and suggests how a company manager should deal with this:

“It is not to criticize, but I think, the environment in the university is very ego-centric. There are big egos. If you really as a company want to be able to work with these type of characters in universities, you have to be able to go pass that and to be able to focus on the relationships rather than on the person... You really need to be open-minded, flexible and to be politically astute in a sense, to read the situation, to get to know exactly what is going on. That type of skill is really needed at this job.” (Interviewee 3).

We have also asked our interviewees to picture a personality of an ideal manager to be responsible for collaboration with universities. All of them admitted that it has to be an open-minded person or a curious extravert, a person ready for experimenting and tolerant towards failures – all to make sure that such a manager can listen to others. It needs to be a person with a long-term view and strategic thinking – that will allows understanding of the strategic benefits of collaboration with academia and helps to find a fit in the timeframes. Moreover, it needs to be a leader able to manage multi-disciplinary and heterogeneous team, and influencer able to lobby ideas both on the management level
and within the group of ordinary employees. On top of that, it has to be a person that ‘likes people’ and makes others like him/her back. One of the interviewees puts it simply as:

“Generally, you need to be a good guy, somebody people are getting along with.” (Interviewee 1).

All of our interviewees tend to admit that all the skills and abilities mentioned (and summarised in the table 7) are to be learned by doing rather than to be taught. Even though some of the basics could be taught (see Education section in the table 7), most of the human capital is to be developed through actual engagement in collaborations. That is why any experience in relationship management would be a valuable asset for such professional (see Experience section in the table 7). To illustrate an importance of experience in relationship management, one of the persons we talked to uses the term ‘attrition’:

“Humans actually learn by attrition. So, the more you interact with all the people, the more you learn and the more diverse cases you have of relationship ... good and bad, and different types of personalities. That creates not just achievement but a confidence, that I can manage any situation.” (Interviewee 3).

Table 7 – Sets of skills, abilities and knowledge required specifically for establishing and running successful collaborations with universities

<table>
<thead>
<tr>
<th>Skills and abilities set</th>
<th>Knowledge set</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Based on answers to closed-ended question</strong></td>
<td><strong>(mentioned by a number of interviewees)</strong></td>
</tr>
<tr>
<td>(by average score):</td>
<td></td>
</tr>
<tr>
<td>1. Adaptability and flexibility (‘agility’)</td>
<td>1. Technical knowledge (basic/advanced – case specific) (9)</td>
</tr>
<tr>
<td>2. Ability to work in an interdisciplinary environment</td>
<td>2. Business law and IP (7)</td>
</tr>
<tr>
<td>3. Strategic thinking</td>
<td>3. Knowledge of the industry and understanding where it goes to in the long term (6)</td>
</tr>
<tr>
<td>4. Ability to work with different professional communities</td>
<td>4. Knowledge of the funding schemes and funding opportunities (4)</td>
</tr>
<tr>
<td><strong>Additionally highlighted, case specific (mentioned by a number of interviewees):</strong></td>
<td>5. Knowledge of where to find the right person in the university and how to approach the person (unit). (2)</td>
</tr>
<tr>
<td>5. Human relation skills and trust building (9)</td>
<td></td>
</tr>
<tr>
<td>6. IP management skills (7)</td>
<td></td>
</tr>
<tr>
<td>7. Diplomatic skills (5)</td>
<td></td>
</tr>
<tr>
<td>8. Ability to translate science into business opportunities (5)</td>
<td></td>
</tr>
<tr>
<td>9. Expectations’ management skills (3)</td>
<td></td>
</tr>
<tr>
<td>10. Project portfolio management skills (2)</td>
<td></td>
</tr>
<tr>
<td><strong>Experience</strong></td>
<td></td>
</tr>
<tr>
<td>1. Any managing relation experience (8)</td>
<td>1. Project management (8)</td>
</tr>
<tr>
<td>2. Worked in inter-disciplinary teams (7)</td>
<td>2. Some courses on IP, business law (4)</td>
</tr>
<tr>
<td>3. Worked in R&amp;D environment or specifically in the university (case specific) (6)</td>
<td>3. General business courses (3)</td>
</tr>
<tr>
<td>4. Experience in applying for funds (4)</td>
<td></td>
</tr>
<tr>
<td>5. Worked in the business or in particular company (to know its needs) (2)</td>
<td></td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Personal characteristics</strong></td>
<td></td>
</tr>
</tbody>
</table>
5 Discussion

In this study, we explored the role of human capital in university-industry collaboration, particularly in open innovation context. We found that the set of skills and abilities proposed in previous studies is valid and all of the human capital’ characteristics are important for open innovation professional to a certain extent depending on particular context (e.g. company goals, mission, particular collaborative partners, etc.).

Our study proves a proposal by Carayannis et al., (2000) that even though there are many generic skills important for managing collaborations with any type of external partner, there are certain peculiarities of human capital applicable specifically for company collaboration with universities. These peculiarities reflected in the required skills include a need to deal with differences in the timeframes between universities and companies (to be addressed by strategic thinking and ability to look at the long-term perspective). It also includes differences in basic rationale: invention-oriented universities and innovation-profit oriented companies, which requires to be very good at communication, being agile and continuously engaged with people from academia.

It also requires excellent negotiation skills, knowledge of IP to deal with bureaucratic procedures and debates on IPR and publishing related issues (widely acknowledged in the literature as common issues in UIC (Bruneel et al., 2010; Hall et al., 2001)). Collaboration with academia also requires acknowledging the university mission, goals, success metrics and milestones, and a search for alignment in between university and industry goals in order to ensure a win-win partnership.

The company manager also needs to acknowledge the difference in organizational structures between university and company, understand how and whom to build relationships with. Then, it requires understanding the technical field and being politically astute in communicating with academia that will assist in trust building – a fundamental requirement for any collaboration with external partner (Lindegaard & Kawasaki, 2010). Knowledge of available funding opportunities and experience in applying for funding is a valuable asset for such a professional, since it helps to understand the monetary drivers of each actor (Santoro, 2000; D’Este & Perkmann, 2011).

To collaborate with academics, the manager will have to understand and respect the academics personality, be tactful with academics, which could be very ambitious and quite
ego-centric. Being open-minded, curious and being an influencer type of person should help at this position.

An additional skill identified by us is an expectations management skill – another soft skill, not yet widely covered by university-industry collaboration literature (as a problem in UIC context it is discussed by Barnes et al., (2002) and Şendoğdu & Diken (2013)).

We have found that a human capital required from the company needs to be nurtured by experience or attrition. The attrition phenomenon is explored in the psychology literature for instance by Schneider (1987) and further by Ployhart et al., (2006), while not yet widely acknowledged in the literature on UIC.

6 Conclusions and suggestions for further research

This study explores the components of human capital required for a company manager to collaborate with external partners and distinguish those aspects of human capital, which are particularly important for collaboration with universities.

We have identified and validated 28 skills and abilities required for collaboration with external partners and defined the key ones. We have also defined the key peculiarities of such skills as communication, trust building, relationship building, IPR management and negotiation for the context of collaboration with university. Our research has revealed an importance of expectation management skills for UIC context. We found that human capital for UIC is to be continuously developed and contracted by engagement in various relationships with academia.

Our study contributes to the existing body of knowledge on human capital and university-industry collaboration. It also serves practitioners with a profile of UIC manager.

As directions for further research, we suggest exploring the effect of rapidly growing phenomenon of university entrepreneurship on university human capital. We also propose clarifying the links between company human and social capital in the context of university-industry relationships as well as further search for human capital aspect in this domain, since we all know that the world, organizations and humans are continuously developing and changing.

References


Appendices

Appendix 1 – Open Innovation Skills, Abilities and Competences (operationalization of variables)

<table>
<thead>
<tr>
<th>Skill, ability or competence</th>
<th>Description</th>
<th>Reference(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. IP management skills</td>
<td>IPR securement skills, knowledge and understanding of sourcing, control, commercialization, licensing, valuation, pricing</td>
<td>Love, 1998; Holgersson, 2012</td>
</tr>
<tr>
<td>3. Entrepreneurial skills</td>
<td>To run ideas and research into real products and services’ (Lindegaard &amp; Kawasaki, 2010, p. 51)</td>
<td>Lindegaard &amp; Kawasaki, 2010; Sloane, 2011</td>
</tr>
<tr>
<td>4. Leadership skills</td>
<td>Skills to lead, coach and energize multi-disciplinary teams, to influence senior managers, drive decisions, and direct outside resources</td>
<td>Lindegaard &amp; Kawasaki, 2010; Dabrowska and Podmetina, 2014.</td>
</tr>
<tr>
<td>5. Team-working skills</td>
<td>Ability to deal with low proximity, structural team composition and functional team composition, coordinate and synchronize activities, information, and tasks between team members, develop team spirit</td>
<td>Miller, 2001; Knowles, 1990</td>
</tr>
<tr>
<td>6. Multi-tasking skills</td>
<td>Manages tensions created by multiple accountabilities, tasks and roles.</td>
<td>Williams, 2002</td>
</tr>
<tr>
<td>7. Problem-solving skills</td>
<td>Ability to evaluate the problems, break them down and find solutions under pressure of external factors</td>
<td>Sartori, 2013</td>
</tr>
<tr>
<td>8. Virtual collaboration skills</td>
<td>Ability to manage collaborations online</td>
<td>Hafkesbrink et al. 2010; Sartori et al., 2013</td>
</tr>
<tr>
<td>9. Internal collaboration skills</td>
<td>Strong ability to develop high profile, influential and collaborative relationships across teams, functions and layers</td>
<td>Hafkesbrink et al. 2010; Orinos, 2012; Sloane, 2011</td>
</tr>
<tr>
<td>10. External collaboration skills</td>
<td>Excellent relationship management skills across public and private sector</td>
<td>Hafkesbrink et al. 2010; Orinos, 2012;</td>
</tr>
<tr>
<td>11. Trust skills</td>
<td>Ability to make people rely on relationships</td>
<td>Lindegaard, 2010</td>
</tr>
<tr>
<td>12. Communication skills</td>
<td>The ability to convey information to another effectively and efficiently</td>
<td>Hafkesbrink et al. 2010; Sloane, 2011;</td>
</tr>
<tr>
<td>13. Networking skills</td>
<td>Ability to build long-term relationships with people in a mutually beneficial way</td>
<td>Sloane, 2011; Lindegaard, 2010;</td>
</tr>
<tr>
<td>14. Technology and business mind-set</td>
<td>Translating technology development into tactical commercial plans; application of business experience, concepts, and theories without guiding precedent</td>
<td>Hafkesbrink et al. 2010; Orinos, 2012</td>
</tr>
<tr>
<td>15. Project management skills</td>
<td>The application of knowledge, tools, and techniques to project activities to meet the</td>
<td>Sartori et al., 2013; Orinos, 2012</td>
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<tr>
<td>16. Adaptability and flexibility</td>
<td>Agility in facing changes</td>
<td>Sartori et al., 2013; Orinos, 2012</td>
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<tr>
<td>17. Managing inter-organisational collaboration processes</td>
<td>Understanding of the organizational structures and operations, ability to coordinate relationships between groups of people</td>
<td>Hafkesbrink et al. 2010; Sloane, 2011</td>
</tr>
<tr>
<td>18. Ability to work in an interdisciplinary environment</td>
<td>Understanding and knowledge of various disciplines</td>
<td>Hafkesbrink et al. 2010; Orinos, 2012</td>
</tr>
<tr>
<td>19. Ability to work in internal cross-functional teams</td>
<td>Skill to manage relationships of different cultures' representatives</td>
<td>Hafkesbrink et al. 2010; Orinos, 2012; Sloane, 2011; Lindegaard, 2010</td>
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<tr>
<td>20. Strategic thinking</td>
<td>Long-term view and understanding of principle goals</td>
<td>Lindegaard, 2010</td>
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<tr>
<td>22. New media literacy</td>
<td>Awareness and ability to work with emerging media channels</td>
<td>Hafkesbrink et al. 2010; Sloane, 2011</td>
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<tr>
<td>23. Cultural awareness</td>
<td>Understanding and knowledge of various cultures</td>
<td>Lindegaard, 2010</td>
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<tr>
<td>24. Ability to work with different professional communities</td>
<td>Skill to coordinate a work in between distinct groups of people</td>
<td>Sartori et al, 2013</td>
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<tr>
<td>25. Ability to share knowledge and ideas internally / within an organisation</td>
<td>A skill to disseminate and communicate the information within the company</td>
<td>Sloane, 2011; Lindegaard, 2010</td>
</tr>
<tr>
<td>26. Ability to share knowledge and ideas externally</td>
<td>A skill to disseminate and communicate the information outside the company</td>
<td>Sloane, 2011; Lindegaard, 2010</td>
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<tr>
<td>27. Risk awareness</td>
<td>Acknowledgement of risks</td>
<td>Lindegaard, 2010</td>
</tr>
<tr>
<td>28. Failure tolerance</td>
<td>Readiness for unsuccessful results</td>
<td>Hafkesbrink et al. 2010; Lindegaard, 2010</td>
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</table>
Appendix 2 – Skills required from the university staff engaged in university-industry links (Haywood et al., 2000)

<table>
<thead>
<tr>
<th>KEY ROLES</th>
<th>Research Skills</th>
<th>Organisational skills and coordination skills</th>
<th>Commercial and interface skills</th>
<th>Professional, strategic and marketing skills</th>
<th>Project management skills</th>
<th>Teaching, scholarship and assessment skills</th>
<th>Management, administration, and IT skills</th>
<th>Business and finance skills</th>
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</thead>
<tbody>
<tr>
<td>1. Manage Information and Communications</td>
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<tr>
<td>1.1 Obtain Information</td>
<td>✓</td>
<td>✓</td>
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<td>1.2 Exchange Information</td>
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<td>1.3 Organise Information</td>
<td>✓</td>
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<tr>
<td>2. Manage Relationships</td>
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<td>2.1 Relationships with other parts of HEI</td>
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<td>2.2 Relationships outside HEI</td>
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<td>2.3 Relationships between external agencies and HEI</td>
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<td>3. Manage Projects</td>
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<td>3.1 Manage a range of projects</td>
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<td>4. Manage the Commercial Interface</td>
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<td>4.1 Recognise opportunities</td>
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<td>4.2 Develop opportunities</td>
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<tr>
<td>4.3 Market and promote the HEI</td>
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<td>5. Manage opportunities within a legal context</td>
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<td>5.1 Understand basis of intellectual property</td>
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<td>5.2 Understand impact on operational activity</td>
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<td>6. Problem solve and manage decision making process</td>
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<td>6.1 Resolve problem areas</td>
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23
## Appendix 3 – Importance of skills for active OI activity adopters

### Intensive adoption of OI activity/Skills

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<tbody>
<tr>
<td>4. Collaborative innovation with external partners</td>
<td>5.3226</td>
<td>5.7600</td>
<td>5.6566</td>
<td>5.3300</td>
<td>5.2245</td>
<td>5.5670</td>
<td>5.9900</td>
<td>5.2887</td>
<td>5.8990</td>
<td>6.0404</td>
<td>5.8673</td>
<td>6.3636</td>
<td>6.0306</td>
</tr>
<tr>
<td>7. Using external networks (e.g. associations, intermediaries, knowledge brokers)</td>
<td>5.2857</td>
<td>5.7021</td>
<td>5.9362</td>
<td>5.7021</td>
<td>6.4130</td>
<td>5.9545</td>
<td>6.3830</td>
<td>5.8913</td>
<td>6.3830</td>
<td>6.4681</td>
<td>6.3966</td>
<td>6.4255</td>
<td>6.2667</td>
</tr>
<tr>
<td>9. Free Revealing (e.g. Ideas, IP) to external parties</td>
<td>5.5909</td>
<td>5.6923</td>
<td>5.9615</td>
<td>6.0000</td>
<td>6.3077</td>
<td>6.1154</td>
<td>6.1600</td>
<td>5.7308</td>
<td>6.3077</td>
<td>6.2308</td>
<td>6.3333</td>
<td>6.5000</td>
<td>6.1364</td>
</tr>
</tbody>
</table>

**Sample Ave**: 5.2691, 5.4761, 5.6376, 5.4227, 6.1230, 5.3441, 5.9203, 5.2734, 5.8059, 5.9151, 5.8205, 6.2068, 5.9861, 5.7, 10, 12, 13
### Appendix 4 – Importance of abilities for active OI activity adopters

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</thead>
<tbody>
<tr>
<td>9. Free Revealing (e.g. Ideas, IP) to external parties</td>
<td>6.0800</td>
<td>5.8846</td>
<td>6.0769</td>
<td>5.9200</td>
<td>6.0400</td>
<td>5.8846</td>
<td>5.4615</td>
<td>5.7692</td>
<td>5.5600</td>
<td>5.3600</td>
<td>5.8846</td>
<td>6.2400</td>
<td>5.8800</td>
<td>5.5385</td>
<td>5.7692</td>
<td></td>
</tr>
<tr>
<td>Sample Ave</td>
<td>5.9385</td>
<td>5.5068</td>
<td>5.8980</td>
<td>5.6613</td>
<td>5.7159</td>
<td>5.7768</td>
<td>5.8223</td>
<td>6.0068</td>
<td>5.1613</td>
<td>5.0406</td>
<td>5.6598</td>
<td>6.0205</td>
<td>5.7002</td>
<td>5.6224</td>
<td>5.3233</td>
<td>1.72</td>
</tr>
</tbody>
</table>

25
What does open innovation mean? Business versus academic perceptions

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Published 9 April 2018

Abstract:
Since the first appearance of ‘open innovation’ as a theoretical concept in 2003, the debates on its essence still continue among academics, while its interpretations within the business community also seem to differ from one company to another. Using a survey of 251 companies operating in Europe, in this research, we compare the perceptions of open innovation that exist within both the academic and business worlds, to assist in the conceptual development of the phenomenon. Our research reveals a mismatch in these perceptions, as only a few activities counted as ‘open’ by innovation scholars appear to affect companies’ self-reported state of open innovation implementation. Moreover, our research has shown differences in the interpretation of open innovation among companies of different sizes. Only free revealing, acknowledged by scholars as one of the open innovation practices, has been recognised as such a practice by all the studied firms. This paper contributes to conceptualisation of ‘open innovation’ and shares practical insights on bridging academia and business perceptions of it.

Keywords: Open innovation; open innovation definition; academic perception of open innovation; business perception of open innovation; open innovation activity; open innovation in Europe; open innovation self-perception; survey; quantitative research.

* All authors have contributed equally
† Corresponding author
1 Introduction

Academic journal publications, practice-oriented books, and business cases have provided an enormous number of definitions of open innovation (OI) and a variety of firms’ activities associated with OI (Chesbrough and Bogers, 2014; Dahlander and Gann, 2010; Greco et al., 2015; Renneland-Wikhamn and Wikhamn, 2013). OI has rapidly gained great popularity both as a ‘trendy’ managerial approach within the business community and as a theoretical concept intensively studied by business scholars. However, around the glorious story of ‘open innovation’, there is some criticism of its doubtful newness and, furthermore, confusion over what is perceived to be behind these two ‘magic’ words — both between and within the business and scientific communities.

The first critical notion regarding the concept of OI raised the idea that most of ‘so called’ OI practices were applied by companies long before the time when the term was introduced (Trott and Hartmann, 2009; Oakey, 2013). The weaknesses and limitations of OI are also heavily criticised by the academic community (Piller and Walcher, 2006; Trott and Hartmann, 2009; Dahlander and Gann, 2010; Knudsen and Mortensen, 2011). Such criticism is, in fact, a natural process of theory development (Popper, 1994). Furthermore, even OI scholars express their concern about the conceptual ambiguity of OI, which brings us back to the problems of the different understanding of OI in business and academia.

Thus, the problem of conceptual ambiguity around ‘open innovation’ (Trott and Hartmann, 2009) could not yet be solved simply by academic researchers clarifying and describing their vision of OI as the roots of the problem lie deeply along the rigour-relevance debate in management research (Gulati, 2007). In this respect, Groen and Linton (2010) legitimately stress the relevance of the ‘open innovation’ concept per se, and particularly, in respect to its overlap or its certain complementarity with the term of ‘supply chain’, where different actors along the supply chain or various company stakeholders (Freeman et al., 2010) create value jointly. In response to this strong and relevant argument, van de Vrande and Man (2011) make a stand for ‘open innovation’ as it ‘cuts across various existing research domains and therefore may help to integrate them’ (p. 186). However, in the same discussion note, van de Vrande and Man (2011) heavily stress the issue of the relevance of general managerial research (in respect to ‘open innovation’ relevance) for practitioners. They confirm the lack of such relevance together with a desperate need for the ‘new theoretical lens, grounded in practical problems, that supersedes the pre-existing individual lenses’ and suggest that ‘the core problem should be solved by focusing our research more on integrative, practical problems…’ (van de Vrande and Man, 2011, p. 186). Among a few recipes for achieving rigour and relevance while developing a new theory (as the scholars currently do in the OI landscape), Gulati (2007, p. 780) proposes scholars to ‘appreciate and synthesize the dialectic between theory and phenomenon’. That is why we claim that it is critically needed to examine the relevance of ‘open innovation as a concept,’ for ‘open innovation as a phenomenon’ — compare the perceptions of OI among scholars and practitioners —
in order to improve the rigour and relevance of OI as a theoretical lens in management research.

The researchers analyse the variables reflecting companies’ activities perceived as ‘open’ by the academic literature, and the measurements are proposed and validated by, again, the researchers (see, e.g., Chesbrough and Brunswicker, 2014). However, in practice, companies might have a different view of their operations. Thus, the companies’ actual activities need to be assessed against, first, the practices acknowledged as ‘open innovation’ in the academic literature, and second, the companies’ own perception of such practices. OI suffers from a lack of sufficient methodology and measurement instruments (Podmetina et al., 2014), and this limitation requires contributions from both the practical and academic sides. The extensive usage of the OI concept has led to a very diverse interpretation of it within academic versus business communities. Thus, the question remains ‘what should be counted as open innovation and what should not be?’.

Trying to answer this question, we first measure the activities that companies apply in practice: ‘what companies do’. We asked firms to specify whether they adopt (and if yes, then how intensively) the activities acknowledged as ‘open innovation’ activities by the literature. The list of these 13 activities (elaborated based on the academic literature) was provided in the questionnaire. Then, we analyse companies’ own perceptions of their OI adoption, aiming to understand ‘what companies think they do’. We asked firms to choose, from the offered list, the stage of their firm’s OI adoption, from ‘not implementing open innovation, and not planning to implement’ to ‘experienced adopters of open innovation’ (see the table on operationalization of variables for further details).

Based on these concepts and the identified research gap, we formulated our research questions as follows:

1. How does actual OI adoption vary between companies who claim to be OI adopters, and those who claim that they do not adopt OI?

2. What OI activities, identified as such by academic researchers, are not considered ‘open’ by business practitioners?

The paper is structured as follows: in the literature review, we go through OI definitions and classifications, and the measurement of OI activities, as proposed in the academic literature, and we look for existing confusion and inconsistencies. We also analyse the perception of OI in companies, as presented in business cases. The methodology section explains our data collection process, sampling, and methods of analysis. Then we present and discuss our results. In the conclusion, we summarise our findings and propose directions for future research.

2 Perceptions of open innovation in academia and in business
The history of the concept of OI started with a book by Chesbrough and several case studies (Chesbrough, 2003a,b, 2004). Gassmann and Enkel conducted the first empirical study on OI in 2004. Since 2006, the number of publications on OI has increased significantly (Chesbrough and Bogers, 2014) and crossed the 500-article threshold in 2013 (Podmetina et al., 2014). By this time, the research on OI had passed through several stages: from the initial theory building, conceptualisation, and development of the methodological instruments (2003–2006); through exploring the concept using qualitative methods, case studies, and first attempts to quantify OI research (2007–2008); to numerous quantitative studies, large-scale surveys, and the application of novel research methods (2009–2013) (Podmetina et al., 2014). Since then, we have been able to observe the new waves of empirical research and case studies, clarifying the main OI components and developing the new applications of the OI paradigm. In this literature review, we go through the perception of the concept of OI reflected in the academic research, as well as in the practitioner-oriented literature, and analyse the confusion and debates that have arisen around this concept.

2.1. Definitions of Open Innovation – an overview

The interest in OI in the research community has led to the rapid emergence of studies aiming to frame and conceptualise the phenomenon. The first definition of OI by Chesbrough says ‘Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology’ (Chesbrough, 2003a, p. xxiv). West and Gallagher (2006) later gave another wording to OI as ‘(. . .) encouraging and exploring a wide range of internal and external sources for innovation opportunities, consciously integrating that exploration with firm capabilities and resources, and broadly exploiting those opportunities through multiple channels’ (West and Gallagher, 2006, p. 1).

In 2006, Chesbrough defined OI as ‘the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively’. Since then, there have been many attempts to define a firm’s openness (e.g., Dahlander and Gann, 2010; Van de Vrande et al., 2010), with an emphasis both on external sources of innovation (Laursen and Salter, 2006) and previously hidden internal ideas (Henkel, 2006). According to Henkel (2006), OI is similar to the phenomenon of ‘collective invention’ associated with user innovation.

Contradictory to OI proponents, several authors (e.g., Dahlander and Gann, 2010; Groen and Linton, 2010; Oakey, 2013; Trott and Hartmann, 2009) claim that the concept is not particularly new. They refer to a strong research tradition examining the results of opening up a company’s boundaries to the external environment (Freeman, 1974; Pavitt, 1984; von Hippel, 1986; Chandler, 1990). Moreover, they also note a significant overlap between the OI paradigm and the already existing concept of supply-chain management (Mowery, 2009). In response to the criticism, Chesbrough and Bogers (2014, p. 27) give another definition to help in unifying the future work in this area: ‘open innovation is a distributed innovation process based on purposively managed knowledge flows across
organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with each organization’s business model’.

Despite the existence of the well-acknowledged definitions of OI, the ‘multidisciplinary origin of the researchers’ dealing with OI ‘makes it far from easy to form one strong, unified research community which shares one workable, all-encompassing definition’ and OI ‘can be framed in many different — not always congruent — ways’ (Remneland-Wikhamn, 2013, p. 386). This broadness of OI concept thus provides additional ground for conceptual ambiguity and the gap in understanding of it by scholars and practitioners.

2.2. Classification of open innovation

Prior research has already pointed out that the ambiguity in OI might cause confusion in companies’ understanding of what OI actually is (Dabrowska et al., 2013). Therefore, there is a research gap in structuring OI activities and understanding how companies associate the degree of engagement with the level of OI adoption.

From the academic perspective, Gassmann and Enkel (2004) classified the OI process as the outside-in, the inside-out, and the coupled process. This classification was later applied in research papers by Enkel et al. (2009), Van de Vrande et al. (2009), Rohrbeck et al. (2009), Dahlander and Gann (2010), and others. In 2006, Chesbrough et al. introduced another typology of OI, which is based on ‘purposive inflows and outflows of knowledge’: inbound and outbound (Chesbrough and Crowther, 2006, p. 1). Inbound OI reflects the outside-in process, and outbound OI respectively means the inside-out process. In 2010, the inbound-outbound classification was supplemented with monetary (pecuniary) and nonmonetary (non-pecuniary) dimensions (Dahlander and Gann, 2010). Chesbrough and Brunswicker (2014) later used this matrix for an empirical study in which they also provided a list of inbound and outbound OI activities. In the same year, 2014, Chesbrough and Bogers wrote about OI and ‘knowledge flows across [an] organizational boundary’ (Chesbrough and Bogers, 2014, p. 27), following Gassmann and Enkel’s (2004) classification of OI as outside-in (or inbound), inside-out (or outbound), and coupled OI. They also listed the mechanisms that help companies to manage the purposive knowledge flows for each of the OI dimensions.

Respectively, in the age of knowledge-based economy, in the OI processes, there coexist ‘knowledge owners/sellers’ (which in addition to a business player may be a university or a research institution) and ‘knowledge seekers/buyers’ as the core actors on the knowledge markets (Natalicchio et al., 2014; Dushnitsky and Kluter, 2017). The actual characteristics of the knowledge-based transactions between the two appear very context-specific due to also the nature of tacit knowledge (Natalicchio et al., 2014; Polanyi, 1966; Nonaka and Takeuchi, 1995). Thus, depending on the contextual settings (which also include environmental ones (Alexy et al., 2009)), the companies adopt various strategies in their OI partnerships — from very formal agreements (Gomes et al., 2016) to less formal, trust- or in-kind-based relationships and/or involving intermediaries (Elmquist et al., 2016).
This dualism of the OI nature — inclusion of both pecuniary and non-pecuniary activities, diversity in terms of the relationships formality — reflects ‘libre’ versus ‘control’ debate and keeps OI along the entire spectrum, which in turn ‘tends to give a somewhat fragmented and incoherent perception of what open innovation is and how it should be applied in practice.’ (Remneland-Wikhamn and Wikhamn, 2013, p. 375).

It can be observed from the empirical studies examining OI adoption that companies tend to engage more with inbound rather than outbound activities (e.g., Van der Meer, 2007; Van de Vrande et al., 2009; Schroll and Mild, 2011). Likewise, the academic research pays more attention to inbound rather than outbound or coupled OI (Chesbrough and Bogers, 2014; West and Bogers, 2013). However, the question of what activities practitioners and researchers associate with inbound and outbound and/or coupled OI remains open.

2.3. Measurement of open innovation

The confusion in the classification of OI activities leads to the other wave of criticism: the separate measurement constructs differently applied by researchers. The most commonly used is, perhaps, external ideas and knowledge sourcing and acquisition (proposed by Chesbrough, 2003a). Among the OI measurement instruments, knowledge acquisition refers to the activities when companies seek and acquire technologies from outside (Laursen and Salter, 2006) in order to complement internally developed R&D and achieve better competitiveness in the market. External technology acquisition is most commonly measured by the level of external knowledge ‘breadth’ (a combination of 16 sources of knowledge for innovation) and ‘depth’ (‘the extent to which firms draw intensively from different search channels or sources of innovative ideas’ (Laursen and Salter, 2006, 134)) (Ebersberger et al., 2012; Köhler et al., 2012; Laursen and Salter, 2006; SoKa and Grimpe, 2010; Spithoven, 2013; Tether and Abdelouahid, 2008, and others).

The study on external knowledge sourcing by Laursen and Salter (2006) has been based on secondary data, and mainly the Community Innovation Survey (CIS). However, CIS was not initially designed to measure OI, which led to the modification of the proposed measures. Thus, Idrissia et al. (2012), in their study on Canadian small- and medium-sized enterprises (SMEs), identify 21 various external knowledge sources instead of the original 16. The application of other secondary sources forces authors to adjust measures for their purposes, and to use proxies (Freitas et al., 2013; Holl and Rama, 2012; Kafouros and Forsans, 2012; Sandulli et al., 2012). The development of an original questionnaire enables the application of more robust indicators specially designed to capture OI adoption, which eventually results in a greater variety of measures aiming to analyse various aspects of OI (e.g., Clausen et al., 2013; Hung and Chou, 2013; Remneland-Wikhamn and Wikhamn, 2011; Theyel, 2013).

The use of intellectual property (IP), ideas, and technologies from outside of the company (or an external path to market for internally developed and not used technologies)
(Chesbrough, 2006; Gassmann and Enkel, 2004) is still implemented much more rarely than external technology acquisition (Athreye and Cantwell, 2007). Before the introduction of the OI concept, outbound innovation was considered as part of the knowledge transfer phenomenon (Granstrand et al., 1992), as outbound technology transfer. Later, Lichtenthaler (2005, 2007b, 2008a) proposed a measurement for outbound OI, utilising unused technologies within the firm and technology commercialisation mechanisms. This activity, circumventing the Not-Sold-Here syndrome (Herzog, 2011), can be illustrated, for example, by cases of firms aiming for new distribution channels, lower risks, and decreasing R&D costs, such as IBM and Novartis (Gassmann and Enkel, 2004).

Cooperation in R&D is widely used as one of the measures of OI (Laursen and Salter, 2006; Spithoven, 2013). Cooperation in innovation and R&D resulted from a lack of internal resources and has been studied in pre-OI times (Hagedoorn, 2002; De Propris, 2002). There was research on the companies cooperating with external partners (Hagedoorn, 2002), learning to integrate external knowledge (Cohen and Levinthal, 1990) and to combine internal and external R&D in an optimal and risk-free way, making a choice between ‘making internally’ and ‘buying’ (Cassiman and Veugelers, 2002).

Chesbrough and Brunswicker in their study (2014) develop and validate a list of OI activities focusing particularly on the large firms. Burcharth et al. (2014) apply a slightly different set of practices in measuring OI in the context of particularly SMEs. Despite the differences brought by the contextual settings, the practices proposed by both studies called for creation of an organisational culture that enables a search for and acquisition of external knowledge. Such a culture in turn helps in overcoming Not-Invented-Here and Not-Shared-Here syndromes (Katz and Allen, 1982; Chesbrough, 2011; Burcharth et al., 2014; Chesbrough and Brunswicker, 2014) and is crucial for OI nowadays (Gassmann et al., 2010).

2.4. Open innovation understanding in the business community

As can be seen in the academic literature, OI as a theoretical concept is still being shaped and developed, and such an evolutionary process also seems to be happening in the business community. If we look at the business-oriented literature, ‘open innovation’ (as two words used together in the context of strategic innovation development) has already been widely acknowledged by the business community as an integral part of companies’ strategic plans, although many problems linked with the related practices remain unsolved (Accenture Survey, 2015; Huston and Sakkab, 2006; Narsalay et al., 2016). However, the perception of OI — the broadness of the term, and the particular company activities that lie behind it — may differ significantly from company to company, as we can see simply by looking at the web pages that describe the role of OI in corporate strategy.

For instance, some of the companies emphasise explicitly the importance of external ideas for their internal competencies and technologies, and, for example, run idea
competitions (see AkzoNobel, 2017; Nokia, 2017; Unilever, 2017; Verizon, 2017). In other words, they use the term ‘open innovation’ predominantly to imply inbound types of OI activities. Such an understanding is well illustrated by an approach towards OI taken by one of the leaders in OI consultancy, NineSigma:

‘Open Innovation, also known as external or networked innovation, is focused on uncovering new ideas, reducing risk, increasing speed and leveraging scarce resources. … Open Innovation enables a company to connect with someone who has already developed the technology in need or who is further along the development path.’

(NineSigma, 2017)

Thus, looking at OI only through the prism of inbound OI, and taking a perspective of benefits for the focal company, reflects a ‘take’ approach rather than ‘give and take’, although a financial reward is often to be offered to innovation contributors. Another open innovation incentive for collaborating scientists can be access to ‘technologies, services and know-how’ and ‘a possibility of joint publications in high-profile journals’, as mentioned by Astrazeneca (Astrazeneca, 2017). Or, as the ‘classical’ example of the P&G Connect and Develop programme (Huston and Sakkab, 2006) suggests, sharing the company’s needs helps external parties to discover a path towards joint value creation (P&G Connect and Develop, 2017).

Some of the companies using a corporate website as their media channel mention OI practices as being those directly associated with the success of their business, and may particularly highlight the role of inbound and outbound practices in their success (see, e.g., Phillips, 2017; Samsung, 2017; and the case of DSM described by Kirschbaum, 2005). Others may also use outbound, non-pecuniary activities as an open-source practice (see IBM, 2017; also described by Chesbrough, 2007), or may diversify the modes of collaboration and the types of collaborating parties when inviting others to collaborate ‘openly’ (see Bayer, 2017).

As can be seen from an overview of just a few examples from well-known companies, the understanding of OI varies a lot, not only within academia, but also within the business community. In our research, we aim to explore and analyse the patterns existing within both the academic and business worlds, and to compare the two to assist in the conceptual development of the phenomenon.

To summarise, even though, among scholars, there is some degree of agreement about activities related to the OI paradigm, very few researchers have actually made an attempt to systematise and classify such activities and, further, even between those few ones there is a diversity in measuring OI (e.g., Chesbrough and Brunswicker, 2014; Burcharth et al., 2014). Furthermore, it has already been pointed out that the conceptual ambiguity in OI might cause confusion in companies’ understanding of what OI actually is. Therefore, there is a research gap in the meticulous classification of OI activities and the understanding of how companies associate the degree of engagement with the level of OI adoption. To
address the gap, we propose that there are certain open innovation activities perceived as open innovation ones by academia, but not by businesses/practitioners.

Thus, we propose the following hypothesis: *There is at least one open innovation activity perceived as open innovation by academia, but not by businesses/practitioners.*

In other words, we suggest there is at least one OI activity (among 13 activities associated with OI, as derived from the academic literature) that does not have an impact on a company’s self-identification as an OI adopter. Testing this hypothesis will enable us to understand, firstly, whether the gap between the perceptions of OI adoption actually exists, and secondly, where exactly it lies.

3 Methodology

3.1. Questionnaire development and operationalisation of variables

This study is a part of a large European project in which one of the aims is to analyse OI adoption in Europe and study the industrial need for OI. This paper is quantitative in nature, and it uses the survey as a research strategy. We developed a questionnaire using the in-depth analysis of the academic literature, consulting and executive reports, and existing questionnaires (e.g., CIS). The structured questions resulted in scales. Some of the variables used in this analysis are summarised in Table 1. The survey questionnaire also included a set of open-ended questions, and in one of those, we asked our respondents to provide their own definition of OI. Even though it was an optional question, 164 respondents provided their own definition of OI. In order to improve the reliability and validity of the study, we adopted data triangulation and analysed the qualitative answers to enrich the interpretation of the quantitative analysis results.

We used the self-assessed construct of OI status (Table 1) as a dependent variable. The respondents were offered six alternative stages of OI adoption and were asked to choose the most appropriate for their firms. For stage 6, which relates to the companies that ‘had OI activities, but decided to discontinue them’, we received only one response, therefore we excluded this company from the analysis. The other stages include Stage 1 ‘We are not adopting and not planning to adopt open innovation’; Stage 2 ‘We are not currently adopting OI, but plan to implement OI in the nearest future’; Stage 3 ‘We are in the early stages of implementing OI activities’; Stage 4 ‘We are in the process of refining OI activities and shaping programmes to help establish best practices in OI’; and Stage 5 ‘We are experienced adopters of OI (processes, procedures, and best practices are in place)’. 
Table 1. Operationalisation of Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Measurement</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-perception of open innovation adoption (OI status)</td>
<td>Dummy: 1-Adopters 0-Non-adopters</td>
<td></td>
</tr>
<tr>
<td>as adopters or non-adopters of open innovation</td>
<td></td>
<td></td>
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<tr>
<td><strong>Independent</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open innovation Activities - Measurement of actual level of open innovation adoption</td>
<td>Intensity of adoption: 8-point scale, where 1-No, we don't (adopt), 2-Very seldom, 8-Very intensively</td>
<td>Based on Chesbrough and Brunswicker, 2013 and 2014, and interpreted by authors</td>
</tr>
<tr>
<td>IP in-licensing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>External technology acquisition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subcontracting R&amp;D</td>
<td></td>
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</tr>
<tr>
<td>Using external networks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Idea &amp; start-up competitions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaborative innovation with external partners</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crowdsourcing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer co-creation in R&amp;D projects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scanning for external ideas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IP out-licensing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selling unutilised technologies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participation in standardisation</td>
<td></td>
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<td>Free revealing</td>
<td></td>
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<tr>
<td>Controls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>Large, &gt;250, Small and Medium-sized 10-250, Micro 1-9</td>
<td>The European Union classification*</td>
</tr>
<tr>
<td>Region</td>
<td>Dummy variables for Eastern, Western, Northern and Southern Europe</td>
<td></td>
</tr>
<tr>
<td>Manufacturing firms</td>
<td>Dummy variable</td>
<td></td>
</tr>
</tbody>
</table>

For the purposes of regression analysis, we recoded the variable into binary form. Category 0 accounts for stages 1 and 2, and represents non-adopters, whereas Category 1 includes stages 3, 4, and 5, and corresponds to adopters of OI.

We used 13 OI activities (Table 1) as independent variables. The actual list of activities has been elaborated based on Chesbrough and Brunswicker (2014). The combined list was subject to evaluation by 50 experts, and the final list after expert evaluation is presented in Table 1. Companies were asked to evaluate the intensity of adoption of each activity using an 8-point scale ranging from one to eight, where one corresponds to non-adoption of the activity, two to very low intensity adoption, and eight means very high intensity of adoption. It is worth noting, that we do not exclude a possibility that the

company is an OI adopter even if it does not practice all 13 activities intensively. As mentioned in the title, hence, our intention is to compare self-reported status of OI adoption and their real (actual) understanding of the OI paradigm, its strategy and activities.

We applied company size as a control variable. It was demonstrated by Spithoven et al. (2013) that large and small companies tend to have different approaches to OI. In estimating the company size, the respondents were asked to assign their company to one of four groups, ranging from micro to large, depending on the number of personnel. Then groups of small- and medium-sized firms were merged, to address the EU definition of SMEs (European Commission, 2003). Therefore, in the analysis, we considered large enterprises, SMEs, and microenterprises (see Table 1 for details). Additionally, we controlled for the company’s sector (manufacturing vs. services, and high-tech vs. low and medium tech) and region.

3.2. Data collection process

The survey respondents were innovation, R&D, HR, or top managers. As the survey was a part of a large European project aiming to identify industry needs for OI specialists, and the consequent development of the curricula, the inclusion of HR managers in the target respondent group was a necessary prerequisite in order to collect data on the skills and abilities that OI specialists should have (these issues are not within the focus of the current paper, however). We applied the economic significance criteria of the top 5–10 industries in the countries for stratification of the sample. The data were collected using the online survey tool Webropol, between September 2014 and June 2015.

Overall, we received 525 responses to the survey from 38 countries, with an average response rate of 10% to satisfy the research objectives. The rationale was to focus precisely on private business actors and their understanding of OI. After cleaning the data and removing incomplete questionnaires, we ended up with a sample of 251 firms; this sample was used in further statistical analysis.

The collected sample of European firms presents a particular interest for the study objectives. Although the initial ideas of OI were developed analysing the experience of large multinational companies (though with USA origins) such as P&G, IBM (see e.g., Dodgson et al., 2006; Huston and Sakkab, 2006; Chesbrough, 2007), the consecutive stream of studies was to great extent based on findings derived from European companies business practices (Teirlinck and Spithoven, 2013; Presenza et al., 2017). European CIS data sets were found particularly useful and lead to emergence of numerous influential works, enriched our knowledge and helped shape the theoretical framework of OI concept (Laursen and Salter, 2006; Sofka and Grimpe, 2010; Spithoven, 2013). Furthermore, OI advantages were well recognized by European policymakers (European Commission, 2016). Therefore, we believe, studying the difference in the concept perception will be
especially important in the European context and has the potential to contribute to theoretical debates about the OI concept as well as results into useful practical implications helping policymakers and establishing common language enabling successful industry-university collaborations.

The sample structure presented in Table 2. The companies represents different Europeans regions, particularly Eastern (Bosnia and Herzegovina, Croatia, Czech Republic, Hungary, Macedonia, Poland, Romania, Serbia, Slovakia, Slovenia, Turkey), Western (Austria, Belgium, France, Germany, Ireland, Luxembourg, Switzerland, The Netherlands, United Kingdom), Northern (Denmark, Estonia, Finland, Latvia, Lithuania, Sweden) and Southern (Greece, Italy, Malta, Portugal, Spain) Europe. The majority of firms belong to service industries whereas manufacturing firms account relatively modest share (37.8%). In our study, we applied aggregation of high-tech industries developed by Kile and Phillips (2009) based on Global Industry Classification System (GICS)⁷. Consequently, the minor part of the sample (19.9%) belongs to high-tech industries.

The sample contains firms of different sizes. However, the majority of respondents belong either to large firms (98 responses, 39%) or SMEs (106 responses, 42%). Microenterprises (less than 10 employees) are less widely represented (47 responses, 19%). Such a distribution reflects the current state of OI adoption among firms (Brunswick and Van de Vrande, 2014): OI is often considered to be a strategy for large firms. Although smaller companies can potentially benefit from OI (Van de Vrande et al., 2009; Vanhaverbeke et al., 2012), they often do not have the necessary resources and capabilities to engage in such activities. Consequently, the emphasis was placed on a quantitative exploration of OI practices in large firms and SMEs.

⁷ https://www.msci.com/gics
3.3. Method of analysis

Due to the binary nature of the dependent variable, we applied binary logistic regression as an estimation method. Unlike linear regression, logistic regression uses the maximum likelihood method and aims to predict not the actual values of the dependent variable, but the probability that the dependent variable belongs to the specific groups (Hair et al., 1998). In other words, we estimate the impact of the independent variables on the probability of firms to identify themselves as OI adopters. Therefore, the greater the estimation coefficient for the specific OI activity, the higher the probability that a company with a high degree of adoption of this specific activity will identify itself as an OI adopter. We conducted the statistical tests using SPSS software. To examine the hypothesis, we conducted regression analysis and analyse three models: Model 1 is a pooled model, based on the full sample, Model 2 consists of large firms, and Model 3 contains SMEs and microenterprises (due to the small sample size, we did not examine a model consisting of microenterprises only).

3.4. Test for common method bias

The cross-sectional nature of the data used in the study creates a risk of common method bias (see, e.g., Podsakoff et al., 2012). To control this, we applied Harman’s one factor test. The conducted principal component factor analysis resulted in seven factors with eigenvalues greater than 1. The scree plot (Fig. 1) confirmed the initial decision based on eigenvalues extracted. Although this criterion tends to produce larger number of factors compared to latent root criterion (see Hair et al., 1998, pp. 103–106) in our case, the difference between extracted numbers of factors is small. The variance explained by the first factor is 24.89%, and the overall variance explained by seven factors solution is 65.93% which is acceptable for social science studies (Hair et al., 1998). The emergence of several factors instead of just one accounting for all variance suggests that bias due to common method is unlikely (cf. Podsakoff and Organ, 1986). Additionally, the survey design (i.e., organisation of the questionnaire, wording) was adjusted to lower the risk of common method bias (Chang et al., 2010). In particular, the respondents were not asked
to report specifically the degree of engagement with OI activities, but rather just activities without a specific mention of OI at this stage of the survey.

4. Research findings

4.1. The gap between open innovation activities adoption: de facto and self-perception

The data reveal that the average level of OI adoption vary for different OI activities: from a maximum of 95.6% adoption (collaborative innovation with external partner and scanning for external ideas) to a minimum of 57.1% (selling unutilised/unused technologies and crowdsourcing). Cooperative and inbound modes of OI are adopted more often and more intensively than outbound modes.

Figure 2 presents the activities arranged by the percentage of companies indicating their adoption. The most intensively adopted OI activities are collaborative innovation, scanning for external ideas, using external networks, and customer co-creation in R&D projects. The least intensively adopted ones are crowdsourcing, selling unutilised/unused technologies, and IP out-licensing.
To assess the gap between self-perception of OI status and actual adoption of activities, we first analysed the descriptive statistics. We found that self-reported adoption of OI in companies is 62.2% (62.2% of firms claim that they adopt OI). Additionally, 14.7% of firms claim that they do not adopt OI now, but plan to start doing so in the near future. At the same time, 23.1% of the respondents indicated that they do not adopt OI and do not have plans to do so (Fig. 3). Large firms have the highest level of OI adoption (67.7%), followed by microenterprises (63.9%), whereas SMEs demonstrate the lowest degree of engagement (56.6%). Interestingly, microenterprises and SMEs have a higher share of respondents planning to adopt OI in the near future, at 19.1% and 18.9%, respectively (compared to large firms). This can be interpreted as a sign of the growing interest of smaller enterprises in collaboration with other parties, which is also supported by the high share of micro firms and SMEs in the early stages of OI adoption (38.3% and 30.2%, respectively).

Furthermore, we analysed the actual adoption of OI across the sample. The analysis of the adoption of 13 OI activities shows that, on average, 75.9% of the companies in our sample practice OI as per an academic perception of the concept. Our results show a 13.7% gap between the actual (de facto) open innovation adoption and companies’ self-reported openness.
The gap between companies’ perceptions of their OI status and the actual level of all the OI activities they adopt is illustrated in Fig. 4. Not surprisingly, companies who claim to be OI adopters perform all activities more intensively than self-proclaimed non-adopters. The difference between the two groups (adopters vs. non-adopters) is significant for all 13 activities (t-test is significant at $p < 0.05$ for external technology acquisition and selling unutilised/unused technologies and at $p < 0.001$ for other activities). However, as shown in Fig. 4, even non-adopters still demonstrate a low to medium degree of adoption of various practices. Another interesting point is that external technology acquisition and selling unutilised/unused technologies show the least difference in the means of activity implementation by OI adopters vs. non-adopters. This could indicate that these particular practices are not considered to be OI activities by the companies in the sample, in contrast with the academic perception. Moreover, interestingly, the intensity of adoption of scanning for external ideas and collaborative innovation with external partners is high both for OI adopters and for non-adopters, which explains the overall popularity of these activities in the sample.

**Figure 3. Distribution of self-perception of OI adoption in sample firms**

The gap between companies’ perceptions of their OI status and the actual level of all the OI activities they adopt is illustrated in Fig. 4. Not surprisingly, companies who claim to be OI adopters perform all activities more intensively than self-proclaimed non-adopters. The difference between the two groups (adopters vs. non-adopters) is significant for all 13 activities (t-test is significant at $p < 0.05$ for external technology acquisition and selling unutilised/unused technologies and at $p < 0.001$ for other activities). However, as shown in Fig. 4, even non-adopters still demonstrate a low to medium degree of adoption of various practices. Another interesting point is that external technology acquisition and selling unutilised/unused technologies show the least difference in the means of activity implementation by OI adopters vs. non-adopters. This could indicate that these particular practices are not considered to be OI activities by the companies in the sample, in contrast with the academic perception. Moreover, interestingly, the intensity of adoption of scanning for external ideas and collaborative innovation with external partners is high both for OI adopters and for non-adopters, which explains the overall popularity of these activities in the sample.
Figure 4. Intensity of average OI activities adoption by OI adopters versus non-adopters

Figure 5 provides additional insight into the discovered issue. The figure enables a comparison between the share of firms who adopt a specific activity and those who do not. Each bar in Fig. 5 represents the degree of activity adoption (i.e., the proportion of those respondents who are not engaged in the specific activities, and those who adopt it to at least some degree of intensity). We also divide firms into those that identify themselves as OI adopters (reddish colour) and non-adopters (bluish colour). From this picture, we can clearly observe that a mismatch between perception and applied activities exists for both categories. We can identify companies whose actual degree of adoption of predefined OI activities is lower than their self-assessed status (adopters). On the other hand, there are also firms that appear to underestimate their OI status (i.e., they consider themselves to be non-adopters, whereas they are, in fact, engaged in a number of activities).

The share of such mismatches is noticeably different for different activities. For example, we observed that less than 1% of companies that report themselves to be OI adopters do not, in fact, adopt activities such as scanning for external ideas and collaborative innovation with external partners very intensively. However, for activities like selling unutilised/unused technologies, crowdsourcing, and IP in licensing, this percentage is noticeably higher (up to 37%).

The second group of firms also demonstrates a noticeable mismatch between perception and actual activity adoption. In general, even if firms considered themselves to be non-adopters of OI, all the activities achieve noticeable engagement (the lowest share is 35% for IP out licensing and the highest is 89% for collaborative innovation with external partners and scanning for external ideas).
These findings cause concern as to whether these activities are considered by companies to be OI related. Although, at this stage, we cannot make a formal conclusion, the preliminary results indicate that the degree of engagement in specific activities is quite weakly connected to firms’ perceptions about OI adoption. Therefore, in the next stage, we proceed with formal hypothesis testing.

**Figure 5.** Differences in activities adoption between “OI adopters” and “OI non-adopters”

4.2. Regression analysis

Table 3 contains descriptive statistics (means and standard deviations) of the variables and the correlation matrix. Even though the dependent variable (OI status) has significant correlation coefficients, with all proposed OI activities, the absolute value of the coefficients is quite small. The lack of a strong relationship between proposed OI activities and companies’ self-evaluation provides some preliminary support for the hypothesised mismatch between business and academic understanding of OI. To proceed with further analysis and to make a formal test of the connection between OI activities and companies’ self-perception of OI, we performed regression analysis.
| Variable                                      | Mean  | s.d.  | 1       | 2       | 3       | 4       | 5       | 6       | 7       | 8       | 9       | 10      | 11      | 12      | 13      | 14      | 15      | 16      | 17      | 18      | 19      |
|----------------------------------------------|-------|-------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Subcontracting R&D                           | 4.036 | 2.281 | .359**  | .375**  | .238**  | .287**  | .533**  | 1       |         |         |         |         |         |         |         |         |         |         |         |         |         |
| Idea & start-up competitions                 | 3.307 | 2.364 | .373**  | .301**  | .406**  | .320**  | .324**  | .413**  | 1       |         |         |         |         |         |         |         |         |         |         |         |         |
| Using external networks                      | 4.315 | 2.213 | .260**  | .227**  | .296**  | .391**  | .335**  | .239**  | .411**  | 1       |         |         |         |         |         |         |         |         |         |         |         |         |
| Participation in standardisation            | 4.104 | 2.351 | .273**  | .180**  | .148**  | .161**  | .175**  | .190**  | .245**  | .273**  | 1       |         |         |         |         |         |         |         |         |         |         |         |
| Free unveiling                               | 2.960 | 2.116 | .390**  | .342**  | .447**  | .316**  | .309**  | .299**  | .441**  | .431**  | .233**  | 1       |         |         |         |         |         |         |         |         |         |         |
| IP in-licensing                              | 2.884 | 2.114 | .276**  | .173**  | .343**  | .318**  | .308**  | .312**  | .400**  | .232**  | .278**  | .297**  | 1       |         |         |         |         |         |         |         |         |         |
| IP out-licensing                             | 2.67  | 2.037 | .357**  | .397**  | .335**  | .338**  | .417**  | .564**  | .257**  | .349**  | .420**  | .718**  | 1       |         |         |         |         |         |         |         |         |         |
| External technology acquisition              | 4.295 | 2.355 | .154’  | .238’  | .269’  | .245’  | .314’  | .272’  | .334’  | .270’  | .346’  | .265’  | .446’  | .388’  | 1       |         |         |         |         |         |         |         |
| Eastern Europe (dummy)                       | 0.458 | 0.499 | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       |
| Northern Europe (dummy)                      | 0.195 | 0.397 | .136’  | .078’  | .116’  | .064’  | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       |
| Southern Europe (dummy)                      | 0.183 | 0.387 | 0.009  | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       | -       |
| High-tech firms (dummy)                      | 0.20  | 0.400 | 0.081  | 0.120  | 0.000  | 0.091  | 0.115  | 0.067  | 0.121  | -       | 0.072  | 0.014  | 0.098  | 0.136’  | 0.018  | -       | -       | 0.082  | -       |         |         |
| Manufacturing firms (dummy)                  | 0.378 | 0.486 | 0.084  | 0.031  | -       | -       | 0.122  | 0.114  | -       | 0.081  | -       | 0.124’  | 0.075  | 0.143’  | 0.081  | 0.173’  | -       | -       | 0.002’  | 1       |         |         |

Table 3. Variable means, standard deviations, and correlation matrix

- Correlation is significant at the 0.05 level (2-tailed)
- Correlation is significant at the 0.01 level (2-tailed)
The regression results are presented in Table 4. Model 1 is a pooled model containing the full sample \( (n = 251) \), Model 2 contains only large firms \( (n = 98) \), and Model 3 analyses SMEs and microenterprises together \( (n = 153) \). All the models are significant and have sufficient predictive power (min. 79.1%). However, not all activities provide equal impact on companies’ self-perception as OI adopters. Considering Model 1, only five activities (free revealing, scanning for external technologies, subcontracting R&D, customer co-creation in R&D projects, and idea and start-up competitions) have coefficients significant at least at a 5% level. Participation in standardization and external technologies acquisition are marginally significant \( (p < 0.1) \). Notably, the latter activity has a negative coefficient, meaning that increased engagement in external technologies acquisition tends to decrease chance that the company considers itself to be an OI adopter. In addition, manufacturing firms are more likely to embrace OI compared to the service sector. Looking at companies’ regions, those from Eastern Europe appear less optimistic in considering their self-perceived status in OI adoption. Interestingly, other models have different sets of significant variables, meaning that, depending on firm size, various activities have an impact on company self-identification as an OI adopter. Similarly, for Model 1, the majority of included variables do not have a significant effect. Only one activity (free revealing) features significant coefficients (at least at a 5% level) for all models. For some activities, the coefficients have negative signs. Moreover, in Model 3, one such activity (external technology acquisition) is significant at a 5% level, meaning that the active adoption of such a practice by companies leads to a higher probability of self-identification as an OI non-adopter rather than as an adopter. Similarly to Model 1 (full sample), Model 3 (SMEs and microenterprises) demonstrates certain regional as well as industry differences, whereas for large companies (Model 2), these variables are not significant. Therefore, the regression results of all three models provide support for our hypothesis stating that not all practices typically considered to be OI activities by academia are assumed to be as such by business practitioners.
### Table 4. Regression results

<table>
<thead>
<tr>
<th>Model</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer co-creation in R&amp;D projects</td>
<td>0.169**</td>
<td>-0.032</td>
<td>0.224***</td>
</tr>
<tr>
<td>Crowdsourcing</td>
<td>0.115</td>
<td>-0.181</td>
<td>0.214</td>
</tr>
<tr>
<td>Scanning for external ideas</td>
<td>0.269**</td>
<td>0.329</td>
<td>0.381*</td>
</tr>
<tr>
<td>Collaborative innovation with external partners</td>
<td>0.035</td>
<td>0.074</td>
<td>0.091</td>
</tr>
<tr>
<td>Subcontracting R&amp;D</td>
<td>0.217**</td>
<td>0.435***</td>
<td>0.189</td>
</tr>
<tr>
<td>Idea &amp; start-up competitions</td>
<td>0.253**</td>
<td>0.366</td>
<td>0.234</td>
</tr>
<tr>
<td>Using external networks</td>
<td>-0.064</td>
<td>0.018</td>
<td>-0.196</td>
</tr>
<tr>
<td>Participation in standardisation</td>
<td>0.161***</td>
<td>0.216</td>
<td>0.143</td>
</tr>
<tr>
<td>Free revealing</td>
<td>0.317*</td>
<td>0.957**</td>
<td>0.331**</td>
</tr>
<tr>
<td>IP in-licensing</td>
<td>0.140</td>
<td>-0.148</td>
<td>0.164</td>
</tr>
<tr>
<td>IP out-licensing</td>
<td>-0.021</td>
<td>0.591</td>
<td>-0.103</td>
</tr>
<tr>
<td>External technology acquisition</td>
<td>-0.171***</td>
<td>0.251</td>
<td>-0.341**</td>
</tr>
<tr>
<td>Selling unutilised technologies</td>
<td>-0.103</td>
<td>-0.413</td>
<td>-0.010</td>
</tr>
<tr>
<td>Eastern Europe (dummy)</td>
<td>-1.693*</td>
<td>-0.171</td>
<td>-2.735*</td>
</tr>
<tr>
<td>Northern Europe (dummy)</td>
<td>-0.232</td>
<td>1.018</td>
<td>-1.117</td>
</tr>
<tr>
<td>Southern Europe (dummy)</td>
<td>-0.215</td>
<td>-1.154</td>
<td>0.402</td>
</tr>
<tr>
<td>High-tech firms (dummy)</td>
<td>-0.319</td>
<td>0.933</td>
<td>-0.433</td>
</tr>
<tr>
<td>Manufacturing firms (dummy)</td>
<td>0.984**</td>
<td>0.163</td>
<td>1.438**</td>
</tr>
<tr>
<td>Constant</td>
<td>0.169**</td>
<td>-0.032</td>
<td>0.224***</td>
</tr>
<tr>
<td>Sample size</td>
<td>251</td>
<td>98</td>
<td>153</td>
</tr>
<tr>
<td>-2Log-likelihood</td>
<td>211.975</td>
<td>59.777</td>
<td>126.726</td>
</tr>
<tr>
<td>Model Chi-square statistic</td>
<td>121.011*</td>
<td>64.035*</td>
<td>80.588*</td>
</tr>
<tr>
<td>Cox &amp; Snell R Square</td>
<td>0.383</td>
<td>0.480</td>
<td>0.409</td>
</tr>
<tr>
<td>Nagelkerke R Square</td>
<td>0.521</td>
<td>0.669</td>
<td>0.552</td>
</tr>
<tr>
<td>% correct prediction</td>
<td>81.7</td>
<td>87.8</td>
<td>79.1</td>
</tr>
<tr>
<td>Hosmer &amp; Lemeshow (Pr &gt; ChiSq)</td>
<td>5.741</td>
<td>5.934</td>
<td>5.312</td>
</tr>
</tbody>
</table>

Model 1: Full sample Model 2: Large firms Model 3: SMEs and micro enterprises *p<0.01; **p<0.05; ***p<0.1

### 4.3. Analysis of definitions of open innovation collected using the survey

In order to achieve a deeper understanding of the regression results, we extended our analysis using qualitative data. The survey offered a possibility for respondents to report their own understanding of OI. We looked precisely at the answers of those companies that demonstrated a gap between self-perception and the actual intensity of adoption of OI practices. We found a few interesting examples of misinterpretation of OI (compared to the concept definition accepted by the academic community) in the qualitative data. For instance, one respondent, representing a company that, according to the survey response, is at quite a high level of OI status (4 out of 5) and, at the same time, is not very active in selling unused technologies (2 out of 7 levels of intensity), gives the following definition of OI:

‘Harnessing external technologies to supplement internal R&D’.

Such a definition represents clearly and exclusively inbound open innovation and excludes outbound forms of it. That illustrates well the mismatch between companies’ perception and factual adoption, which we found earlier for selling unused technologies.
Here is a definition of OI given by another respondent (whose company OI status is 4, while they do not sell unused technologies at all, according to our respondent):

‘Outsourcing challenges to find solutions for them’.

These findings provide us with one possible explanation of the regression results, demonstrating that understanding of OI as only inbound activities leads to constricted (self-)evaluation of the company’s current OI adoption status, as some OI activities are not included for consideration (even if the company is involved in them).

5. Discussion

The results prove the issue of contextual ambiguity (Dahlander and Gann, 2010) and dualism (Remneland-Wikhamn, 2013) surrounding OI concept. Particularly, our results well illustrated the fundamental issue of rigour and relevance of the management research to the real problems (van de Vrande and Man, 2011; Gulati, 2007). The results show that certain confusion exists in the understanding of the OI concept and, associated with it, OI activities (as stressed by Trott and Hartmann, 2009; Oakey, 2013), not only between academia and business, but also within these groups. However, in this study, we were aiming not only to prove this proposition, but also to try to shed light on where exactly this confusion may fall.

OI was proposed by Chesbrough more than 10 years ago as a paradigm highlighting the most possible utilisation of internal assets, as well as external ones. Our results show that the lesson of using external ideas, capabilities, and other assets (inbound OI) was learned by the studied companies, but when it comes to extracting the maximum possible benefit from internal technologies, there is still confusion in understanding it as a kind of OI practice. In particular, according to our results as per business perspective, this activity has not yet achieved a large enough weight in the whole composition of the portfolio of OI activities to have sufficient influence on defining the general level of OI adoption by a company.

At the same time, we found several activities that are well recognised by companies as OI practices. Among these is an activity, idea and start-up competitions, which was widely disseminated in the literature (and especially in business-oriented case studies) as an OI practice (Chesbrough, 2012; Huston and Sakkab, 2006; Piller and Walcher, 2006), and maybe such wide coverage in the literature contributed to increased awareness among large companies.

Subcontracting R&D is another business practice that, according to our results, is acknowledged especially by large companies as an OI activity. Even though this activity requires much less collaborative effort and involvement of internal R&D staff than, for instance, collaborative R&D does (Spithoven and Teirlinck, 2010), it requires sharing (opening up) the challenges with other organisations.
When it comes to sharing for free, our analysis also showed an almost unanimous view by the companies’ representatives. Free revealing, without any doubt, is considered to be an OI activity by firms of all sizes. At the same time, external technologies acquisition — an activity that can be considered typical of OI — demonstrates, in fact, the opposite impact on company self-positioning. This could mean that although a firm may focus on exclusively inbound OI (Van der Meer, 2007; Van de Vrande et al., 2009; Schroll and Mild, 2011; see also our results in part 4.3), the acquisition of external technologies is considered to be a self-sufficient, well-established process, and is not perceived as a specific OI activity (c.f. Trott and Hartmann, 2009).

When it comes to other activities defined as OI, based on the analysed literature (crowdsourcing, collaborative innovation with external partners, using external networks, IP in- and out-licensing, and selling unutilised technologies), we were unable to identify a common recognition of these practices among business representatives as kinds of OI activities, based on our data.

We also noticed certain differences between companies of various sizes (Model 2 vs. Model 3). Some activities that have a significant impact on self-assessment for large firms may not have the same effect on smaller companies, and vice versa (e.g., subcontracting R&D, scanning for external technologies, external technologies acquisition). Thus, we propose a further and more in-depth analysis of separate OI activities, performed in companies of different sizes, as a direction for future research.

Manufacturing SMEs appeared more optimistic about their OI status, which may reflect a higher need for external technologies and knowledge (c.f. Brunswicker and Van de Vrande, 2014; Spithoven et al., 2013). At the same time, we found some regional differences: companies from Eastern Europe (mostly from post-Soviet countries) tended to be sceptical in evaluating their OI engagement, whereas other regions did not show a significant effect on self-identification as OI adopters. Overall, we were able to identify three groups of companies. First, those whose knowledge aligns well with the current academic understanding of OI, and, as a result, are able to identify themselves as OI adopters on the level corresponding to their actual adoption of OI activities — self-evaluation status equals the actual adoption level. Second group is those who tend to assess the intensity of their own adoption of OI activities as high, and evaluate themselves as OI adopters, but in fact do not adopt OI activities intensively — self-evaluation status is higher than the actual adoption level. Finally, third group — those who tend to underestimate their own adoption of OI activities and evaluate themselves as not adopting OI, but in fact adopt OI activities intensively — self-evaluation status is lower than the actual adoption level.

The existence of these groups illustrates, again, a mismatch that we found between self-perception and actual adoption of OI activities, between academia and practitioners.

This gap is particularly noticeable in relation to outbound activities. The reason might lie, for instance, in not-sold-here syndrome (Herzog, 2011), or in a company’s strategy, size,
industry (some activities could be irrelevant for certain industries), maturity of innovation practices, and market needs, as well as other institutional factors. Additionally, the reason could lie in cross-functional coordination, and subsequently in the location of the OI and cooperation function within the company, as well as the task and responsibility allocation for OI, and possibly other unobserved factors.

At first glance, these findings may be viewed as a support for Trott and Hartmann (2009), critics of the concept. Indeed, we found that there are companies adopting so-called OI activities without acknowledging that. At the same time, this finding goes in line with later Chesbrough and Bogers’ (2014) notion that merely performing certain activities should not be considered as an exclusive indicator for OI adoption. Instead, OI activities should be analysed in the connection with firm strategy and business model.

Overall, due to the conceptual ambiguity of OI, its broadness, dualism, and the lack of standardised measures (Dahlander and Gann, 2010; Remneland-Wikhamn and Wikhamn, 2013), both practitioners and academics tend to express different interpretations of OI activities. In other words, different understanding of ‘openness’ in the business and academic worlds leads to different judgements about the actual level of company openness. Hence, further research on the reasons behind the discovered mismatch as well as search for the ways to omit this gap through, for instance, binding OI as a theoretical lens even more tightly with the real practical problems (van de Vrande and Man, 2011) are required.

6. Conclusion

In this paper, we aimed to contribute setting up the OI landscape, clarifying the drawbacks on the way to achieving rigour and relevance of ‘open innovation’ as a theoretical lens (Gulati, 2007). To do so, we explore the differences in the understanding of the OI concept by companies and academia in order to understand better where the concept meets with the practical problems and where still lies the mismatch between the two (van de Vrande and Man, 2011). It contributes to stimulating the debate within the innovation management community about the differences in perception of OI between these two groups, but also outlines the roots and reasons for this debate.

Our study proves that the overall actual intensity of the adoption of OI differs between companies who claim to be OI adopters, and those who claim that they do not adopt OI. However, this difference varies a lot across different activities classified as open by scholars. Additionally, there is a difference between openness measured as self-perception and openness measured as the cumulative adoption of OI activities. The latter is higher. This means that companies underestimate their level of OI adoption, and there is a lack of knowledge on OI among companies, when compared to the body of existing scientific knowledge on this phenomenon.

We discovered that only five activities (free revealing, scanning for external technologies, subcontracting R&D, customer co-creation in R&D projects, and idea and start-up
competitions) have coefficients that are significant at a 5% level and that affect companies’ self-reported status in adoption of OI. However, we found that companies do not count commercialisation of unused technologies and IP out-licensing as an OI practice, while among scholars it is an acknowledged component of outbound OI (Dahlander and Gann, 2010). The data demonstrate that the other activities that belong to the OI paradigm, as per scientific research, do not yet determine the level of OI adoption as expressed by practitioners. Thus, we found our hypothesis, proposing the lack of an effect between the intensity of adoption of OI activities and a company’s self-perceived status in OI, to be partly supported.

This paper contributes to conceptualising ‘open innovation’ by identifying and analysing the gap between the existing theoretical concepts and their perception by the business community. The process of the survey undertaken for this study has contributed to the recognition of so-called ‘open innovation activities’ by company managers and also to the popularisation of OI among enterprises.

The outcome of this paper — the illuminated gap between companies’ and scholars perceptions of OI — will contribute to future qualitative and quantitative studies on conceptualising OI. Thus, the results of this paper are useful for researchers studying OI, business representatives seeking a collaborative strategy, and policymakers evaluating the level of adoption of OI activities. However, such limitations of this research as size of the sample and geographic coverage of sample need to be taken into account. The results can be influenced by the sample composition and significant share of East European companies who might be less acquainted with OI concepts and service industries who also embrace OI less actively.

Respectively, this paper has a number of implications for the broad research community studying OI or using it as a theoretical lens, for practitioners and for policymakers.

For the research community, the key message is in the need for being extremely careful when using OI concepts in the research, explaining upfront what exactly is implied by OI in the particular study, what companies’ activities are included behind it. Furthermore, the researchers should also ensure rigour and relevance of their study and its findings through e.g., triangulation or member-check techniques (Krefting, 1991). The researchers are also invited to invest greater efforts in finding the links between and integrating the OI with more established and bettergrounded theoretical frameworks. One of the limitations of this study is exactly the lack of theoretical triangulation, which is due to the need for us to stay focused on the phenomenon and concept of OI. Future research may assist in overcoming this limitation via trying to explore the other theoretical lenses in their effort of explaining the gap in the perceptions that we have discovered and described.

For practitioners, this study outlines the broadness and dualism of the OI concept, highlighting the relevance of outbound OI activities for value creation. Our research explains how wide IS the scope of activities, WHICH have scientific reasons for being
labelled as ‘open innovation’. Thus, this study increases the potential relevance of the OI research for practitioners along with increasing the practitioners’ understanding of it.

Our study also alerts the policymakers and attempts to make them careful when using the term ‘open innovation’ — avoiding senseless usage of it as a buzzword, as that has a great risk of misleading to unclear policy recommendations, which fail to equally meet the needs of business and academia as the core stakeholders on the knowledge market. The policymakers, as well as the research community, whenever using the term ‘open innovation’ are invited to set up clear boundaries of it, outline the practices addressed in a certain policy study and explain the value of those as well as limitations of a concrete recommendations set.

This paper creates a background for future research in the development and validation of measurement scales for OI activities and processes, and in fine-tuning the definition and methodology of OI. We see potential in the dissemination of the results of this study and the ideas of OI through business–academia workshops. This type of academia–business cooperation will help decrease the confusion in understanding OI, and will let both sides get the maximum benefits from the implementation of OI.

Acknowledgement

The data leading to this article were collected by the European Academic Network for Open Innovation (OI-Net project), which received funding from the European Union Lifelong Learning Programme under the Grant Agreement Number 2013-3830 (http://oi-net.eu).
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AUTHORSHIP STATEMENT

Manuscript title:
*What does open innovation mean? Business versus academic perceptions*

All persons who meet authorship criteria are listed as authors, and all authors certify that they have participated sufficiently in the work to take public responsibility for the content, including participation in the concept, design, analysis, writing, or revision of the manuscript. Furthermore, each author certifies that this material or similar material has not been and will not be submitted to or published in any other publication before its appearance in the *International Journal of Innovation Management*.

**Authorship contributions**

Please indicate the specific contributions made by each author (list the authors’ initials followed by their surnames, e.g., Y.L. Cheung). The name of each author must appear at least once in each of the three categories below.

Each of the authors made an equal contribution to each of the following categories.

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Acquisition of data: E. Albats; D. Podmetina; R. Teplov  
Analysis and/or interpretation of data: E. Albats; D. Podmetina; R. Teplov

**Category 2**

Drafting the manuscript: E. Albats; D. Podmetina; R. Teplov  
Revising the manuscript critically for important intellectual content: E. Albats; D. Podmetina; R. Teplov

**Category 3**

Approval of the version of the manuscript to be published (the names of all authors must be listed): E. Albats; D. Podmetina; R. Teplov

**Acknowledgements**

All persons who have made substantial contributions to the work reported in the manuscript (e.g., technical help, writing and editing assistance, general support), but who do not meet the criteria for authorship, are named in the Acknowledgements and have given us their written permission to be named. If we have not included an Acknowledgements, then that indicates that we have not received substantial contributions from non-authors.

**This statement is signed by all the authors:**

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8.8.2017  
28.8.2017  
28.8.2017
Publication IV

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Innovation intermediaries in university-industry collaboration: analysis of online platforms

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Innovation intermediaries in university-industry collaboration: analysis of online platforms

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Abstract: The importance of intermediation in university-industry collaboration (UIC) has been widely acknowledged, however, the phenomenon of UIC online tools is not yet studied in detail. In this paper, we examine fifteen UIC online platforms, identify their functions and role that they play in UIC. By combining secondary data with interviews with platform developers and users, we identify five main archetypes of collaborative online platforms: education-focused, knowledge transfer platforms, crowdsourcing platforms, networking tools and platforms for innovation marketing. We also present a number of the benefits the platforms bring. These tools reduce the time and resources spent establishing and managing collaborations; they help to make networking more targeted; they help to reveal the value that university research has for business and increase the adoption of university education. Our findings suggest that whilst facing some challenges, the platforms analysed represent a scalable, rapidly growing and more importantly demand-led business opportunity.

Keywords: university-industry collaboration, innovation intermediary, online platform

*corresponding author

1 Introduction and research problem

Effective collaboration and knowledge exchange between universities and companies has been widely acknowledged by academics, practitioners and policy makers (Perkmann et al., 2013) to create sources of corporate innovation. Given the radical differences in the objectives and rationale of 'profit-oriented enterprises' when compared to 'educational
institutions’ (Parker, 1992) the role of intermediary organizations, who help develop collaboration, has increased and now draws specific attention in the literature on knowledge and technology transfer (Wright et al., 2008; Kodama, 2008). Intermediaries are commonly understood to be bridging organizations, which help to develop bilateral or multilateral relationships (Dalziel, 2010). Although the academic research of innovation intermediaries is not yet focussing specifically on university-industry relations, it is readily acknowledged that many of the current challenges in university-industry collaboration (UIC) could be resolved by carefully designed intermediary services (Wright et al., 2008). Concurrently, in practice, such intermediaries are rapidly developing and bringing new forms of intermediation – one example of this is online platforms focussing on developing UIC.

The aim of this study is to identify the new or novel forms of online intermediation platforms in the UIC sphere; to analyse the role they fulfil and to identify what functions they offer for UIC. Therefore, the two underpinning research questions for this study are:

*RQ1: What are the emerging types of online intermediaries in UIC?*

*RQ2: What are the roles and functions these different types of intermediaries have in UIC?*

We hope that by undertaking an in-depth study of the role of online platforms as innovation intermediaries in university-industry collaboration, we will help in defining the phenomena and thus contribute to theory (Dalziel, 2010), which is still fragmented when it comes to intermediation in UIC (Korff & Kesting and, 2013) and particularly online platforms (Soendergaard et al., 2015). Therefore, our submission contributes to research in the field by (1) developing a theoretical basis for understanding rapidly emerging university-industry collaboration platforms and (2) beginning to categorize them by analysing their functions and role they fulfil in university-industry relationships.

This paper is structured as follows: first, we review the existing typologies of innovation intermediaries and compare these with intermediaries operating in UIC, before presenting the gaps in the literature. We then explain the research methodology of our study, after that we provide the results and we conclude by discussing our main findings and directions for future research.

### 2 Background

**Barriers in UIC: why intermediating platforms are needed?**

There are certain barriers in university-industry relationships, which are quite generic and close to ones identified for inter-firm relationships: lack of trust, mutual understanding and transparency (Barratt, 2004), IP issues (Bader, 2008). The principal difference in barriers to collaboration in firm-to-firm and firm-to-university relationships arises from the difference in primary objectives and motives of these two types of partners. Universities, as partners are more oriented to searching for new ideas and fundamental knowledge, while companies are more profit and practice-oriented (Parker, 1992). That is, in part, why a collaboration between academia and business can be difficult to
establish and manage. This is illustrated by different motivations (Siegel et al., 2003b), level of internal bureaucracy (Bruneel et al., 2010), the languages the parties speak, time horizons and day-to-day practices undertaken (Barnes et al., 2002; Plewa et al., 2005; Muscio & Pozzali, 2012). Frequently, university employees involved in collaboration lack marketing skills to communicate the university research results to industry (Siegel et al., 2003b), while business representatives could feel uncomfortable or simply do not have enough time to digest the relevant scientific papers. Thus, an intermediary able to speak both business and academia languages and capable of smoothing the differences between the two worlds is often required to make collaboration happening.

Additionally, a lack of resources on both sides inhibits UIC (Hughes, 2011), but also hinders the actual search for partners and awareness of collaboration opportunities (Muscio & Pozzali, 2012) forming a ‘connection’ barrier in UIC (Galán-Muros, & Plewa, 2016). Browsing through other organizations’ websites to find a likely partner is to be an inefficient strategy and that is why tools, which help guide the search or build a connection could be highly valuable in solving the connection problem.

**Typologies of innovation intermediaries in UIC**

The phenomenon of intermediation is addressed from the different perspectives and units of analysis. Certain studies analyse exclusively particular type of intermediary, e.g. technology transfer offices (TTOs) (Alexander & Martin, 2013; Siegel et al., 2003a). A number of studies is devoted to analysing and classifying innovation intermediaries (Howells, 2006; Lopez-Vega & Vanhaverbeke, 2010). A particular group of research works analyse the phenomenon from the broader perspective looking at the National Innovation System, Triple Helix concept, institutional and network theories (e.g. Watkins et al., 2015; Dalziel, 2010; Klerkx & Leeuwis, 2008; Westergren & Holmström, 2012). Interestingly, one stream of the literature on open innovation and crowdsourcing platforms (Frey et al., 2011; Marjanovic et al., 2012) creates a foundation for the emerging topic on university-industry collaborative online platforms (Soendergaard et al., 2015).

When it comes to categorising intermediary organizations, Wright et al. (2008) divide intermediaries in UIC into two groups: internal intermediaries (as university TTOs) and external intermediate organizations (as Collective Research Centres, regional development agencies, etc.). Lopez-Vega & Vanhaverbeke (2009), looking at innovation intermediaries (but not specifically in UIC), define four archetypes of innovation intermediaries by their value proposition: innovation consultants, innovation traders, innovation incubators and innovation mediators. Howells (2006), again looking at general inter-organizational mediators, analyse intermediaries from the perspective of the functions they perform. They define ten functions: foresight and diagnostics, scanning and information processing, knowledge processing and combination/recombination, gatekeeping and brokering, testing and validation, accreditation, validation and regulation, protecting the results, commercialisation and evaluation of outcomes.

We suggest that the three typologies discussed above could be partly integrated and adopted for the UIC context (see Table 1). **Innovation mediators**, which manages a collaborative environment could be either internal (university-based Living Labs) or external - independent external organizations (as publically co-funded Living Labs or independent private initiates) or corporate initiatives targeting particular company’s interests in collaboration (Connect and Develop by P&G (Huston & Sakkab, 2006)). They can all be combined in one group by their main function – providing an
environment (physical or digital) for collaboration between companies, universities and authorities. *Innovation incubators* could be also university-based (as startup and business acceleration programmes launched by university), independent public/private initiatives (FinTech Innovation Labs) or corporate innovation incubators (Samsung Accelerator), but again, they share the main functions – transforming knowledge into innovation utilizing the expertise of academia and business. At the same time, independent (external) companies normally represent *innovation consultants* assisting corporates in detecting technological and innovation opportunities, technological foresight, advising on technology acquisition. However, university TTOs do provide assistance in similar functions, but for university employees – these are internal intermediaries. Finally, *innovation traders* (as NineSigma, InnoCentive, etc.) represent purely external intermediaries for UIC, which play the role of gatekeepers and brokers in between challenge holders (companies) and solution providers (universities).

**Table 1** A summary of innovation intermediaries for UIC context

<table>
<thead>
<tr>
<th>Internal vs External for university (Wright et al., 2008)</th>
<th>Intermediaries by value proposition (Lopez-Vega &amp; Vanhaverbeke, 2009)</th>
<th>Intermediaries by functions (Howells, 2006), (Lopez-Vega &amp; Vanhaverbeke, 2009)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal (External) UIC intermediaries</td>
<td>Innovation mediators Creates spaces for knowledge processing, generation and combination; intermediaries between science policy and industry; demand articulation; testing and validation</td>
<td>Knowledge processing and combination/recombination, Testing and validation, training, evaluation of outcomes</td>
</tr>
<tr>
<td>Innovation incubators</td>
<td>Innovation consultants Scanning and information processing, Protecting the results, Commercialisation, foresight and diagnostics</td>
<td>Gatekeeping and brokering; scanning and information processing, foresight and diagnostics, Commercialisation</td>
</tr>
<tr>
<td>External (Internal) UIC intermediaries</td>
<td>Innovation traders</td>
<td></td>
</tr>
</tbody>
</table>

Howells (2006) put an emphasis on the importance of the intermediaries’ ties with knowledge exchange actors, the building of long-term relationships and complexity of the network required for fruitful intermediation. An illustrative example of a complex knowledge exchange system for university-industry collaboration is the Knowledge Integration Community (KIC) model developed by Cambridge-MIT Institute and analysed by Acworth (2008). It highlights the importance of strong ties between research, education, industry and government meaning a number of stakeholders to be involved, and, as a result, – a need for a separate entity with an organizational structure enabling continuous knowledge exchange (Acworth, 2008).
Despite the fact that the literature examines many aspects of mediation in cooperation of universities and business, the theory is very fragmented and is lagging behind the practical development of online platforms playing an intermediation role in university-industry relationships (Soendergaard et al., 2015).

3 Research methodology

This study is qualitative and explorative by nature, since it aims at answering our open-ended research questions, which enable us to begin to understand the nature of the phenomenon.

The data collection process was broken into two phases, as follows. Firstly, we analysed 15 online platforms in total, by viewing their webpages and collecting all available secondary data on their aims, target audience, requisite functionality and performance. Based on this preliminary analysis, five distinct types of intermediary online platforms were identified. Secondly, data were then collected via a series of interviews with owners of UIC platforms, which represented one of each type. These data were then augmented, where possible, with interviews with a small number of their users. Finally, supplementary data were collected, which included additional secondary data (press releases, web-sites and platform users’ public feedback). In total, seven interviews were conducted in February-April 2016. The duration of the interviews varied from 30 minutes to 70 minutes. Interviews were conducted via Skype or in person. The interviews were recorded. The interview guide consisted of 10-15 open-ended questions, tailored to the specific focus of each platform and/or respondent, which in turn was informed by the secondary data.

To ground the initial data further, one of the researchers participated in a subject-specific conference, where each of the platform developers were presenting their solution. Field notes were collected explaining how the platforms meet the needs of their current users and what might be attractive to new ones, who wish to exchange ideas or configure responses to specific challenges.

Finally, in order to test the interpretation of the results we applied a member check technique. We asked our interviewees to read and comment our results and we revised the paper in accordance with their comments. That decreases the chances of misrepresentation and thus, increases the validity of our study (Krefting, 1991).

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* It is important to note that a large number of open innovation online platforms exist at present (e.g. InnoCentive, Yet2.com, NineSigma). However, we have limited the scope of our research only to those online platforms, which explicitly target collaboration between universities and businesses.
4 Results

Data arising from Phase 1

Based on the initial review of the literature coupled with the primary analysis of the secondary data devoted to web-based platforms serving university-industry relationships, we identified five archetypes of UIC online platforms. These are presented in Table 2.

These are education-focused platforms; platforms for knowledge or technology (via IP sales etc.); crowdsourcing platforms; networking platforms and innovation marketing platforms.

Education-based platforms are those online tools, which enable students to ‘learn by doing’ – running a project for a company (as EduSourced) or take a course designed by company (as those offered by Coursera).

Online platforms that aim to transfer knowledge from universities to companies exist in many forms. These ranged from the transfer of very tangible assets (as patents and licensing – e.g. easyaccessip.com or globalipexchange.co.uk) to a larger number of forms of knowledge sharing through establishing connection (e.g. In-part.com).

The platforms generally applying crowdsourcing principles collect ideas or problem solutions from any individual or any team globally, while the crowdsourcing platforms for university-industry collaboration aim specifically at sourcing ideas from students and university researchers to solve business challenges (e.g. nimblebee.eu or marblar.com) or also to jointly solve scientific challenges (e.g. challengeacademy.eu (Ventura et al., 2015 Rakitina-Qureshi, 2015)).

Table 2 A typology of university-industry collaboration online platforms

<table>
<thead>
<tr>
<th>Platform type</th>
<th>Platform Functions</th>
<th>Platform examples</th>
</tr>
</thead>
</table>
| 1. Education-focused platforms    | Enabling project-based learning and students working on the real companies' problems | www.edusourced.com
                                           |                                              | www.coursera.org                           |
| 2. Knowledge, technology and IP transfer focused | Enabling easier search for required knowledge, technology or IPR | www.in-part.com
                                           |                                              | www.easyaccessip.com                       |
                                           |                                              | www.praxisunico.org.uk                    |
                                           |                                              | www.globalipexchange.co.uk                |
| 3. Crowdsourcing platforms         | Collection and assessment of ideas and solutions for companies from students and university researchers | www.challengeacademy.eu
                                           |                                              | www.nimblebee.eu                           |
                                           |                                              | www.marblar.com                            |
| 4. Network building platforms      | Mapping a network of valuable actors, enabling easy search for | www.uin.org
                                           |                                              | www.bridgelight.co.uk                      |
5. **Innovation marketing platforms**

Innovation marketing platforms use a number of tools that help to disseminate information about academic research online and make it more accessible and understandable by business – in essence, to make science more open. Friesike et al. (2015) provide a comprehensive overview of the initiatives supporting open science, including online tools, such as Atlas Twiki Portal – an open-access platform that provides access to the results of the CERN lab. Another example is Sciworthy, which delivers easy-to-understand scientific news. A platform specifically dedicated to marketing university research has been developed by the UK-based start-up called Leading Edge Only. Using the principles of online marketing, Leading Edge Only provides a space for scientific discoveries to be presented, generates and analyses statistics concerning interest in particular technologies or ideas by tracking clicks and number of kits downloaded.

**Data arising from Phase 2**

As part of the phase 2 data collection we interviewed the owners of one platform of each type identified. Table 3 presents a summary of the results.
Education-focused platform: EduSourced

The EduSourced is a web-based platform developed for managing student-company collaborative projects. It’s run by a USA-based start-up founded in 2013. The platform enables the creation and management of new projects (using the functionality of traditional project management tools), whilst also collecting feedback from both students and clients (companies). Moreover, the platform provides a function for supervising a project by the university teacher or supervisor. Therefore, for universities the platform provides a digital space allowing centralized and efficient management and monitoring of collaborative projects. In addition to actual involvement into project-based learning, the students also learn about project management tools. The projects are funded by a company and run by a team of students, often with faculty oversight, in collaboration with a company manager. According to the interview with the EduSourced CEO, there are cases, when after working for the company the students were hired by the client organization. The main benefits of EduSourced for companies is that first, they get an easy access to low-cost skilled students, which through collaborative work could be evaluated and can lead to relationships where new employees could be discovered. The second benefit is that they use digital tools to manage difficult projects in a fast moving environment, with businesses that are used to working with (project management tools). EduSourced also runs a number of joint seminars and webinars on university-industry collaboration and project-based learning along with other topics involving both companies and universities. The main revenue streams for EduSourced are the fees paid by universities. According to EduSourced CEO, the demand and interest in EduSourced is growing and the current team ambition is to expand its presence globally.

Knowledge, technology or IP transfer platform: IN-PART

IN-PART is a three year old UK-based start-up. The main goal of their online platform is to match new university technology and opportunities for collaboration, directly to industry.

Initially started as a pilot with a small amount of funding, six universities and 40 companies became involved, now IN-PART has raised funds and grown into a network of 52 universities (mainly UK-based, but also leading institutions from the USA, Australia and Japan), with users from over 500 companies.

IN-PART strategically introduces university technology and/or opportunities for collaboration, to a curated network of users from industry. Opportunities range from very early-stage research with potential commercial application, to ready-to-licence technologies. Their approach is exclusively to company executives, with the goal of connecting them to the university for further discussion about an opportunity. If the company is not interested, IN-PART collects qualitative market feedback on the technology or solution, and shares this with the respective university TTO. This is also reported within regular Impact Reports, which also contain quantitative user interest metrics, and helps universities to better understand the commercial value of their solutions, and at the same time get a better picture of current industry needs. If a company is interested in the university opportunity, IN-PART personally introduces parties directly.

We interviewed two IN-PART users - representing an innovation and technology transfer office of the same university in the UK - and received very positive feedback.
about the platform from both. One comments on the usefulness of the platform for collaboration (universities and companies):

"There are many of these platforms, but mostly it’s about IP. … They [InPart] are quite useful for some companies, that have technology scouts and companies actively looking. … The really good thing [for university] is the reports that come out, which detail the people that are interested…".

For companies, the platform helps in saving resources used to scout for new university technology or commercial research ideas, as they no longer need to browse individual university websites; instead receiving opportunities tailored to their interests via email. This links companies to applicable university opportunities on IN-PART, these consist of around 500 words, explaining the university technology/collaboration opportunity in a standardised format. Specifically this reviews: background to the technology, its benefit over existing technology, and the actual form of collaboration the university is looking for e.g. licencing, funding, collaborative research, etc.

When the university representative was asked about an ideal online platform, they admitted that university-industry relationships are all about people, noting that at the end the actual connection often happens offline, because it could be challenging to understand online if the people are able to collaborate or not - but the IN-PART tool provides an initial point of contact. The main revenue stream for IN-PART is an annual fee paid by universities.

Crowdsourcing platform: NimbleBee

NimbleBee is a crowdsourcing platform developed by a small Belgium company in 2013, where the main concept behind the platform is to engage students to solve industry challenges. These industry-led projects are undertaken within their university programme (as part of the curriculum) and take the form of a competition, where the best results are validated by the end-user. The platform currently operates across around 40 universities and 4 B2C companies and to date it is focussed on design and packaging challenges. As each project round must align with the university curriculum, NimbleBee runs two competitions each year, although the companies have an appetite for more frequent competitions. According to the NimbleBee programme manager, when comparing the quality of the outputs across other crowdsourcing initiatives open to the public, NimbleBee scores higher in terms of client satisfaction and quality.

Each NimbleBee cycle starts by scouting for industrial challenges among the companies, firstly within the NimbleBee network but then beyond it. The NimbleBee team works on designing the challenge to make sure that it fits the NimbleBee scope (design and packaging) and then sets out the scope to ensure the company expectations are clear to the universities and are applicable to the university study programme. If the university decides to join the competition, only at that point is it publicised to the students, who then in turn accept (electronically) the programme terms and conditions (responsibilities of the parties and overarching legal framework). Then the competition starts and runs over two rounds. The first is a three months design round. Each university gets a private space on the platform and cannot see the others’ work in progress, but the sponsor has an access to all the design solutions. Then experts representing the industrial sponsor of each competition evaluate the proposed designs and select 10 finalists out of an average of 50 submitted per challenge. The second round is a consumer-sparring
round, when 10 finalists submit their solutions and a panel of about 50 consumers representing the company’s target audience evaluate the proposed design solutions (again enabled by the online platform). The consumer panel votes and comments on the proposed designs and then volunteers from the consumer panel are invited to start working directly with the designer and through an iterative development process the designers improve their solutions and resubmit their final proposition. All the communication is via the platform. Finally, the sponsor selects three winners, who receive a monetary reward as well as the knowledge and experience gained form the process. In terms of IPRs, by default the IP created during the NimbleBee competition belongs to the student or to the university (depending on the conditions of university-student agreement). However, the company gets, by default, a non-exclusive right to use it for their purposes or they have a six-month time sterile period of non-disclosure, to decide if they wish to buy the exclusive IPRs from the student/university.

From a few month programme and for a relatively small fee the companies (sponsors) get a new design-concepts validated by end-users for relatively low costs and they also get access to jointly trained and developed potential employees (talents). The whole process happens via the closed and secure web-based platform. This keeps the development process protected from competitors and efficient, since it avoids the costs of all the actors (university teachers, students, corporates and end-users) travelling to meet each other, as has been the case in previous, similar projects. The universities in turn get a free access to real industrial challenges, receive direct inputs from industry in the curriculum development and get their students trained with real industrial experience and monetary reward.

In terms of why the NimbleBee platform has grown, the main competitive advantage, according to the programme director is:

“We are compared with existing crowdsourcing platforms, like 99Designs for instance, but we do not like this as we think we are an alternative to those programs. The main differentiator is that it [99Designs] is not linked with the curriculum. Another differentiator is that most programs, if not all, stop with the first round and they deliver only the ideas. I don’t think there is another program that also includes consumer-sparring”.

For more detailed analysis of NimbleBee in the crowdsourcing context see Still et al. (2015) and Still & Soens (2016).

Currently negotiations for expanding the tool towards engineering challenges, in addition to design and packaging, are ongoing. Also the NimbleBee team is intensively working on getting all the processes (including negotiations, achieving sign-up, company acceptance etc.) even more automated to increase the function and scalability of the business.

Network building platform: Bridgelight

Bridgelight is a UK-based start-up that offers a unique tool, which applies semantic textual analysis, to enable the construction of a visual map of organizations and linked individuals, based on their networks expertise and current interests. Currently, Bridgelight has more than 250 academic and industry users. Its client base includes universities, research centres, members of the UK Catapult network, trade associations and manufacturing organisations. The platform uses a combination of data available online and data provided by the organizations themselves (e.g. specific financial information, their own network of partners, or their interests in innovation and
collaboration challenges and requirements). The platform’s main function is to dynamically interrogate the network map, refocussing it around keywords that could represent challenges, or funding calls or any other common opportunity for collaboration. Initially, Bridgelight started out focussed on a particular sector, the UK railway industry, but since the platform was launched it has received a growing interest from a number of other sectors. Another particular sector with rapidly developing potential at the present is university-industry collaboration, and the Bridgelight CEO has challenging targets for populating growth over the coming months. He describes the origins of the idea behind Bridgelight:

“If you look at one person’s unique data profile, and then you compare it to thousands of other people’s unique data profiles ..., you can begin to build clusters of people, who’ve have the same types of activities, interests and therefore problems, and perhaps who’ve all got the same sort of goals or aspirations and maybe who have the same type of skills or capabilities and expertise. Once you began to build up that map, you can then begin to apply your knowledge or your ability to use that map in a whole range of different ways. … up until know, bridging the gap between the network’s connections has been done manually, by people operating in a boundary-spanning role.”

The Bridgelight platform is a powerful tool, which enables the initial construction and visualisation of the network. Creation happens as an automated process and consequently, radically reduces the time and resource normally allocated by companies to try to understand their connections and market entry points. By using this platform, companies can rapidly find a new customer (or market), or identify collaboration and innovation opportunities, which otherwise were not visible.

Once the data sources are identified, the users begin by entering a set of keywords which dynamically generate the construction of the map of relevant nodes. Exploring a particular node within the map uncovers relevant themes where the user can drill into more information about the related organizations, individuals, and, eventually, the source data. The Bridgelight CEO describes the value his platform brings:

“I would say that a map or visualisation of who does what across any industry sector is useful at any level of business. In fact, it is one of the most valuable sources of business intelligence that you can possibly get hold of. ... The fundamental benefit that we offer is that we provide that map of who does what.”

As the platform analyses a university’s skills, competencies and track record (including the UK Government Gateway to Research database), it is able to help companies in searching for university partners and likewise, for universities vice-versa. The Bridgelight map helps to identify the challenges that industry faces, who is working on these challenges and thus makes a partner / collaborator search both easier and more targeted.

Bridgelight’s specific competitive advantage, when compared to such platforms such as LinkedIn etc., is that it aggregates not only the information provided by actors themselves, but also all the data provided by third parties – for example, it can analyse press releases, interviews, third party websites, etc., to generate a more comprehensive picture of the organization’s true profile. The other main advantage is Bridgelight’s ability to visualize the network of companies and actors surrounding a problem therefore giving a view into the sector structure. Unlike manual projects to map and analyse a capability network (typically costing organisations £50k-£250k, taking 3-6 months and
delivering a static picture), the Bridgelight platform provides a live asset that can grow and maintain itself on an ongoing basis.

**Innovation marketing platform: LeadingEdgeOnly**

LeadingEdgeOnly (LEO) was selected from a set of innovative marketing platforms as the platform is specifically designed to promote university research and lead to adoption by industry. The LEO platform was launched by the UK-based start-up in January 2014. LEO currently has about thirty universities (based in USA, UK, The Netherlands, Australia, Singapore and China) and over 80% of FTSE100 and over 60% of the Fortune 1000 companies as clients. In addition, a number of investors represent a part of the LEO network.

For thirty universities that LEO has on board, it prepares a brief digital profile of the university assets (it could be a ready for market prototype, or just an idea or even a research methodology), publishes it on the platform and supply the corporates interested in the relevant innovation with these profiles via emails. The LEO founder notes that the general problem that universities have is a lack of marketing skills to promote their innovation, which even puts them in a weak position compared to high-tech SMEs. LEO suggests it can help, according to their CEO:

“I think, where the universities suffer … is while competing with the SMEs that do understand inter-degree marketing.”

For companies, LEO provides an access to description of university assets (knowledge, ideas or technologies) formulated in industry-oriented language. LEO also collects the challenges that industry search solutions for and provide universities an access to these challenges, so university researchers can better understand the industry needs and possibly address them in their research. As a result, the company gets a comprehensive description of the innovations available from all the universities on the platform or as a customized set – depending on the company request. This enables the process of searching for academic partners and reduces costs. The platform founder says, in respect to the benefits that companies get:

“If you are in America, you are not going to go and look at … the Helsinki University innovation or Hong-Kong University… It is impractical… So, one big advantage that corporates like is they know they can come to our platform and see at the moment innovations from thirty universities. So, they don’t have to go to each university’s website, which they just will not do.”

The LEO platform is developing quite fast from a start-up, to a worldwide online tool. That illustrates a demand existing for such an intermediary as well as scalability of their platform. Having a real-time access to both the university knowledge assets and industry interests tracked by monitoring clicks and downloads of the university innovation profiles, LEO is able to identify the trends in certain areas both in science and in business. The CEO of the LEO platforms comments on its progress:

“Yes, we can track the sector. … In 2014 we had 60.000 of these engagements (the number of times the innovations are open and read), now in April 2016 it got to 600.000 of these engagements… and yes, we have 15 employees… yes, it’s a good business model.”
In terms of the actual revenue streams, LEO’s main stream are contracts with large corporate clients, while the universities get the innovation dissemination service for free.

Table 3 provides a summary overview of the five UIC online tools. In the following section we discuss our main findings.

5 Discussion

In our study of intermediation in the UIC field, we have considered a range of intermediation platforms and undertaken a two-stage evaluation of the platforms. We can note that the emerging forms of intermediation analysed in this study represent “external” type of intermediary (e.g. they are not university-based, but represent a separate organization) according to the classification proposed by Wright et al. (2008). Similarly, in terms of the key functions performed by intermediaries, as proposed by Howells (2006), our cohort of emerging intermediaries undertake scanning and information processing; knowledge processing and combination/recombination; testing and validation; evaluation of outcomes, although to differing degree for each platform. What is more noticeable, and constitutes a function not expressly identified by Howells is that all of our intermediaries in the UIC context focus on the derivation and solution of problems. Two of them utilise this problem focus to create a project-based learning opportunity as a supplementary outcome. This aligns with the concept that suggests that a problem-orientated focus is an important tool to galvanise stakeholders with diverse organisational goals and motivations (Krajcik & Blumenfeld, 2006; Hung et al., 2008). What is also evident from our cohort is that the emerging platforms also focus on enabling collaboration across the globe, thus, diminishing the importance of geographical proximity (studied precisely by Laursen et al., 2011 and D’Este et al, 2012).

From analysis of secondary sources, we were able to construct a primary typology. The key five types of intermediating platforms defined are: education-focused, knowledge and technology transfer focused, crowdsourcing platforms, network-building platforms, technical platforms supporting joint research. By mobilising our second phase of data collection, we confirmed that we can populate the emerging typology for online platforms which are playing an intermediation role in university-industry collaboration. This typology uses specific functions and forms of intermediation, types of stakeholders involved and also challenges observed in certain mediation type as differentiators. In terms of the benefits offered by the platforms we analysed, all of them focus on the facilitation of university-industry collaboration in a virtual space, which in turn offers resource savings on both sides. It also enables matching and networking to be more targeted. Only one of the platforms, however, used automated text recognition to automate data collection and comparison – with the remainder relying on more ‘people’ centred activities.
This paper was presented at The XXVII ISPIM Innovation Conference – Blending Tomorrow’s Innovation Vintage, Porto, Portugal on 19-22 June 2016. The publication is available to ISPIM members at www.ispim.org.

Table 3 Analysis of university-industry collaboration online platforms

<table>
<thead>
<tr>
<th>Platform</th>
<th>Platform Functions</th>
<th>Platform benefits for universities</th>
<th>Platform benefits for industry</th>
<th>Platform revenue stream(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education focused platform</strong></td>
<td>Supporting the transition in Higher Education toward real-world experience.</td>
<td>1) Access to web-based tool, which integrates the teaching programme and collaborative project functionality</td>
<td>1) An access to web-based tool, which allows collaboration with low cost problem solvers</td>
<td>Annual fees paid by universities</td>
</tr>
<tr>
<td><strong>EduSourced</strong></td>
<td>1) Creation, management and assessment of the learning projects</td>
<td>2) Possibility to facilitate and monitor online the collaboration between students and companies (clients)</td>
<td>2) An access to web-based tool, which allows collaboration in education and uses an interfaces and functionality that business is used to</td>
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</tr>
<tr>
<td></td>
<td>2) Internal communication between students, teacher/supervisor and company representative</td>
<td>3) Linking multiple experiential initiatives together for a more consistent student experience and better university records</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3) Team dynamics monitoring and student impact assessment</td>
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<td></td>
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</tr>
<tr>
<td><strong>Knowledge transfer focused platform</strong></td>
<td>A platform connecting universities and companies:</td>
<td>1) Access to up-to-date information on industrial needs in a target area</td>
<td>1) An access to up-to-date information on university expertise in a target area</td>
<td>Annual fees paid by companies and universities</td>
</tr>
<tr>
<td><strong>INPART</strong></td>
<td>1) continuous monitoring and analysis of the universities capabilities and companies’ needs</td>
<td>2) Access to companies executives interested in the university innovation via platform</td>
<td>2) Minimized time and costs on search for the right people in academia</td>
<td></td>
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<tr>
<td></td>
<td>2) Preparing an introduction of university innovations</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>3) Putting companies and universities in direct contact based on their common interests</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Crowdsourcing Platform</strong></td>
<td>A competition-based platform for solving industrial challenges in a curriculum-integrated process</td>
<td>1) Access to real industrial challenges</td>
<td>1) New ideas and their validation by end-users for relatively low costs</td>
<td>Fees paid by companies</td>
</tr>
<tr>
<td><strong>NimbleBee</strong></td>
<td>2) Receiving an industrial guidelines in development of the curriculum</td>
<td>2) The platform is closed and secure</td>
<td>2) The platform is closed and secure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3) Competition as a motivational factor</td>
<td>3) Access to jointly trained and</td>
<td>3) Access to jointly trained and</td>
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</tbody>
</table>
for students (monetary benefits are not the main)
4) Coaching and mentoring of students by industry representatives
5) Real-life study projects to offer students: including collaborations with company and lead-users

Network building platform 
*BridgeLight*

- Builds a map of actors describing, who is doing what and who is currently interested in what based on both the data provided by third parties and by the companies themselves:
  1) Mapping the networks based on the known relationships (supply chains, project dependencies and organizational structures)
  2) Mapping the networks based on match in capabilities and expertise, technology and innovation, funding and investment
- Annual fees paid by companies and universities

Innovation marketing platform 
*LeadingEdgeOnly*

- Digital market place for university innovations:
  1) Publishing digital profiles of the university innovations
  2) Distribution of information among companies in the sector
  3) Monthly reports on marketing performance of innovation
  4) Collection and publishing of industry challenges
  5) Putting universities and companies in direct contact
- Fees paid by large companies

examined potential employees
4) It's a full-service program: the company only needs to bring a challenge and the fee. Everything else, including legal framework and IP-transfer, is taken care of by the intermediary

1) Access to industrial problems
2) Access to a dynamic visualised map of companies interested in particular areas and at the same time interested in collaboration with universities

1) Mapping the known relationships: supply chains, project dependencies: better visualization of the entire network, better navigation, access to clients problems and better control over the sector
2) Mapping the network of existing expertise: discover new collaboration opportunities, discover new seed collaboration, identify new technology, find funding and investment opportunities

1) University innovations got promoted worldwide and also targeting specific companies – potential partners
2) Better understanding of the university innovation market position
3) Knowledge of the industry challenges in the field
4) Getting access to targeted and interested industrial partners’ contacts

1) Free access to direct connection with university
2) Receiving a solid and clear picture of the university innovation in the area on a regular basis
3) For large corporate clients: targeted search for required partner or technology among universities
When considered from a policy perspective, all of the platforms offered a way to disseminate university research results and attempted to help industry to learn and gain value for the businesses concerned, while the provision of industry feedback helps universities to better understand industry problems and the value that university research has for industry (Wilson, 2012). This aligns well with policy drivers and research onto the triple and quadruple helix models of interaction (Etzkowitz, 2002; Carayannis, 2014).

At an organisational level, the platforms, which involve students in solving industrial challenges, help universities in developing a more industry-oriented curriculum and improves the image of the university delivering a more substantial amount of industry collaboration and impact achieved. For companies such platforms help in identifying talented potential employees.

Finally, our findings suggested that digital platforms for university-industry collaboration and networking are a rapidly growing market. Even though it is still at a development stage, the number of businesses focussed on breaking down UIC barriers are growing, with some platforms achieving scalability and expansion.

6 Conclusions

This paper contributes to the university-industry research field but helping to understanding how novel intermediaries in university-industry collaboration are forming, in terms of online platforms. We suggest this assists in closing the gap between the theory and rapidly evolving practices of intermediation in university-industry collaboration. Our research also attempts to augment the existing knowledge on UIC intermediaries, borrowing from the theory of inter-organizational relationships, to focus looking at the external ties that UIC intermediaries have (as per research gap addressed by Howells, 2006). More specifically, by defining the typology, role and function of online platforms as innovation intermediaries in UIC, we bridge the gap in understanding the involvement of these organisations in the collaboration process and their position in the collaboration value-chain accordingly. This is of importance for both the theory and practice around university-industry collaboration.

We also consider this study to have an additional practical value. First of all, it creates the awareness of existing UIC platforms and tools within the community of academics and practitioners – which in turn may influence their collaboration by using these tools, especially if they are attracted by the functions that make this activity easier and smoother. We know that collaboration of academia and industry is often problematic and we conclude that the involvement of the intermediary organisations we have studied eases the collaboration process and improves the outcomes.

Finally, we suggest that policy makers may find our typology useful for developing support for intermediary companies (outside of the internal classification) and thus fostering UIC, now that they are better able to identify the types of organisations that are coming forward. We suggest the typology proposed in this research can serve as a starting point.
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Publication V


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