Thorsten Kliewe · Tobias Kesting ·
Carolin Plewa · Thomas Baaken *Editors*

Developing Engaged and Entrepreneurial Universities

Theories, Concepts and Empirical Findings

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Preface

Change is the only constant in our world. The world of higher education is no different. Indeed, higher education systems are undergoing rapid change, with increasing expectations placed on their role in society, beyond traditional roles defined by the first two missions of the university—education and research. While universities seek to maximise their positive social, economic and cultural impact, various strategic directions, missions and approaches focused on achieving such impact are evident: business and society engagement, innovation, entrepreneurship, outreach, transfer and translation have been some of the commonly used terms referring to the kind of activities required to maximise the university's positive role on society. We consider entrepreneurship and engagement as the main pillars of this third mission and, therefore, dedicate this book towards them.

We, the editors of this book, have been strong advocates of the important role universities play in and for their communities, both through engagement and entrepreneurship, and have contributed to it over the past decades through both research and practice. Specifically, we believe in the importance of evidence-based advances, and in encouraging and communicating research that will deepen our understanding and help practitioners, management and policymakers in driving positive change. It is this aim to build a solid foundation for the development of practical tools and methods which help universities to successfully manage the change process and become more entrepreneurial and engaged that has inspired this book.

In our effort to contribute to this aim, we have brought together experts in the field to advance current discourse. Hence, this book features scientific articles on key issues for entrepreneurial and engaged university development. Altogether it reflects multi-level perspectives in the field, namely:

- Ecosystem perspective
- Relationship perspective
- Organisational perspective
- Individual perspective

This multiplicity of perspectives reflects the complex and dynamic nature of both changes in higher education and the role universities and its individual stakeholders play; and reminds us of the need of combining all efforts in our quest to maximise a positive impact on the community. Additionally, we call for a more diverse and collaborative work to realise the impacts society needs.

We are grateful for the valuable time and effort many have invested in this book. First and foremost, we thank all chapter contributors for making their research results and knowledge available in this book. Second, we like to acknowledge the great help of the Springer team, especially Stephen Jones and Ambrose Berkumans, who fostered the publication of the book. Lastly, we thank the team members of the Science-to-Business Marketing Research Centre in Münster who have always supported us with their insights and a helping hand.

The book intends to broaden perspectives and deepen understanding of engaged and entrepreneurial universities. We hope that this will facilitate discussions in the scientific community and in practice alike, and contribute to the change process. Therefore, we invite our readers to join the discussion by contributing ideas, knowledge and experiences on how we can better develop the third mission through entrepreneurship and engagement and jointly shape the future of universities.

Münster, Germany — Thorsten Kliewe
Bremen, Germany — Tobias Kesting
Adelaide, Australia — Carolin Plewa
Münster, Germany — Thomas Baaken

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Introduction: A Brief History of Engaged and Entrepreneurial Universities

Thorsten Kliewe and Thomas Baaken

Abstract We present a brief history of universities and its transformation towards having an engaged and entrepreneurial profile as an introduction to this book. First, a recount from first over second to third generation universities sets the basis of the missions of universities. Second, an overview of research on engaged and entrepreneurial universities details the characteristics of the change. Lastly, a brief account of practitioner developments highlights the events occurring inside institutions. Ultimately, all chapter contribution of this edited book are presented as they contribute to writing the history of universities and their role in society.

Keywords Entrepreneurial universities · Engaged universities · History of universities · Third generation universities

Introduction

It is not by chance that we, the editors of this book, have chosen the title of this chapter following the bestseller "A Brief History of Time" written by the legendary Stephen Hawking.

First, Stephen Hawking had a unique capability to present complex phenomena in a simple way. He was able to educate the general public on sophisticated topics such as general relativity and quantum mechanics. While the development of engaged and entrepreneurial universities can be considered less complex than Stephen Hawking's

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field of work, we are still challenged in decomposing all key bits and pieces necessary to generate common understandings and nurture actions towards universities that provide greater social, economic and cultural impacts. With this book, we contribute to this challenge by providing insights into some key issues regarding the creation, development and management of engaged and entrepreneurial universities.

Second, with this introductory article we aim to provide a brief overview of the developments in the field. Overall, the history of engaged and entrepreneurial universities is a rather short one when we consider that the first university was created in 859 (University of Karueeina) while the term entrepreneurial university was only coined in the 1980s by Etzkowitz (1983). Given this *brief* history, we are still in the early stages of understanding the factors and approaches that foster (or hinder) engaged and entrepreneurial university development.

Therefore, this brief history of engaged and entrepreneurial universities prepares the scene for the book by recounting (1) the history of universities, including 1st, 2nd and 3rd generation, (2) the history of literature on engaged and entrepreneurial universities, as well as (3) the recent history of practical developments in the field. Understanding where we come from and all other aspects of our history allow us to move into the current developments, findings and analysis presented in each chapter of this book.

History of Universities

The emergence and establishment of higher education institutions (HEIs) happened gradually over time. Throughout history, three major types of universities have been characterised: the first generation or medieval university, the second generation (or the Humboldian university), and the third generation or what has been so far called the entrepreneurial university (see Fig. 1). The main differences of these types of universities is how they regard knowledge and their role in society.

The First Generation University

The oldest universities were driven by the church and had religious orientation (Kerr 1963). The church controlled the teaching and learning processes, since these were considered the best protective measures against atheism (Wissema 2009). First generation HEIs were quite exclusive when it came to students' selection (Geuna 1996), thus knowledge was regarded as an elite asset and a tool for power (Jencks and Riesman 1968). These early institutions helped in consolidating the existing political and economic powers; law studies contributed to the state stability and theology supported the public loyalty to the Church (Wissema 2009). These HEIs are also known as Latin schools, since the lectures were given in Latin language. These ancient institutions did not intend to challenge the body of knowledge; their function was to

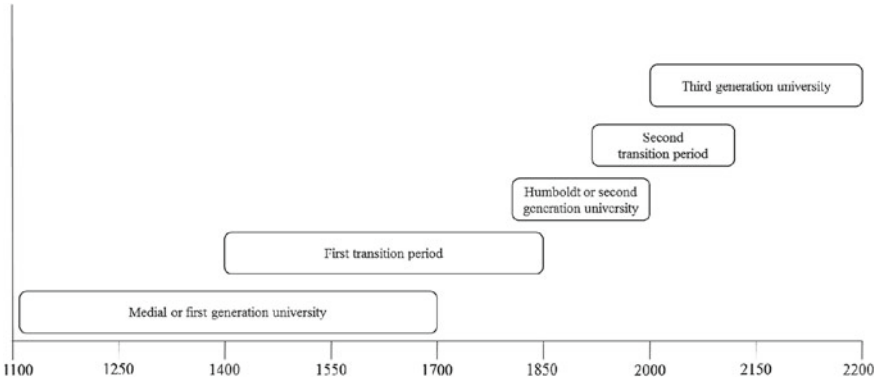

Fig. 1 Development of Universities in History (Wissema 2009, p. 4)

preserve a truth based on religious principles and to contain the knowledge accumulated from the antiquity to the barbarian period in the form of sacred letters (Wissema 2009). Thus, the mission of first generation university was the "cultural conservation, preservation, and transmission" of knowledge in the old society (Etzkowitz et al. 1998, p. 1; Scott 2006; Kerr 1963).

The Second Generation University

The eighteenth century marked a new era for university development. This period of university history was also shaped by the acknowledgement of major inventions, such as the steam engine, telephone, and railways. Universities were not only delivering education. The "modern scientific method" emerged as a consequence of conclusions deducted on bases of experiments and the rational argumentation validated the construction of new scientific findings (Wissema 2009). The main objective was the creation of science (Wissema 2009) and nature discovery was placed as a central issue (Altbach 2011). Two names have changed the history at this point of time: John Henry Newman, who described universities as places for discovery and knowledge exchange, as well as Wilhelm von Humboldt, who advocated three basic principles: unity of research and teaching, freedom of teaching, and academic self-governance (Ash 2006, p. 246; Boulton and Lucas 2011; Kweik 2006; Ruegg 2011). Monodisciplinary faculties emerged and universities were specialising in various fields. The language of instruction changed to the national languages (Wissema 2009). Universities considerably grew in size, since they were accepting many applicants so everyone could have equal opportunities of studying, with no longer centralising the power on exclusive knowledge. Nevertheless, the budget came from the state and this led to an increased governmental involvement and respectively increase in bureaucracy (Wissema 2009). Therefore, this period is known as the Enlightenment,

with the Humboldian or modern universities putting a strong focus on creating new knowledge.

The Third Generation University

Over the last 30 years, HEIs have undergone the second major transformation, which has modified their missions (Berbegal-Mirabent and Ribeiro-Soriano 2015). Nowadays, a central mission of these institutions is the application of knowledge and research discoveries for social and economic development. This 'third mission', focuses on conducting impactful research and preparing students to tackle current and future social and business challenges by developing an entrepreneurial and engaged attitude. Thus, the role of universities becomes more relevant to external stakeholders, as universities become central drivers of knowledge-based economies (Audretsch 2014a, b; Charles, 2006; Etzkowitz 2016; Guerrero et al. 2015; Zuti and Lukovics 2015). The concept of an entrepreneurial university incorporates a notion of the university as a regional innovation hub (Gibb et al. 2009). Innovation in this sense is perceived as a collaboration among universities, industry, and government (Gibb et al. 2009). Furthermore, universities of this new generation have a global orientation and rely on multi-disciplinary faculties and research teams (Wissema 2009). These new educational bodies do not rely only on state budgeting, which encourages them to be more creative in seeking alternative means of financing in order to assure themselves a certain degree of independency (Wissema 2009).

Comparing the three university generations by the type of knowledge (new vs. existing) and practical application of knowledge (low vs. high), we conclude that the first generation of universities focused on preservation of existing knowledge and the level of external engagement was low. With the first transformation to second generation, universities' focus not only on teaching, but also on the generation of new knowledge, through research. These institutions engaged with different stakeholders but not intensively. Finally, third generation universities focus on research with economic and regional contribution. Their objective is to support student and academic entrepreneurship and one possible instrument to achieve this is the intense collaboration with business and non-profit organisations (Davey 2015) (Fig. 2) .

Having outlined the emergence of third generation universities and detailed their focus on entrepreneurship as well as engagement with external stakeholders, the next section will take a closer look at literature that has been published on engaged and entrepreneurial universities.

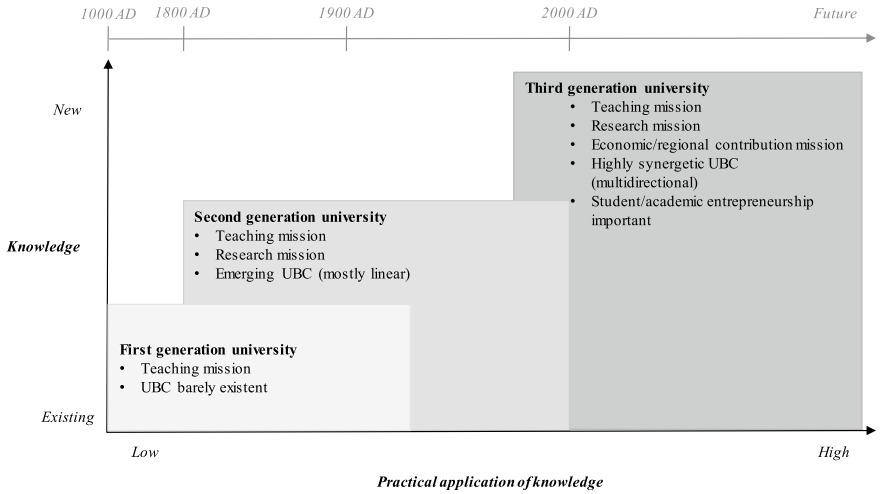

Fig. 2 The three generations of university development (Davey 2015, p. 8)

Table 1 Overview of publications on engaged and entrepreneurial universities

	Engaged university	Entrepreneurial university
Publications	42	314
Citations	340	6330
Average citations per publication	8.1	20.2
First publication year	2000	1983

History of Literature on Engaged and Entrepreneurial Universities

To deepen our understanding on engaged and entrepreneurial universities, we conducted a bibliometric analysis using Web of Science on both "engaged university" and "entrepreneurial university". We found 356 publications in total for both terms, with the majority on entrepreneurial universities, as seen in Table 1.

Our results show that research has a stronger focus on entrepreneurial than engaged universities, with nearly 7.5 times more publications, as Fig. 3 outlines. The term seems to be more commonly used in the scientific community as indicated in the citation activity. On average, each publication on engaged universities generates 8.1 citations while each publication on the entrepreneurial universities is mentioned in more than 20 publications.

The term was established in 1983 with the first publication and since 2014, the number of publications has significantly increased. This can indicate that the term entrepreneurial universities has gained recognition as a research stream. This stability as an independent research stream can explain the appearance of research on

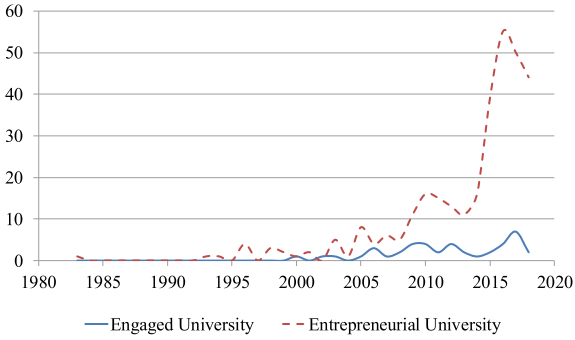

Fig. 3 Number of publications on engaged and entrepreneurial universities per year

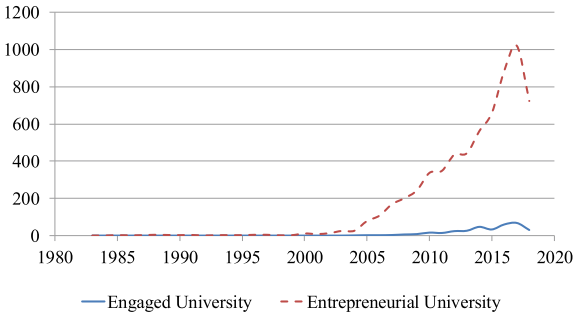

Fig. 4 Number of citations on engaged and entrepreneurial universities per year

more specific characteristics of entrepreneurship, such as engagement. The term engaged university has the first publication in 2000 and publications have significantly increased since 2005.

The data should also be interpreted with care. The decrease in the last data point is explained by the fact that the analysis has been undertaken in September 2018 so that potential publications from October to December 2018 were not included.

Overall, we can summarise that the number of citations on both engaged and entrepreneurial universities has significantly risen (Fig. 4). While an increase of citations can be expected with more publications being available for citation, the data can be regarded as a positive development in the field.

Table 2 outlines the most cited publications in the field of entrepreneurial universities. Clark's (1998) work has been cited most often, followed by a number of publications, especially by Etzkowitz, who coined the term entrepreneurial university. Interestingly, his 1983 publication in which the term was first used is not among the top cited publications.

Due to the limited number of citations of work on engaged universities, we decided to not include any statistics.

Lastly, we identified the main topics in research on entrepreneurial universities. For that we analysed the most common keywords in the papers. We found a strong focus on technology transfer and research commercialization, as it has been the traditional way to connect universities and external stakeholders, including patents.

Table 2 Top cited publications on entrepreneurial universities

Authors	Title	Journal	Year	Citations
Clark, B	Creating entrepreneurial universities: organizational pathways of transformation		1998	112
Etzkowitz, H; Webster, A; Gebhardt, C; Terra, Brc	The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm	Research policy	2000	89
Etzkowitz, H; Leydesdorff, L	The dynamics of innovation: from national systems and "mode 2" to a triple helix of university-industry-government relations	Research policy	2000	86
Slaughter, S	Academic capitalism: politics, policies, and the entrepreneurial university		1997	84
Di gregorio, D; Shane, S	Why do some universities generate more start-ups than others?	Research policy	2003	84
Gibbons, M	The new production of knowledge: the dynamics of science and research in contemporary societies		1994	83
Etzkowitz, H	Research groups as 'quasi-firms': the invention of the entrepreneurial university	Research policy	2003	83
Siegel, DS; Waldman, D; Link, A	Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study	Research policy	2003	78

(continued)

Table 2 (continued)

Authors	Title	Journal	Year	Citations
Rothaermel, FT; Agung, SD; Jiang, L	University entrepreneurship: a taxonomy of the literature	Industrial and corporate change	2007	78
Etzkowitz, H	The norms of entrepreneurial science: cognitive effects of the new university-industry linkages	Research policy	1998	74
Shane, S	Academic entrepreneurship: university spinoffs and wealth creation		2004	74

More recent topics (see yellow in Fig. 5) correspond to education, spin-offs and industry linkages, showing an extension on the mechanism to connect university and society.

History of Entrepreneurial and Engaged University Practice

Having discussed the history of universities as well as the history of research on entrepreneurial and engaged universities, we present next an overview of developments in the practitioner field. The overview is based on the expertise of the editors of this book, primarily gained through leading positions in international networks and accreditation bodies on the topic, in the management of higher education institutions and through consulting projects.

- **Moving from technology transfer to knowledge transfer**
  While the value of university research was long seen as primarily existing in technologies, universities today consider all kinds of knowledge (not only technological knowledge) as valuable and transferable (Castro et al. 2010; Godin 2008). A growing emphasis is thereby placed on the soft sciences (e.g. social sciences and humanities), complementing the existing focus on hard sciences. This development is evident in the broadening of the focus beyond patents (Philpott et al. 2011). Interestingly, most transfer offices are still called "technology transfer office" (TTO) and have not been renamed in accordance with the shift presented.
- **From technology push to market pull**
  In line with the technology focus presented above, universities have long been practicing a technology push approach in which research is conducted in isolation from business and society needs (Vogel et al. 2009). The results of this research

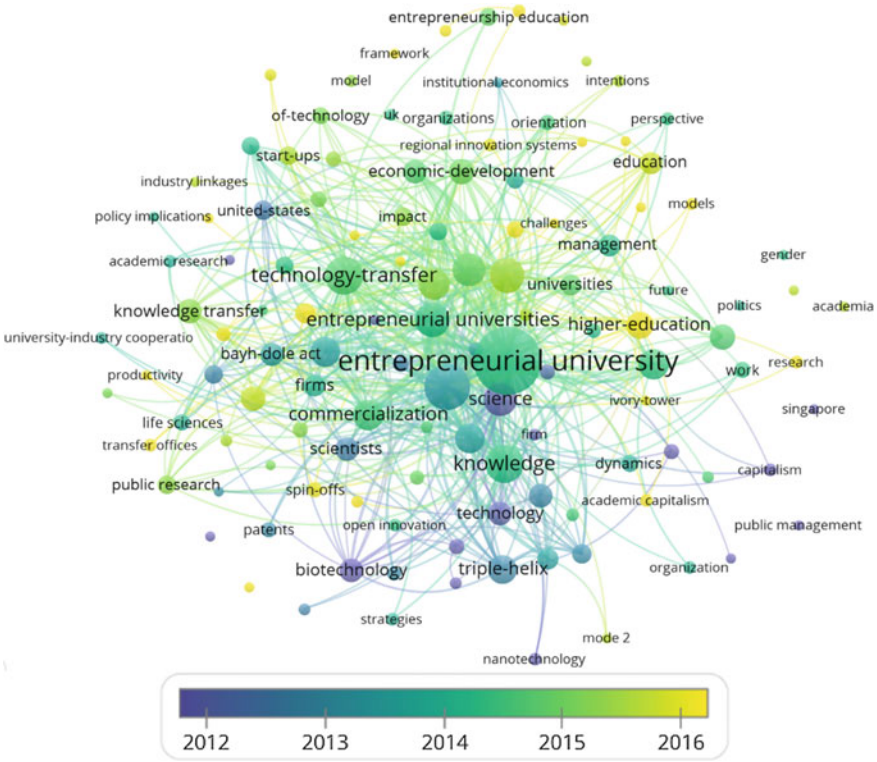

Fig. 5 Word cloud of keywords in entrepreneurial university research

were patented and the TTO was then responsible for the successful licensing of the technology. While this approach has been successful for a few universities, most universities today still invest more money (and further resources) into patenting than they generate as profits from the licensing of these patents. Due to this, many universities today move towards a market pull approach in which they not only determine market needs first, but often also integrate market partners at an early stage in order to ensure that research results find their way into practice (and financial income is generated from the tasks undertaken).

- **From building structures to a broader change**
  "We are an entrepreneurial university; we have a TTO" has been a common response to questions about the entrepreneurial profile of a university. The statement reflects the simplicity and one-dimensional view with which the topic was addressed by many universities in the past, in other words, a focus on creating structures for patenting and licensing. Today, universities acknowledge that being entrepreneurial and actively contributing to the (regional) innovation ecosystem requires a broader change in the university, including strategy, leadership, culture,

support services, incentives and rewards, and quality management (Audretsch 2014a, b; Pugh et al. 2018).

- **Professionalisation of the field**
  A professional support system has been built around universities including public and private associations and networks, providers of educational programmes, accreditations for entrepreneurship and engagement, as well as consultancy offers specialising in the development of engaged and entrepreneurial universities (Parton et al. 2014; Selingo 2018).
- **Recognition of people and relationships as drivers of the process, not technology**
  We also recognise a shift in focus on the main drivers of the third mission. While technology and the value of the technology was seen as key in the past (in line with the technology push approach), a wider recognition of the people and relationship component can be found today (Davey et al. 2018; Rossano-Rivero 2018). In other words, the focus shifted from a transactional approach (e.g. short-term oriented, one-time technology transfer) to a relational approach, which is represented by long-term, trusting partnerships between universities and their stakeholders.
- **Shift from lip service and "matching the numbers" to real impact**
  In our view, universities have neglected the development of the third mission for a long time. Rather than approaching the topic in a pro-active way, university leaders continued to focus on matching the numbers that the government expected (e.g. universities focused on patent registrations but without a clear exploitation strategy). Today, we see that universities aim to gain presence and recognition in different spheres of society in a way that they can better connect with different stakeholders (Ankrah and Omar 2015). This comes with slow changes in metric systems (both rankings and governmental systems), incentive programs (both internal and governmental), and career paths, among others (Wilson 2012).

We provide the above list based on our experience and the work of others. Many small changes are occurring internally in each institution and eventually will lead to major societal transformation. This brief history of the practitioner developments is only a first step into evidencing the changes we are creating. While most changes are still in the making, we acknowledge the path undertaken by many institutions in their quest to have greater impact on society and learn from them to keep writing history together.

Writing History

This book contributes to writing the history of Engaged and Entrepreneurial Universities. In section one, we focus on "The State of Play—Engaged and Entrepreneurial Universities" with the aim to clarify the evolution of the terms and the dynamics of the field. Section two, "The Ecosystem Perspective", provides a landscape overview to better understand the context. Section three, "The relationship perspective", focuses

on the main actors and their interactions as an essential part of the transformation towards engaged and entrepreneurial universities. Section four, "The organisational perspective", highlights the internal institutional dynamics occurring in the change process. Lastly, section five, "The individual perspective", focuses mainly on university leaders and academics as the main actors in engaged and entrepreneurial universities.

History does not stop and with book we aim contribute to the transformation of universities. In the next 12 chapters, we present recent research contributing to our understanding and the advancement of the field.

Section 1: "The State of Play—Engaged and Entrepreneurial Universities"

In the first chapter, *Moussa, Kesting and Clauss* debate the terms engaged and entrepreneurial and the overlapping contents and synergy potential. By structuring current scientific findings and identifying overlaps in research foci, they provide starting points for making use of this integration potential and foster both research and practice regarding entrepreneurial and engaged universities.

Complementing this first debate, *Blankesteijn, Sam, and van der Sijde* work towards building a new research and policy agenda in Chapter "Embedding Entrepreneurial and Engaged Universities—A Holistic View". The authors seek insights into the way in which twenty-first century universities worldwide have performed in the changing world and challenges that they have undergone, in order to address the ever-changing demands of the global knowledge-based economy within the innovative ecosystem. The issues and questions on this agenda provide focal points in discussions and policy debates on the current state and governance of the entrepreneurial university.

Section 2: "The Ecosystem Perspective"

In chapter three, *Landinez, Kliewe and Diriba* evaluate to what extent third mission activities and outcomes are reflected in the global university rankings. The chapter responds to an increasing interest on the introduction of diverse impact measures and outcomes that emerge beyond the research and education missions. The authors suggest new indicators to contribute to the debate on how to better measure HEI performance that reflect and stimulate third mission and the entrepreneurial university activities and outcomes.

The debate moves in Chapter "Entrepreneurial University Indicators in Global University Rankings" towards the link between entrepreneurial university and regional economic development with B*aaken, Baaken, Burmeier and Meerman* pre-

senting an analysis on endowed chairs. This literature review also tries to display the current state of research on endowed chairs which hints at a correlation between their establishment and regional economic development.

Section 3: "The Relationship Perspective"

From a relationship perspective, *Betts and Santoro* present in Chapter "The Entrepreneurial University: Linking Endowed Chairs to Regional Economic Development" a model for success for smaller university programs. Focusing on how universities build relationships with outside partners, they utilize the general stages of group development as a building block for a proposed process model of engagement relationships be-tween smaller university programs and their partners. The authors include various types and scopes of activities employed by engaged and entrepreneurial universities and the partners that they work with to carry out these activities, whereby the main focus of attention is at the small team level within specific interfirm dyads.

Plewa, Rampersad and Ho contribute to university industry-linkages literature in Chapter "The Engaged and Entrepreneurial University: A Model for Success for Smaller Programs". They examine the interplay between relationship characteristics (trust, understanding and communication) and relevant outcome variables across three relationship phases (initiation, engagement and maintenance). The results indicate a consistent yet complex web of interactions, with characteristics in each phase impacting not only the outcome in that phase but also the respective characteristics in the following phase.

Section 4: "The Organisational Perspective"

From an organisational perspective, C*adorin, Germain-Alamartine, Bienkowska and Klofsten* analyse universities and science parks. In Chapter "The Dynamics of Managing Evolving University-Industry Linkages", the authors review literature regarding the interactions existing between science parks or their tenants and their local universities. Talent recruitment and entrepreneurship issues are addressed as the building blocks of these interactions. The authors strive to identify types of interactions that could differ in function of the maturity levels of the firms since their aims are not the same: at an early stage, firms tend to focus more on growth, whereas at a later stage, they tend to focus more on their development.

In addition, in Chapter "Universities and Science Parks: Engagements and Interactions in Developing and Attracting Talent", *Løkkegaard and Lykke* focus on engagement through communication. They explore how university engagement can be encouraged through the communication of scientific knowledge to SMEs. An analysis of eight Danish SMEs provides insights into their situation (circumstances, barriers

and potentials). Optimising the dissemination of scientific knowledge to SMEs is a relevant focus area regarding the creation of engaged universities because this optimisation could create value for not only SMEs and universities but also for society at large.

An entrepreneurial university taxonomy proposal is then presented by *Markuerkiaga, Errasti and Igartua* in Chapter "Engagement Through Communication: Communicating Scientific Knowledge to SMEs". They identify three distinct groups which are in different phases within the transformation into an Entrepreneurial University: (i) the first group of universities is in the first phase of the path, since they are not obtaining high Entrepreneurial University's results yet; (ii) the second group is in the second phase of the path, obtaining good results; and finally, (iii) the third group is composed by the most Entrepreneurial Universities.

Section 5: "The Individual Perspective"

Finally, from an individual perspective, *Korff, Plewa and Baaken* present the role of experience of academics in university engagement. The authors analyse in Chapter "An Entrepreneurial University Taxonomy Proposal" the impact individual experience has on project and relationship success, as well as related changes in three levels: strategic, personal and operational.

In Chapter "The Role of Experience of Academics in University Engagement: Looking at University-Industry Linkages", *Rossano-Rivero* debates that academics are nowadays considered to have a more prominent role in the creation of new social and economic through the commercialisation of their research and also through their engagement in collaborations with other actors to create value for the students, the university and society as a whole.

The book closes with *Purcell*'s conceptual framework of leadership and governance in sustaining entrepreneurial universities, presented in Chapter "Entrepreneurial Educators as Academic Intrapreneurs". The framework illustrates the ways universities can use to undertake strategic transformation in becoming more entrepreneurial, that is, more agile, resilient and innovative.

Conclusion

This introductory chapter brings attention to the main events in the development of universities' third mission and the engaged and entrepreneurial profile. Even given the relative short history, there have been major advances positioning the common view that universities are not only required to perform educational activities and research, but also to take a broader responsibility to the social, economic and cultural development of our society. The strategic development of engaged and entrepreneurial universities to fulfil the third mission has recently gained momentum. The concept,

coined in 1983 and a widely spread in 1998, has shaped the development of the management field to speed more recently.

This book evidences the times of change in HEIs. The contributions presented here nurture both theory and practice integrating the advancements in the two fields to sharpen our understanding and instigate further developments. Following our analogy to Stephen Hawking, we, the editors, aim to depict throughout the 12 chapters the complexity of the topic bringing together various levels of analysis such as the ecosystem, the organisation, the relationships and the individual. The dynamics amongst these levels shows that the entrepreneurial and social engagement occur simultaneously and follows a broad stakeholder orientation. We acknowledge and address the multiple perspectives necessary to nurture the process of change towards greater social responsibility and impact through an engaged and entrepreneurial university.

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Part I
The State of Play—Engaged and Entrepreneurial Universities

Embedding Entrepreneurial and Engaged Universities—A Holistic View

Aurel Moussa, Tobias Kesting and Thomas Clauss

Abstract Within the last few years, the concepts of entrepreneurial and engaged universities have been receiving increased attention, both from a scientific and a practical point of view. Yet, surprisingly, these two concepts have largely been treated separately so far, although they obviously bear similarities, overlapping contents and synergy potential. Making use of this integration potential may considerably foster both research and practice regarding entrepreneurial and engaged universities. A stakeholder-based literature conceptualization serves to categorize and compare publications on entrepreneurial and engaged universities and is linked with an overview of dimensions regarding both concepts. Thus, this chapter aims at structuring current scientific findings and identifying overlaps in research foci and alignments in research to provide concrete starting points for embedding entrepreneurial and engaged universities. This embedment from a scientific perspective also serves for deriving practical implications on how to align the research streams to provide greater societal benefits.

Keywords Entrepreneurial university · Engaged university · University-business collaboration · Community engagement · Stakeholders · Society · Students · Teaching

Introduction

Both the entrepreneurial and the engaged university have been receiving increased attention in the past years. The research focus on the concept of the engaged university is more recent, with most articles having been published after 2010, whilst the concept

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of the entrepreneurial university had already been raising research interest in the 1980s and 1990s (e.g. Etzkowitz 1983; Clark 1998). Another remarkable difference is the number of journal publications: Applying the search term "Entrepreneur* Universit*" (with quotation mark) in a Web of Science search, Clauss et al. (2018) identify 108 publications on entrepreneurial universities between 1983 and 2015, whilst an analogous search query on the concept of the engaged university resulted in merely 18 articles between 2000 and 2017 (Web of Science search term: "Engaged universit*", May 22, 2017). This discrepancy shows that contributions on the engaged university are rather seldom featured in higher-ranked journals. They are instead often found in more practice-oriented publications. It is therefore mainly whitepapers, practical publications and edited books that raise and shape the concept of the engaged university (e.g. Beere et al. 2011; Watson et al. 2011; Benneworth 2013). In any case, the growing literature base regarding both entrepreneurial and engaged universities eventually led to a rather unstructured and fragmented research status quo. As pointed out by Clauss et al. (2018), most papers on the entrepreneurial university focus on particular elements and stakeholders related to this university concept.

Given the situation outlined above and due to the different scientific discipline foci of the two concepts (i.e. business, engineering and natural sciences are often linked to the entrepreneurial university (e.g. Toma 2011); whereas engaged university issues are more prominently featured in the context of social sciences and healthcare science (e.g. Pezzoli et al. 2016)), the similarities between entrepreneurial and engaged universities in terms of impacts, interfaces and issues have hardly been treated concretely in literature. This results in lost opportunities with respect to making use of potential synergies, as similarities to be identified between the two concepts foster research results and methods from the entrepreneurial university to be applied for a better understanding of stakeholders and their interaction in the engaged university, and vice versa.

Hence, this chapter aims at structuring and concretising the research status quo by categorizing the fragmented literature with a stakeholder-based conceptualization. Combining the latter with an overview of dimensions regarding both concepts then focuses on similarities and overlaps in research foci, we seek for an approach on how to embed research on both entrepreneurial and engaged universities. This serves for identifying future research directions as well as practical implications. Thus, we aim at answering the following questions:

(1) Which are the main peer-reviewed findings in the research fields of the entrepreneurial university and the engaged university and how do they compare? Are there overlaps in research foci?
(2) In which ways does the more recent concept of the engaged university align with the concept of the entrepreneurial university?
(3) In which ways can research streams on the engaged and the entrepreneurial university be embedded?

To answer these questions, we structure our chapter as follows; Section "Characteristics" provides a basic overview of the characteristics of the entrepreneurial university and the engaged university concept. This allows for a better understanding of

the subsequent contents. Based on a stakeholder-based approach, Section "Research Themes and Findings" points out the main peer-reviewed research themes and findings related to both concepts. This will enable readers to see general reflections and research trends for the two concepts. Section "Alignment" aligns both concepts, hereby pointing out the similarities, interfaces and issues they share. Section "Concretising Embedding Potential" highlights the necessity and potential application areas for a better integration of the two concepts. Lastly, Section "Conclusions" provides a conclusion with further implications and opportunities for potential benefits of this embedment as well as limitations and future research directions.

Characteristics

According to the European Commission (EC) and the OECD (2012), there is no consensus regarding a uniform definition of "entrepreneurial universities". Basically, the concept of the entrepreneurial university can be understood best by delineating it from classic models that focus solely on the missions of teaching and research. Following Etzkowitz (2008) though, entrepreneurial universities can be characterized by four pillars. First, academic leadership is a requirement to formulate and implement the university's strategic vision. Second, legal control over academic resources is required. Third, the university needs to have the organizational capacity to transfer technology through various methods, such as patenting, licensing and spin-offs. Fourth, the entrepreneurial university requires an entrepreneurial ethos among administrators, faculties and students. This shows a certain overlap with the entrepreneurial university elements defined by Clark (1998), namely (1) an expanded development periphery such as research transfer centers, joint ventures with industry, spin-offs, training programs for industry partners; (2) a diversified funding base that not solely relies on the state level but also other public agencies, NGOs and student services, (3) a strong steering core that is able and willing to make authoritative decisions, (4) a stimulated academic heartland that recognizes, encourages and remunerates collaboration and innovation in research, as well as (5) an entrepreneurial culture. The entrepreneurial university is embedded in the Triple Helix model of academia, industry and government and aims to fulfil a third mission of economic and social development (e.g. Etzkowitz 2003b). Thus, at first sight, aspects of academic capitalism (Clark 1998) and commercialization activities seem to define the external and internal interactions of the entrepreneurial university.

Additionally, Etzkowitz (2003a) highlights that entrepreneurial universities have a 'Third Mission', namely providing contributions to the economy and society, and are embedded as one of the elements of the innovation-generating Triple Helix that are critical for knowledge-based economies (e.g. Etzkowitz and Leydesdorff 2000; Etzkowitz and Dzisah 2008). Therefore, the entrepreneurial university goes hand-in-hand with university technology transfer and commercialisation activities and provides an important basis for university-business collaboration (Etzkowitz et al.

2000; Rasmussen et al. 2006; Kesting et al. 2018), as well as an entrepreneurial ethos among staff, faculty and students (Etzkowitz 2008).

Compared to the entrepreneurial university, the engaged university's Third Mission is less defined from an economical perspective. Instead, it is more closely related to civic service, mostly understood as community outreach and working for public good (Beere et al. 2011). Synonymously used terms to be found in literature are "engaged campus" (Holland 2001) or "university civic engagement" (Watson et al. 2011). The core feature of engaged universities is community engagement aimed at fostering the well-being of a (primarily regional) society and its individuals by contributing to regional development (Holland 2001; Bridger and Alter 2007; Watson et al. 2011; Breznitz and Feldmann 2012). To be more precise, an engaged university's ideal external goals are improving the citizens' life, sharing knowledge, engaging in outreach activities, collaborating with local and regional companies, as well as transferring technology (Alter and Book 2001), while internal goals have been identified as creating political, social and personal responsibility, preparing students for responsible citizenship and fostering their psycho-social development and skills in informed empathy (Butin and Seider 2012). To do this, the engaged university is responsive to community-identified needs, opportunities and goals in a way that is appropriate to the university's research strengths and mission (Holland 2001). Engaged universities seek to be creative in their relationships with their city and region (Powell 2016). This requires a teaching philosophy and pedagogy of engagement, service-learning and collaborative learning, as well as research that integrates the community and is applicable to community needs (Holland 2001).

Research Themes and Findings

As stated by Clauss et al. (2018), academic research on the entrepreneurial university can plausibly be classified by a focus on particular stakeholders internal and external to the university. The underlying theory this classification is based on is the stakeholder theory, whose applicability in the context of universities had already been emphasized before (Jongbloed et al. 2008). The stakeholders in question are (1) the entrepreneurial/engaged university itself, (2) academics, (3) the economy and society, (4) new ventures, (5) existing firms, (6) students, and (7) administrators and coordinators. This section is based on the aforementioned article by Clauss et al. (2018) when it comes to findings about the entrepreneurial university. We summarize these findings and, for comparison purposes, additionally present our findings on the engaged university in the same way. Table 1 at the end of this section summarizes the current peer-reviewed research themes.

Table 1 Current peer-reviewed research themes

Main stakeholder	Entrepreneurial university	Engaged university
University itself	• Conceptual • History • Barriers and facilitators • Differences • Case studies	• Conceptual • Barriers • Case studies
Academics	• Motivations • Impacts on academics • Barriers • Roles and attitudes • Perception and awareness	• Conceptual • Impacts on academics • Barriers
Economy and society	• University's role in different economic models (mostly conceptual) • Impact of university (mostly economical) • Regional and national focus	• University's role (conceptual) • Community engagement and interaction • Local and regional focus
Existing firms	• Contact points, knowledge transfer and exchange mechanisms, interaction • Interaction channel factors • Motivations • Benefits and drawbacks	• Interaction channels
New ventures	• Spin-off factors • Spin-off impacts • Comparison university spin-offs to unrelated spin-offs	• Campus-community partnerships
Students	• Methods and structures to influence students • Impacts on students	• Service-based learning • Community engagement
Administrators and coordinators	• Relations and interactions	• Administrator engagement and barriers

Stakeholder: Entrepreneurial University

The historical pathway of the entrepreneurial university is particularly highlighted by Etzkowitz (1983, 2003a, b) as a combination of researchers attempting to commercialize their research findings (Etzkowitz 1983), military research funding (Etzkowitz 2003a) and commercialization-favourable policies, such as the 1980 US Bayh-Dole Act (Kenny and Patton 2008). Barriers and facilitators, both within and outside the university, have also been receiving attention in literature. For example, Nelles and Vorley (2011) emphasise the necessity of a bottom-up approach and Stensaker and Benner (2013) highlight the problems resulting from "one-size-fit-all" entrepreneurial university templates. Kirby et al. (2011) state that the viability of

an entrepreneurial university model heavily relies on favourable staff attitudes and industry links, and that university governance structures may constitute barriers in this context. Further critical factors are attitudes towards entrepreneurship from both academics and students (Guerrero and Urbano 2012), as well as an innovation culture and acceptance of risk (Bhayani 2015). Additional research highlights intra-country and inter-country differences of entrepreneurial universities, and various case studies with a special focus on the USA, UK and Scandinavian entrepreneurial universities (Clauss et al. 2018).

Stakeholder: Engaged University

The engaged university derives it wording directly from the Kellogg Commission 1999 Report (McDowell 2003), Boyer's expanded definition of scholarship of more inclusion and direct applicability and relevance to the community (Boyer 1990) and service-learning (Westney 2006). Critical barriers regarding the engaged university include the difficulty of convincing faculty and administrators to fully implement engagement programs and to think and act more from a critical holistic point of view instead of taking over the perspective of an expert (Hikins and Cherwitz 2010). Furthermore, institutional structures are prone to hinder academics from collaborating outside of their department, due to problems in acknowledging teaching efforts, funding allocation and faculty evaluation methods which overvalue first-author papers and individual grants (Whitmer et al. 2010).

Weerts (2014) examines the effect of state support on US universities and finds that they affect level and type of engagement. Bender (2008) argues that an engaged university is classified by community engagement being reflected in the university's mission and strategic plans, the university having a policy environment that supports community engagement, the curriculum containing a number of ways for students to engage with the community and the development of partnerships among communities, the university and the service sectors. The author further presents three models of community engagement for universities in South Africa and highlights that community engagement can either be confined to community outreach and student/staff volunteering (Silo model), have various intersections with teaching/learning and research (Intersection model) or be the fundamental idea which informs and animates both teaching/learning and research (Cross-cutting model). A comparison between the UK, Sweden and Austria shows that policy institutions in the UK favor both entrepreneurial and engaged university types, as well as Regional Innovation Systems (RIS) universities and Model 2 universities, while Sweden and Austria mostly focus on RIS universities (Trippl et al. 2015).

Stakeholder: Academics in the Entrepreneurial University

Research on academics in relation with the entrepreneurial university is rather well-developed and focuses on their motivations in dealing with the entrepreneurial university, the impacts of entrepreneurial university structures and processes on them, their changing roles and attitudes, as well as their perception and awareness of elements of the entrepreneurial university (Clauss et al. 2018). Dealing with industry, academics' motivational factors are commercialization, learning, access to funding and resources (D'Este and Perkmann 2011), reputation gains and practical application of opportunities (Franco and Haase 2015). Certain monetary incentives, such as higher revenue shares, are associated with more researcher patents (Baldini 2010a), whilst Derrick and Bryant (2013) find that such incentives have no effects on high-impact publishing and commercialization. However, external, in particular industry funding also seems to have negative effects, such as keeping research findings a secret (Hong and Walsh 2009; Czarnitzki et al. 2015). Similarly, patenting in collaboration with businesses instead of the non-profit sector is associated with lower publication output and quality (Czarnitzki et al. 2009), but general involvement in patenting does not impede dissemination of published research (Magerman et al. 2015).

Further structures and processes associated with the entrepreneurial university and their effects on researchers are the entrepreneurial orientation of departments, contextual and structural ambidexterity (Chang et al. 2009), entrepreneurial university policies in relation with subjective norms (Guerrero and Urbano 2014) and quantitative measurement systems (Frost and Brockmann 2014). Additional negative effects on researchers are the dissolution of academic culture and freedom, quality losses in undergraduate teaching (Baycan and Stough 2013), and the decreased status of social scientists in the context of necessitating direct commercial applications (Mok 2013). Regarding the academics' self-concept and attitudes vis-à-vis the entrepreneurial university, current research is marked by a general positivity regarding new roles, but also a desire for more support and personal autonomy (Clauss et al. 2018). In comparison to natural scientists, social scientists are less likely to perceive their departments as highly entrepreneurially-oriented (Kalar and Antoncic 2015), and there is a general lack of awareness regarding technology transfer processes (Martinelli et al. 2008).

Stakeholder: Academics in the Engaged University

In contrast to the availability of peer-reviewed research on academics in entrepreneurial university settings, scientific literature on engaged universities is rather sparse. This points to unused research potential. Some of the works can be given as examples: Carrying out a case study of Auburn University School of Nursing, Hamner et al. (2002) identify the benefits of service-based learning for researchers in a more efficient use of faculty time gained through mixing service, practice, teaching and research roles. Engagement allows researchers to increase the relevance of

their teaching and to partially fund research or institutional activities via student projects aimed at solving particular problems (McDowell 2003). Action-oriented research affects researchers by making them focus less on the role of scholarship of discovery and more on application and dissemination, which may allow academics' activities to be more meaningful and useful (Small and Uttal 2005). However, this type of research also changes the researchers' procedures as they need to collaborate more with the community, compelling them to construct their research in such a way as to be meaningful to the community partner and adopt more flexible research methods (Small and Uttal 2005). Scholars need to adopt habits of on-going dialogue among themselves and with the public (Weis et al. 2007). Transdisciplinarity allows these researchers to deal with complex problems (Hikins and Cherwitz 2010) and to revitalize their own discipline (Montano 2009). Additionally, faculty roles and reward structures must be shifted towards acknowledging, validating and encouraging community engagement (Chantler 2016) and interdisciplinary efforts (Whitmer et al. 2010). To sum up, research on academics in the engaged university settings is currently marked by conceptual papers.

Stakeholder: Economy and Society Surrounding the Entrepreneurial University

When it comes to focusing on the economic and social goals of the entrepreneurial university, Etzkowitz's model of the 'Third Mission' (economic and social development, next to teaching and research) is often highlighted (e.g. Etzkowitz 2003a). Papers dealing with economy and society surrounding the entrepreneurial university can be categorized according to different economic models and the entrepreneurial university's role therein; and the actual impacts of the entrepreneurial university on the economy and society. For example, according to the model of Etzkowitz and Klofsten (2005), regional economic development is a multi-stage processes until a self-sustaining phase is reached. Following Etzkowitz and Dzisah (2008), the Triple Helix strategy differs considerably from traditional development models in that innovation has to be established and institutionalized as a fundamental societal value. Criticisms about the Triple Helix model are its emphasis on macro-sociological, functionalist and consensus-focused aspects (Cooke 2005), an overreliance on neoliberal ideas (Subotzky 1999) and the need for careful planning in incorporating the university in the regional or national innovation model (Goddard et al. 2012).

More concrete impacts of the entrepreneurial university on the society and the economy are talented educated people, job creation, spin-off creation, an increase in regional attractiveness to firms and knowledge-sharing as well as R&D infrastructure (Bramwell and Wolfe 2008; Baycan and Stough 2013). However, due to differing national foci, considerable national differences in these impacts exist: According to Trippl et al. (2015), the UK promotes commercialisation, local engagement and knowledge transfer, Sweden focuses on inter-organisational infrastructure; fur-

thermore, Korea emphasises skilled graduates and Japan focuses on strong connections with local firms (Ho 2014). Qualitative studies support the view that an entrepreneurial university's teaching, research and entrepreneurship activities positively affected economic development in the UK (Guerrero et al. 2015), whilst various case studies aimed to investigate their precise regional economic footprint (Benneworth 2007; Benneworth and Hospers 2007; Svensson et al. 2012).

Stakeholder: Economy and Society Surrounding the Engaged University

The focus of articles concerning the engaged university differs from the ones presented before, with a higher emphasis on the local and regional community. Trippl et al. (2015) compare regional development contributions of universities that follow the entrepreneurial view, Regional Innovation system, Mode-2 knowledge transfer and engaged model in the UK, Sweden and Austria. They find that the engaged university is active in all other model's activities but is unique in being engaged in contributions related to social, political and civic roles. Bender (2008) argues that the Third Mission of the university is not primarily economic but rather defined as community engagement: initiatives and processes that aim to solve issues relevant to the community by using the university's expertise in teaching and research. She goes on to present three different models of such community engagement: a silo model, an intersecting model, and an infusion/cross-cutting model. In public health and biomedical research disciplines, this form of community-based participatory research is already well-established (Whitmer et al. 2010). Schensul (2010) argues that engaged scholarship aims at solving social, cultural and health-related inequalities by conducting research together with and for communities.

Interaction between the university and the local community is not limited to unidirectional communication of scientific findings. For example, Weis et al. (2007) argue that a civically engaged university conversation partner is the diverse social landscape which includes the local, regional, national, and global publics that lie outside the university. However, this interaction differs between universities as case studies of six US universities (Weerts 2014) show the perceived variation in these institutes' contribution to the state's economic and social well-being. The development of closer linkages between the engaged university and the society has also been criticized as jeopardizing the preconditions upon which the universities' contribution to society depend, namely the disinterested pursuit of knowledge for its own sake (Chantler 2016).

Stakeholder: Existing Firms Surrounding the Entrepreneurial University

Existing firms and their relations with entrepreneurial universities are extensively covered in university-business collaboration literature. Clauss et al. (2018) identify the following main research areas in the relationship between firms and the entrepreneurial university: Which contact points, knowledge exchange and transfer mechanisms and channels exist between the two actors, and how are these influenced by various factors? What is the motivational basis for firms to actually collaborate with an entrepreneurial university? And, which benefits and drawbacks do firms perceive in the course of such collaboration? Interaction channels differ according to scientific area and department (Franco and Haase 2015), age and gender (Franco et al. 2014), as well as industry grants (Boardman and Ponomariov 2009) and funding arrangements (Hu 2009). Nevertheless, the main transfer mechanisms remain traditional and service channels (Martinelli et al. 2008; Franco and Haase 2015).

According to Ankrah et al. (2013) the industry actors' main motivation factors for collaboration are responsiveness to government and institutional policies, and the desire to attract collaborative funded projects, as well as access to knowledge. Association with a research institute also raises a firm's valuation (Meoli et al. 2013) and improves innovative ability and exposure to technologies (Ankrah et al. 2013) but often raises too high expectations (Ankrah et al. 2013).

Stakeholder: Existing Firms Surrounding the Engaged University

The stakeholder categorization regarding existing firms is less useful for an analysis of current research on the engaged university. The engaged university does not follow the logic that a state's interests are best served when corporate interests are fulfilled and as such attempts to collaborate with a much wider spectrum of organisations and communities apart from existing firms (e.g. McDowell 2003). Local industry may be one among many different community partners—for example, certain campuses have high-profile partnerships not only with the community, but also with businesses and industry, and frame these relationships as two-way and mutually beneficial (Weerts 2014). This multi-stakeholder approach goes hand-in-hand with the necessity for more holistic and trans-disciplinary thinking (Hikins and Cherwitz 2010). Focusing on the relationship between local industry and engaged universities, Breznitz and Feldman (2012) highlight that certain universities have gone beyond the traditional idea of technology commercialization towards ensuring the development of local industry, for example by assisting local companies with and without prior connections to the university (e.g. Georgia Institute of Technology). However, the authors note that this might be expecting and demanding too much from the university.

Stakeholder: New Ventures in the Entrepreneurial University

According to Clauss et al. (2018), a regularly mentioned knowledge transfer mechanism of entrepreneurial universities is the creation of university spin-offs and other new organisational ventures. Analysed papers are grouped into those that aim to understand underlying factors leading to university spin-off growth and success, the impact of university spin-offs, and comparing university spin-offs to spin-offs unrelated to universities. Important factors are the university's science and engineering base, staff research quality, university policies and culture, and regional context (O'Shea et al. 2007), industry-university permeability (Etzkowitz 2012), local entrepreneurial and developed clusters, venture capital availability, university ranks (especially overall, technological and business schools) and TTO efficiency (Avnimelech and Feldman 2015), location, sector of activity, ownership structure (Iacobucci and Micozzi 2015), as well as the size and characteristics of the domestic market (Styhre 2014). University spin-offs are unlikely to be major sources of income (Harrison and Leitch 2010) or to have considerable effects on the economy (Iacobucci and Micozzi 2015), but do not seem to have a lowering effect on contract research or patent activity (Van Looy et al. 2011) nor on publications (Baldini 2010b).

Stakeholder: New Ventures in the Engaged University

The engaged university creation of new organisational ventures is wider than the focus on university spin-offs in entrepreneurial universities, since its contributions are not limited to commercialization activities (Trippl et al. 2015). As stated by Lyons (2009), the engaged university aims to make its community a high priority by creating campus-community partnerships which could take the form of new organizational venture. As stated by Bender (2008), to build collaborative relationships, the university system has to fully understand the dynamics of the communities with which it seeks to work and be prepared to adapt and develop structures and processes to make them accessible and relevant to these. This would certainly require new ventures and organisational structures linked to the engaged university.

Our literature search did not reveal any papers dealing with specific university spin-offs of engaged universities, nor of other specific organizational ventures directly related to the engaged university's engagement efforts (as exists for the entrepreneurial university in the form of a technology transfer office). Although certain structures related to the engaged university have been researched, such as the reorganisation of merit systems to promote action-based research (Small and Uttal 2005) or the usage of community service projects (Hamner et al. 2002; Weerts 2014), both in-depth and comparative studies on specific new university-affiliated engagement organisations are missing. Due to the holistic and trans-disciplinary character of the engaged university (e.g. Hikins and Cherwitz 2010), new organisational ventures

seem necessary, such as global action research networks (Schensul 2010). Current institutional arrangements are often insufficient (Whitmer et al. 2010).

Stakeholder: Students in the Entrepreneurial University

According to Clauss et al. (2018), research on the link between students and the entrepreneurial university is still in its infancy. The two main research streams are the methods and structures used by entrepreneurial universities to increase students' entrepreneurial skills and desires, and the impact entrepreneurial universities have on students. For example, Arroyo-Vázquez et al. (2010) highlight the essential building blocks of an entrepreneurship support system. Culkin and Mallick (2011), as well as Galeano et al. (2012) show several ways how students can be integrated into entrepreneurial projects, and Rasmussen and Sørheim (2006) as well as Guenther and Wagner (2008) focus on the effects that an entrepreneurial mindset has on the lecturers' teaching content and methods. According to Saeed et al. (2014), high educational support and concept-development support has a positive effect on students' entrepreneurial intentions.

Stakeholder: Students in the Engaged University

Due to its links with community service-based learning, students are more prominent in research on the engaged university. Hamner et al. (2002) dealt with the ways nursing students can learn outside the hospital, while Weis et al. (2007) call for more opportunities for undergraduate students to participate in research projects addressing issues of civic engagement and public policy. Difficulties related to service-based learning by students have also been highlighted by Cann and McCloskey (2017). Community engagement by students is certainly relevant for some universities, like W&M University where 75% are engaged in some form (Weerts 2014). Nevertheless, Martin and Pyles (2013) argue that student engagement can be further improved by placing students in clear engagement university offices.

Stakeholder: Administrators and Coordinators in the Entrepreneurial University

Administrators and coordinators are hardly featured in entrepreneurial university literature (Clauss et al. 2018). So far, very few studies focus on inter-organisational relations and interactions (Sharifi et al. 2014), the mixing of bureaucratic and entrepreneurial elements in entrepreneurial university administrators (Vogel and

Kaghan 2001) and conflicts affecting heads of entrepreneurial university departments (Sotirakou 2004). However, it needs to be noted that one of the most visible elements of an entrepreneurial university, its TTO, has received widespread attention.

Stakeholder: Administrators and Coordinators in the Engaged University

Research on the engaged university focuses on other administration personnel that may be of interest. For example, Lyons (2009) illustrates the way academic business librarians attempt to fulfil their engagement mission, and that there is still room for improvement. Hikins and Cherwitz (2010) as well argue that encouraging administrators to fully commit to engagement initiatives has proven difficult, even though many are convinced of their activities.

Table 1 provides a summarizing overview regarding the current peer-reviewed research themes featured in the literature analyses carried out before.

Alignment

As illustrated by Clauss et al. (2018), the entrepreneurial university has been experiencing a broadening in terms of stakeholders involved, methods of knowledge transfer and an extended understanding of the Third Mission that goes beyond the sole focus on commercialization activities. Such extended understanding of the entrepreneurial university provides a first critical connecting factor for a stronger embedment of the entrepreneurial and the engaged university as an extended breeding ground for identifying further overlaps and similarities.

As pointed out in the beginning of this chapter, publications on the engaged university are largely lacking in highly-ranked peer-reviewed journals. The articles summarized before were mostly published in lower-ranked journals. Nevertheless, there exist numerous other engaged university literature contributions in the form of practical publications, white papers and edited books. Like the entrepreneurial university, the engaged university adds new roles to its core mission in form of societal contributions, engaging in projects with the local community, as well as policy development and economic initiatives (Breznitz and Feldman 2012). This engagement is not one-way but is instead based on the idea of mutually-beneficial relationships and the consideration of community needs (Nicotera et al. 2011). In addition, partnerships on the local level aim to create new and enriching connections between the university and the community (Bridger and Alter 2007). Similar to the entrepreneurial university, these partners may include local and regional firms with which the university collaborates in a service-provider and consultant role,

particularly in regions lacking such support mechanisms (Benneworth and Dawley 2005), as pointed out by the example of Iowa university (Silag and Fields 2001).

Regarding these aspects, engaged universities show similarities with entrepreneurial universities. However, the main difference to the (strict) model of the entrepreneurial university remains evident: Engaged universities are primarily expected to directly tackle community problems such as poverty, inequality, or health problems, and as such are more directly linked to concepts of civic engagement and social responsibility (Watson et al. 2011). Nevertheless, this concept of social responsibility is in line with the recent wider perspective of the entrepreneurial university, as delineated by Clauss et al. (2018). For example, Culkin and Mallick (2011) see the value of the entrepreneurial university in taking over responsibility as well as its willingness to collaborate in form of joint endeavors and partnerships. When it comes to knowledge production, engaged universities are also involved in translational research (Butin and Seider 2012). This is closely related to the wider entrepreneurial university's processes that aim to move towards more transdisciplinarity and context-sensitivity, hereby overcoming the focus on strict discipline-based and context-free knowledge (e.g. Gibbons et al. 1994; Nowotny et al. 2001).

These findings and reflections emphasize concrete linkages between the entrepreneurial and the engaged university. An overview of the similarities of both concepts with respect to core dimensions is featured in Table 2.

Concretising Embedding Potential

Table 2 on the dimensions of the entrepreneurial and the engaged university indicates further overlaps. In the light of the Triple Helix model of the entrepreneurial university and the inclusion of the local and regional community in various forms of the engaged university, universities are developing towards increasingly complex organizations with a wide variety of internal and external stakeholders (Bartell 2003).

Entrepreneurial University Research Embedded into Engaged University Research

In line with almost any organization, the engaged university's efficiency and effectiveness also largely depends on the characteristics of its stakeholders and their mutual interactions (Freeman 2010). Engagement and the development of strong partnerships and collaboration, based on trust and commitment, means that engaged universities need to better understand all relevant stakeholders, their specific goals and needs (Nicotera et al. 2011) and then act in line with these to do more than simply pay lip service to the model. As pointed out by several authors (e.g. Lyons 2009; Hikins and Cherwitz 2010; Whitmer et al. 2010), many critical barriers remain, such

Table 2 Dimensions of entrepreneurial and engaged universities (Accreditation Council for Entrepreneurial and Engaged Universities 2016a, b, slightly adapted and enhanced)

Dimension	Entrepreneurial university	Engaged university
Orientation and strategy Institutional commitment Shared goals Financial planning	**Oriented towards and strategically positioned to deliver a range of contributions, primarily economic ones**	**Oriented towards and strategically positioned to deliver a range of contributions, including economic ones, but focusing on social and cultural one**
People and capacity development Leadership Academics HR	The institution actively develops its people and organisational capacity to take risks and to act intrapreneurially and entrepreneurially	The institution actively develops its people and organisational capacity to address issues and opportunities in a collaborative manner
Drivers and enablers Culture Professional services Resources	Development of an entrepreneurial ecosystem that enables individuals and groups to innovate	Development of strong partnerships and collaboration, build on trust and commitment
Education and research Student learning Graduates research	Education focused on the development of individual mind-sets and skills towards entrepreneurship Research that provides immediate revenue or a high potential for exploitation	Education that is aligned with society and business needs and that integrates external stakeholders. Learning through service. Research that is mutually beneficial
Innovation and impact Continuous improvement Impact Influence	**Oriented towards delivering a range of impacts, primarily economic** Innovation based on what gives the university the optimal conditions to shape the future	**Delivers a range of impacts, including economic, but with a focus on social and cultural issues** Innovation aligned with benefits for other stakeholders

as convincing faculty and administrators to implement engagement programs, the difficulty in establishing a holistic disposition, and institutional structures that hinder societal interaction. These currently identified barriers are linked to "People and Capacity Development" and "Drivers and Enablers", as featured in Table 2. However, the specifics of these critical barriers, their underlying reasons and potential solutions, as well as case studies exemplifying all of the above, are an area of study that is underrepresented in peer-reviewed articles on the engaged university. And it is here where existing research on the entrepreneurial university turns out to be helpful.

The reason for this is as follows: The juxtaposition of stakeholders, research themes, research findings and dimensions in the entrepreneurial and the engaged university presented in the previous sections suggests that the two concepts are not incommensurable or diametrically opposed. For example, as highlighted in Table 2

on "Education and Research", while research in engaged universities has the explicit aim of benefiting the (local) community and society as well as providing valuable research (e.g. Bridger and Alter 2007), research in entrepreneurial universities is also aimed at being mutually beneficial: Universities can be provided with additional third-party funding required for scientific and administrative personnel, research equipment and technical infrastructure (e.g. for medical research) (Lee 2000; D'Este and Perkmann 2011). At the same time, academia is supposed to provide contributions for improving societal welfare by the production of 'public goods'. This so-called social responsibility theory represents a further component for bridging entrepreneurial and engaged universities, as these contributions may ensure access to valuable knowledge and innovation support for businesses and other local and regional organizations (Lee 1996, 2000; Hewitt-Dundas 2012). Engaged universities also aim at collaborating with regional companies to make the life of citizens better—the extensive literature on entrepreneurial universities and their relations with companies will prevent researchers from reinventing the wheel when it comes to engaged universities collaborating with local and regional businesses, but also campus-community partnerships. For example, entrepreneurial university-business issues in areas such as communication might be similar, and similar solutions might be applied. Furthermore, entrepreneurial universities have already experienced many of the issues in attaching a new "mission" next to research and teaching, such as discerning the correct leadership, approach to academics and HR structures (People and Capacity Development). Convincing faculty and administrators to implement engagement programs bears resemblance to convincing faculty and administrators to implement entrepreneurial programs. The difficulty in establishing a holistic disposition may be similar to the difficulty in establishing an entrepreneurial disposition. And, last but not least, institutional structures that hinder societal interaction might well be comparable to institutional structures that hinder academic-business interactions.

Engaged University Research Embedded into Entrepreneurial University Research

It is not only the concept of the engaged university that can learn from the entrepreneurial university, but also vice versa. For example, innovation and creativity are becoming a more and more relevant foundation of advanced knowledge economies (e.g. Rao et al. 2001)—entrepreneurial universities are attempting to develop ecosystems that help individuals to innovate. Nevertheless, no man is an island, and studies suggest that increasingly, creative achievements require group or team collaboration (e.g. Kanigal 1993; Dunbar 1997; West 2002), which in turn requires trust and commitment (e.g. Fawcett et al. 2012). For example, Adler (2001) argues that, as knowledge becomes more important in the economy, high-trust institutional forms are expected to proliferate. The engaged university's focus on the

development of strong partnerships and collaborations based on trust, commitment and mutual understanding might point towards potential structures and methods in the creation and maintenance of entrepreneurial ecosystems that actually enable individuals and groups to innovate. This means applying research results from the engaged university's "Drivers and Enablers" (see Table 2) to the entrepreneurial university. But it is not only the creation and maintenance of feelings of trust and commitment which would enable entrepreneurial universities to succeed in the future. The relevance of non-traditional aspects of intelligence, such as emotional intelligence (Dulewicz et al. 2005), the focus on interdisciplinary research and the ability to synthesize findings from multiple disciplines (Hackett and Parker 2016), might increase with the advance of automation, machine learning and artificial intelligence, e.g. in medical sciences (e.g. Hamet and Tremblay 2017). As such, the entrepreneurial university's education focused on the development of individual mind-sets and skills towards entrepreneurship (Education and Research) might have to be updated. Methods and structures developed by engaged university theoreticians and practitioners in the area of Education and Research might point towards suitable answers when it comes to meeting these future challenges.

Even for universities that aim to solely develop their surrounding economy, the "narrow" kind of entrepreneurial university, as delineated by Clauss et al. (2018), a 'one-size-fits-all' approach focused on patenting, licensing and new business formation is not enough and a more comprehensive and differentiated view should be taken (Lester 2005). Entrepreneurial university leaders should thus learn from different models. Indeed, as stated by opponents of academic capitalism, universities cannot or should not solely be about profit, as this might negatively influence academic freedom and the independence of research activities (e.g. Davis et al. 2011). With a combined consideration of elements of the engaged university, such as its multi-stakeholder view and community/civic engagement, an entrepreneurial university can develop itself to think more sustainable and long-term. An additional "engaged view" within entrepreneurial universities hence may improve the image of universities in general, and their standing in the local environment.

To sum up, researchers on entrepreneurial and engaged universities may focus on a more interdisciplinary and holistic perspective and to utilize findings and tools from research on the entrepreneurial university; as well as vice versa.

Conclusions

This chapter has shown that both concepts are largely treated separately in research. Yet, the stakeholder-based view and the dimension overview point out the multiplicity of similarities and synergy potential with respect to a more holistic view on both concepts. Concept-specific issues that seem to be contradictive at a first glance are (largely) not at all antagonist at a second glance (e.g. economic orientation and societal welfare orientation). Instead, reflections on both concepts can enrich each other in such a way that considerations on the engaged university helps sharpen the

concept of the entrepreneurial university—and vice versa. There are several reasons for this: The stakeholder orientation is critical for both concepts. Organizations such as a universities cannot act separately from the environment they are embedded in. Academia is dependent and may as well benefit from it and at the same time has a responsibility for its environment and the societal need arising from it. This is where the societal sustainability view of the engaged university turns out to be very suited for nourishing the entrepreneurial university concept. Furthermore, in line with the entrepreneurial university, the economic view on university engagement turns out to be important when it comes to ensuring financial safety and long-term existence of universities, which is in fact a critical issue for guaranteeing or increasing the level of a university's community engagement in future. The more strategic view of entrepreneurial university research and practice may at the same time be an important enrichment regarding research and practice with respect to engaged universities, particularly when it comes to setting longer-term objectives and project plans.

A more integrated view towards embedding research on entrepreneurial and engaged universities and its practical implications in sum provides numerous approaches for mutual benefits and win-win-situations. Research on engaged university is currently rather seldom to be found in higher-ranked scientific publication, which at the same is to be regarded as the main limitation of our literature analysis. To sum up, increasingly embedding research streams on entrepreneurial and engaged universities provides a starting point for overcoming this limitation.

Assuming and hoping for this increased embedment, future research directions point towards focusing more on relations and interdependencies between economically oriented objectives and issues (entrepreneurial university) and objectives and issues aimed at community engagement (entrepreneurial university). These foci will as well ensure a more solid breeding ground for an increased interdisciplinary approach.

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Understanding the Governance of the Engaged and Entrepreneurial University in the Twenty-First Century: Towards a New Research and Policy Agenda

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Abstract This paper develops insight into the way in which twenty-first century universities worldwide have performed in the changing world and challenges that they have undergone, in order to address the ever-changing demands of the global knowledge-based economy within the innovative ecosystem. It firstly reviews current theory and practice on entrepreneurial universities. It also analyses the current dispersion of science outside academia, via laws, policies and processes of marketization more broadly. It addresses governance issues which are relevant for both researchers and policy makers, and lastly, sketches the contours of a new research and policy agenda for entrepreneurial universities via reformulating their "third task". The issues and questions on this agenda provide focal points in discussions and policy debates on the current state and governance of the 'entrepreneurial' university. They reflect the importance of (1) rethinking the relation between publicly funded universities cooperating with private parties, (2) the kind of professionals delivered to society by universities, (3) the role of universities as entrepreneurs in innovation ecosystems, (4) the relation between societal relevance and commercial relevance of research, (5) implications of increased dispersion of research activities outside academia, and (6) the independence of academics cooperating with private partners in research projects.

Keywords Entrepreneurial universities · Engaged universities · Governance · University-industry interaction · Third mission · Research agenda · Policy agenda

Introduction

In the era of globalization, the rise of the knowledge-based economy, information technology and global competitiveness have expanded and changed the roles of

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universities from their original task of distributing knowledge through education towards knowledge transfer and more recently to knowledge exploitation for innovation (Etzkowitz and Dzisah 2007; Etzkowitz and Zhou 2007): the entrepreneurial university. Such an ever-increasing demand in the globalized world has caused universities worldwide to undergo significant transformations by adopting organizational innovations, corresponding with this concept of the entrepreneurial university. Etzkowitz (2003) states that universities worldwide have to take up this new institutional concept to be able to promote and be part of economic development and well-being in the global knowledge-based economy. Clark (2003) asserts that this new concept of the university as an "entrepreneurial university" explores new ways that can be useful to create values added to the traditional missions of teaching and research in order to seek external funding through their knowledge exploitation.

This paper aims to seek insights into the way in which twenty-first century universities worldwide have performed in the changing world and challenges that they have undergone, in order to address the ever-changing demands of the global knowledge-based economy within the innovative ecosystem. It firstly reviews current theory and practice on entrepreneurial universities. It also analyses the current dispersion of science outside academia, via laws, policies and processes of marketization more broadly. It addresses governance issues which are relevant for both researchers and policy makers, and lastly, sketches the contours of a new research and policy agenda for entrepreneurial universities via reformulating their "third task". The issues and questions on this agenda provide focal points in discussions and policy debates on the current state and governance of the 'entrepreneurial' university.

How Universities Became Entrepreneurial Universities: Review of Current Developments in Theory and Practice

Universities are resilient organizations, which is proven by the fact that they are one of those organizations—alongside for example the military and legal institutions that survived for centuries. Their legitimacy seems to go by large undisputed—or has constantly been renegotiated, depending on the perspective one takes. Their resilience is shown through their capability to respond to societal needs and to adopt and adapt new tasks if and when required. Wissema (2009) calls the present type of university "the third-generation university". It evolves from an educational institution into an institution that teaches and carries out research (the second generation) and at present has incorporated entrepreneurial activities to cope with societal demands as an entrepreneurial university (the third generation). The world of higher education is both a traditional and an innovative one; in a sense more traditional than innovative by nature, but forced by society into new roles and activities. A university in the present society responds to its environment. One of the first publications on this topic (Davies 1987) introduces the concept of "adaptive and entrepreneurial universities". Although the word "adaptive" disappeared from the concept, most universities are

just adapted to the demands from society. Goddard's concept of the "engaged civic university" emphasizes the pro-activeness of the adaptation of universities (Goddard et al. 2016).

The Changed University Environment in the Global Knowledge-Economy

Science had to become more responsive to the needs of society, and universities have increasingly developed a responsive attitude towards governmental policies, analogous to diagnosis of changes in the practices of knowledge production as have been analysed by Gibbons et al. (1994), Leydesdorff and Meyer (2006), and Etzkowitz (2003). An anecdotal example to illustrate this is from a sector characteristic for the Netherlands, namely water management (Blankesteijn 2011): during the 1970s, it was internationally concluded that the state of the environment was in need of serious attention. At that stage, the Dutch government did not fund ecological research on water quality yet, which was largely due to the fact that research on water up until then was conducted either from a more fundamental point of view, focusing on chemical issues related to water—or from the viewpoint of its use from agricultural purposes, on the applied side. Due to the continuing lobbying of environmental activists, including engaged scientists who saw no use of working in the name of fundamental science only, the dominance of research groups thriving on the science funding system organized around the signifiers "fundamental" and "applied" slowly diminished. This void was filled up with scientists who prioritized *societal* relevance in their research projects. In this example, scientists steering research on water quality in a far more practical direction took over the advisory role of the scientists that were focusing on the more fundamental chemical processes.

On the global level, geopolitical changes affected the course scientific developments took. After the fall of communism and the end of the Cold War at the end of the nineteen eighties, the military-industrial complex focused mostly on fundamental research—mainly in physics—in order to support the development of military technology, deteriorated further. Within the old context, science could function as a solipsistic occupation. In the new context, scientists had to search for new horizons, outside the old confinements of fundamental versus applied, and within the new confinements of being societally relevant. Increasingly, the binary opposition of fundamental versus applied lost its relevance as a discursive ordering mechanism as a result for the search for relevance and the diminishing interest in fundamental science due to geopolitical changes. As institutional structures changed towards an increased emphasis on societal relevance, the responsiveness of universities to societal problems grew as well (Blankesteijn 2011).

Law and Policy for the Marketization of Science Outside Academia

Where as in the nineteen seventies and early eighties these developments were driven largely by environmental concerns and geopolitical changes, it was only after the end of the nineteen eighties that governmental policies came to play an increasingly important role in stimulating this responsiveness and impacting the universities. Neoliberalism was at its dawn in Western societies to become the dominant political paradigm of the nineteen nineties. This is also reflected in the organization of universities. After the search for relevance stimulated by policies steering scientists towards societally relevant research themes (Hessels et al. 2011; Stokes 1997), the search for the societal and market relevance became an important concern in academia. Governmental policies have also been putting more emphasis on the need to develop this commercially inspired responsiveness. It has increasingly emphasized entrepreneurship and an entrepreneurial attitude in science and academia and influenced the academic education and curricula.

Not only in research and industry but also in higher education, marketization became key. Laws and policy on higher education in most countries state three tasks for higher education: teaching, research and "the third task". All the three tasks underwent major changes or, one could say, "innovations". In Galan-Muros et al. (2014), some of these innovations are described using the analogy of Friedman's "flatteners". Some innovations in education that changed the face of it are as follows:

- The Bologna declaration changes the structure of higher education and gives it its new structure of Bachelor and Master. It laid the foundation in Europe for a transferable educational credit system that made the mobility (more) possible.
- Lecturing in English is something most universities do, if not in all their programmes, at least in some.
- Online open education and MOOCs (Massive Online and Open Courses) are opportunities to reach a far wider student audience than just students on campus. It opens up the educational programmes to a world audience when taught in English and accredited.

Driven by these three innovations, the first task, "*teaching*", underwent significant changes. The developments initiated by these innovations in education, gave students the opportunity to study where and when they want. They also lead to (an increased) competition between universities and the foundation of private (commercial) universities. There is also an increased interest of the "world of work" for the academic curriculum from an "employability" point of view ("work-ready practitioners"—Howieson et al. 2014): the world of work, i.e. the professions, becomes an important factor and actor in the design and development of new curricula (see e.g. Barnett et al. 2001) as well as delivery.

The second task "research" has changed. Once, universities had the prerogative on knowledge creation, but no longer: academic research has become part of a country's innovation policy and political visions on the role of research in society. The current

innovation policy in the Netherlands is a point in case; it is dominated by an emphasis on performing research together with market parties, coupled with a focus on *research themes*. Research themes became the organizing principle in Dutch innovation policy, thereby partly replacing the focus on fundamental and applied disciplines. These themes have been formulated based on an analysis of successful Dutch industries together with an analysis of current societal challenges.

Almost as an example of "institutional isomorphism" (DiMaggio and Powell 1983), science policy has, one could say, become a reflection of industry policy—later in the same vein, dubbed *innovation policy*. As a consequence, the science policy agenda is currently dominated by the needs of industry. This signals the discursive coupling of science and innovation to economic progress. As a result, the emphasis shifted from an emphasis on science within universities to science within consortia of both universities, public and private parties. In these consortia, universities often play a smaller part than used to be the case. Universities are thus losing their age-old monopoly over scientific knowledge. R&D departments of companies and other public and private research institutes take over part of their knowledge function. Knowledge production and utilization becomes increasingly dispersed and networked.

These changes in teaching and research culminate in the reformulation of the third task of universities, signalling the rise of the concept of the entrepreneurial university. The third task has traditionally been interpreted as "*service to the community*" and "*outreach*". Now a new dimension—"*innovative entrepreneurship*"—has been added. Implementing this reformulated third task has brought universities to embrace a wide range of activities such as patenting and licensing (Henderson et al. 1998; Mowery and Sampat 2001; Sampat 2006; Shane 2004); spin-out formations based on results of research (Etzkowitz 2008); contract research (Clark 1998b; Etzkowitz et al. 2000; Welch 2011) and continuous professional development (Fink et al. 1999; Zukas 2012). In line with this thinking, Fayolle and Redford (2014, p. 2) have related the third task to "the economic and social valorisation of knowledge produced by researchers, creating the need for strategies, structures and mechanisms within universities that facilitate and intensify knowledge transfer to the private sector…".

Towards a New Research and Policy Agenda: Reformulating the Third Task as Academic Entrepreneurship

In order to counterbalance this development, scientists are trying to develop academic entrepreneurship, as a reformulation of the third task of universities. Mok (2005) has emphasized the expanded role of the university incorporating the third task in relation to entrepreneurial activities in the knowledge-based economy, promoting a dynamic interaction among government, university and industry. Framed in terms of the third task, entrepreneurial activities are increasingly becoming normalized in many universities in the United States and worldwide (Etzkowitz et al. 2001).

The third task also impacts education: the incorporation of entrepreneurship education into the curriculum to enable students to apply (the) new(est) technology, understand what it takes to access new markets, develop new products, manage enterprises, and develop skill levels in job market (Klofsten and Jones-Evans 2000). These are all important elements in entrepreneurship education with which the students need to be well-equipped to be entrepreneurial. Entrepreneurship nowadays is taught to students in science, engineering and technology, as well as at business schools and as part of the humanities curriculum (see Levenburg et al. 2006) with the result that thousands of students worldwide are continuously introduced to entrepreneurship via longer or shorter courses. Entrepreneurship education can be an important element in any business venture support or innovation eco-system (Hansemark 1998), which comes along with incubators, accelerators, innovation centers, technology transfer offices, science parks, and venture capital operations, as part of job creation (McMullan and Long 1987).

University-Industry Interaction

Institutions are conceived of as taken-for-granted understandings (Berger and Luckmann 1967), and shared mental models (North 1990). Together, the formal and informal institutions establish "the rules of the game" (DiMaggio and Powell 1991, p. 9; North 1990, p. 3; Shepsle 1989, p. 141). Of course, universities have changed over time—changes we learned to take for granted. But, especially, the interaction of universities with the business world changed the institution "university" fundamentally and transformed them into amalgamation of the "old" and the "new" academic institution. They are thus on the verge of becoming part of, and, maybe even driving the (establishment of) innovation ecosystem of region. The "new rules of the game" (the new challenges in teaching, research and valorisation) described above show that the world outside the university is becoming a force in higher education; but it also creates a platform for further development and renewal in the academia; in other words, for the entrepreneurship of the university:

- the involvement of or the interaction with the world of work in education leads towards curricula that are intended to improve e.g. the employability of graduates.
- developments in research coming from policy measurements show that new forms of partnerships in research are to be realized: public-private partnerships (university and industry) or even triple helix constellations (with the government as financier via subsidies).
- the third task and valorisation activities create the stimulus for the introduction of entrepreneurship in the university (undergraduate and graduate) curriculum.

Conclusion: Challenges for University Governance

Mass education, limited (and decreasing) public funding, global competitiveness and the ever-changing demands of the knowledge-based economy have more or less driven universities to become more sensitive towards economic development and deploy (more) entrepreneurial activities, culminating in the concept of the 'entrepreneurial university'. Higher education is regarded by some as a commercial product (Altbach 2015). Benner and Sandström (2000) assert that these developments are significant opportunities for change and development in higher education.

As recent European studies (Davey et al. 2011) show, many academics consider themselves involved in some kind of entrepreneurial activity. Most universities nowadays have an "expanded developmental periphery" (Clark 1998a, p. 6), such as a technology transfer office initiates, coordinates and manages its valorisation activities as well as the spin-off company portfolio. The extended periphery has led to the adoption of the triple helix model to promote university-government-industry collaboration, carrying implications for the university governance, which has become a critical issue in the higher education sector in the twenty-first century. Based on his studies in the five European universities to determine how they had gone about changing the way they are operated, Clark (2001, pp. 14–15) relates the university governance issue to "the strengthened steering core", an important element of transformation to encompass "central managerial groups and academic departments" expanding from "highly personal leadership to highly collective or group-based leadership".

Shattock (2002, pp. 235–236) examines "the corporate-dominated and the academic-dominated forms of university governance". The former, a "corporate model", is usually one where the governing body represents the dominant decision-making power on "both a de facto and a de jure basis" over the university, and its membership is usually predominantly non-academic lay governors. By contrast, the latter, a "consensual model", represents the dominance of academics in the governing process.

Moodie and Eustace (2012, p. 233) assert that the governing bodies must rely on academics to govern universities as "no one else seems sufficiently qualified to regulate the public affairs of scholars". Despite this, in the nineteenth century, the corporate model was considered desirable as lay governors were needed to generate funding for teaching and research due to the limited regular funding received from the government (Moodie and Eustace 2012). Notably, as professional service organizations within the changing market-steering environment, universities have moved towards the concept of "shared governance" to secure their future (Shattock 2002; Taylor 2013). Taylor (2013) describes shared governance as a model in which university governance is shared between the academic community and the governing body associated with lay dominance, and is coordinated by the university executive. However, the shared governance model is rejected by the corporate model because the institutional decision-making process is considered rather slow under the shared model (Rhoades 2005).

Universities are encouraged to respond swiftly and appropriately to the ever-changing demands of the knowledge-based economy and to diversify their income sources in the face of limited public funding. Etzkowitz et al. (2000) have found that university governance structures have changed as universities have expanded their roles in innovation, from the generation and dissemination of knowledge to the commercialization of it. With the concept of the entrepreneurial university, faculty staff and technical personnel in academic departments are expected to commercialize research findings and seek collaborations with external partners. Similarly, Torres and Schugurensky (2002) note an increasing presence of market values and forces in academia by which professors, departments, and faculties of both public and private universities are progressively involved in competitive behaviours for funding, grants, contracts, and student selection. Academics are encouraged to develop an entrepreneurial approach to research and teaching.

Notably, the advent of the concepts of the entrepreneurial university (Bercovitz and Feldman 2006; Clark 1998a, 2001; Etzkowitz 2002, 2003, 2008; Etzkowitz et al. 2000; Guerrero and Urbano 2012; Redford and Fayolle 2014; Sam and van der Sijde 2014) carry important implications for university governance. They raise essential issues related to university governance, which leaves us with the contours of future discussions on the further elaboration of the entrepreneurial university, both within the scientific literature on academic entrepreneurship and within university boards.

In summary, these contours are defined by the following issues:

- How do publicly funded universities relate to privately funded counterparts? The Bologna Declaration internationalized and differentiated academic education up to such an extent that privately funded universities became serious competitors of publicly funded universities.
- What does the incorporation of entrepreneurship education mean for the professionals delivered to society—are they academically schooled professionals or professional academics? More fundamentally, what is the nature and differentiating value of an academic education?
- In university-industry interaction: to what extent can an academic institution assume a leading and proactive role in (creating) an entrepreneurial ecosystem in the presence or the absence of the traditional ingredients such as the presence of incumbent firms and existence of adequate local physical infrastructure. What role can responsive universities play in (regional) innovation ecosystems?
- Shared governance of universities: How does societal relevance relate to commercial relevance of research? Can they be linked, and if so how? Taylor (2013) describes shared governance as a model in which university governance is shared between the academic community and the governing body associated with lay dominance, and is coordinated by the university executive. However, the shared governance model is rejected by the corporate model because the institutional decision-making process is considered rather slow under the shared model (Rhoades 2005).
- What are the implications of the diffusion of science outside academia? Due to innovation policy and its pressure on cooperation with private parties, do

universities need to give up their monopoly on developing scientific knowledge. What does this mean for scientific development?

- What does the growing importance of academic entrepreneurship mean for the independence of science and scientists? How is commercialisation different from entrepreneurship? If they are regarded as the same then "making money" becomes more important than seeing and developing opportunities as a result of the "new rules of the game".

These issues and questions provide focal points in discussions and debates on the current state of the, undeniably, *engaged and entrepreneurial* university.

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Part II
The Ecosystem Perspective

Entrepreneurial University Indicators in Global University Rankings

Lina Landinez, Thorsten Kliewe and Habtamu Diriba

Abstract The nature, purpose and ways of work of Higher Education Institutions (HEIs) are fundamentally changing. A new role of transforming knowledge and research discoveries into social and economic development known as 'third mission' is emerging as an important pillar of HEIs fabric. Against the backdrop of this major transformation, this paper attempts to evaluate to what extent third mission activities and outcomes are reflected in the global university performance measurement metrics. Eight prominent global rankings are evaluated through a framework of characteristics of an entrepreneurial university. The analysis shows that third mission activities are only scarcely represented in the rankings, with a focus on a limited spectrum of entrepreneurial activities. The analysis also revealed that there is a tendency to focus on output-based measures of third mission, while overlooking the key activities and systems universities put in place to nurture an entrepreneurial attitude. Based on our subjective classification of ranking indicators, we propose new indicators that could be developed to achieve a better approximation of the third mission activities.

Keywords Entrepreneurial universities · University rankings · Indicators · Third mission

Introduction

Higher Education Institutions (HEIs) are fundamentally changing their nature, purpose and way of work. In the past, HEIs have used education as the main channel to shape society and enrich social welfare by providing knowledge (Daraio et al. 2015).

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This has been evident in the first mission of universities. With the evolution of universities, research was included as the second mission, adding knowledge creation as a central activity (Etzkowitz 2008, 2016). Recently, HEIs have undergone another major transformation, which has changed their service portfolio and has modified these missions (Berbegal-Mirabent and Ribeiro-Soriano 2015). A new role of transforming knowledge and research discoveries into social and economic development is now emerging as the 'third mission' (Rubens et al. 2017).

Together with the traditional missions of education and research, HEIs take the third mission as an entrepreneurial and engaged attitude to prepare students to face current and future social and industrial challenges. Thus, universities are remodelling themselves as natural incubators, which motivate academics and students to initiate their own ideas, not only in the field of business and engineering, but also in social sciences and humanities to tackle societal problems (Etzkowitz 2008, 2016). In this way, HEIs' new role becomes crucial, since they support the knowledge-intensive development of the economy and society (Audretsch 2014; Charles 2006; Etzkowitz 2016; Guerrero et al. 2015; Zuti and Lukovics 2017), by encouraging entrepreneurial thinking and acting in institutions (Audretsch 2014; Zuti and Lukovics 2017).

Attempts to measure HEI's performance in their missions have been made through highly publicized global metrics, known as global university rankings. Rankings, known as "useful lenses" (Pusser and Marginson 2013, p. 545), have shown to have the power to influence the dynamics of the higher education landscape (Horstschräer 2012; Millot 2015) as they depict the prestige of the so called world class universities or centres of excellence. Thus, international university rankings are named to be international proxy measures for quality in higher education (Thompson-Whiteside 2016) and become a trial to account the most influential universities worldwide.

The third mission repositions universities' role in society and raises questions on how to evaluate their impact. There is an increasing interest on the introduction of diverse impact measures and outcomes that emerge beyond the research and education missions (Etzkowitz 2016). University rankings, as a tool of performance measurement, are also questioned with respect to the integration of third mission indicators. Rankings seem to focus on education- and research-based indicators. However, solid research investigating the integration of third mission indicators in the main rankings is missing, especially with respect to indicators that reflect the entrepreneurial profile of universities.

To contribute towards addressing this issue, we scrutinize some of the most influential global rankings and analyse how the third mission is currently reflected and how it can be improved. For the scope of this paper, we focus on the specific dimension of entrepreneurship within the third mission. First we present an overview of the key benefits and critics of global university rankings, presenting them as a debatable but widely used performance measurement and management tool. Secondly, we define the characteristics of an entrepreneurial university to be used as an evaluation framework for the rankings. Using these characteristics, we analyse the current ranking indicators to assess the degree to which third mission indicators are integrated, and to suggest new ones to achieve a better approximation to the third mission. Our

aim is to contribute to the debate on how to better measure HEI performance that reflect and stimulate third mission activities and outcomes.

Overview of Global University Rankings

University rankings have become a credible framework on the global educational market (Hazelkorn 2008; Jöns and Hoyler 2013) as they set a basis for international benchmarking of university excellence worldwide (Thompson-Whiteside 2016). Rankings encourage the collection and analysis of national and international higher education data to inform and increase public awareness about HEIs performance (Millot 2015).

In terms of public awareness, Marginson (2014) claims that ranking is about democracy, as universities nowadays disclose internal information and provoke discussions among various national and international institutions on the topic of education quality (Pavel 2015). Thus, rankings aim to support different stakeholders, e.g. students, in making informed choices about their educational future by providing transparency (Rauhvargers 2013; Yeravdekar and Tiwari 2014), simplicity (Thompson-Whiteside 2016; Marginson 2014) and standardisation (Fowles et al. 2016). Rankings support educational policy making via measurability of certain indicators and worldwide comparisons (Hazelkorn 2008; Rauhvargers 2013). Rankings can be also used as an instrument for convincing the public that certain education reforms are needed, thus supporting the policy making (Rauhvargers 2013).

In terms of HEIs performance, rankings have also become a management tool for strategic planning and continuous monitoring to improve performance (Hazelkorn 2008; Rauhvargers 2013) and to encourage accountability in the governance (Hammarfelt et al. 2017). Universities can improve and adjust business model propositions to attract particular types of students and find partners and sponsors (Hazelkorn 2008; Rauhvargers 2013). Rankings intensify competition among universities, which further encourages enhancement (Marginson 2014; Rauhvargers 2013) and contributes to education quality and diversity (Hazelkorn 2008), for example changes in the curriculum and international study programs. This in turn influences the transformation of the academic profession and the role of the researchers (Hazelkorn 2008) by encouraging international project collaborations, research partnerships and global knowledge networks (Hazelkorn 2008; Pavel 2015).

However, all these benefits come with criticism on the collection and analysis methods, and usage of results. In terms of the methodology, the focus on only certain criteria, usually research-based, like the number of citations, increase the bias towards specific educational fields, such as engineering, natural sciences and medicine, leaving fields such as arts, humanities, and to a large extent social sciences underrepresented (Daraio et al. 2015; Rauhvargers 2013). Also, research-intensive universities are often at the leading positions (Goglio 2016) and English-speaking universities have an advantage, making non-English outputs one of the reasons for a lower ranking position (Rauhvargers 2013; Yudkevich et al. 2015).

The methods are criticized to be superficially presented, the choice of indicators and their weightings are questionable and the scores are not explained in detail (Bougnol and Dulá 2015; Hazelkorn 2008; Rauhvargers 2013; Soh 2016). Millot (2015) points out that global university rankings have a narrow focus, as they could not embrace the entire complexity of the higher education systems. This makes the comparison of universities from different countries difficult, since political structures, history, and cultural and educational traditions are different (Berbegal-Mirabent and Ribeiro-Soriano 2015). Additionally, there is no one standardised ranking mechanism and the ranking bodies differ in their objective and subjective criteria (Jöns and Hoyler 2013).

In terms of results, there is often misinterpretation leading to problems with decisions at university or national level, as decision makers mostly focus on activities which are highly rewarded in the ranking mechanisms (Millot 2015). Since universities strive to get in the exclusive ranking charts, often the focus is placed on institution positioning, rather than on the improvement of educational aspects (Fowles et al. 2016).

Another critical point is the exclusiveness problem. The fact that the global university rankings place elite universities in the spotlight leaving out a large amount of institutions worldwide of their range (Millot 2015; Rauhvargers 2013; Yeravdekar and Tiwari 2014). Only 2–5% of the universities worldwide are included in the global university rankings (Pavel 2015; Yeravdekar and Tiwari 2014) and hardly any of the developing countries are represented in the ranking lists (Millot 2015; Yudkevich et al. 2015).

To summarise, university rankings provide a variety of benefits, but are also widely debated. Current rankings seem to be focused on the first and second mission, education and research. However, given the recent advances in university missions, it is important that the third mission will also be reflected in the rankings in the future. Both pros and cons need to be examined with care when developing new indicators on the third mission, especially in terms of methodology and interpretation of results.

This chapter aims to contribute to the development of rankings by taking a closer look at how well the third mission is represented in current rankings, in order to potentially suggest new indicators. To do so, we first need to understand the characteristics of an entrepreneurial university and identify the criteria required to measure. This analysis is presented in the following section with a specific focus on entrepreneurship, a key aspect of the third mission.

Characteristics of an Entrepreneurial University

The third mission basically means that HEIs aim to strengthen and prioritise their engagement with society, community and institutions (Rubens et al. 2017). From an entrepreneurial perspective, the third mission reflects a need to create partnerships with external institutions and companies, as this could create additional funding,

access to company technology, and feedback and insights to research needs, models, and concepts (Gibb et al. 2009, p. 12; Geiger 2004, 2006).

The third mission demands the development of specific characteristics additional to the ones of education and research. We analysed the characteristics of entrepreneurial universities proposed by different authors and categorise them into six main characteristics, as shown in Table 1.

Different authors agree that HEIs should be developed on essential pillars such as efficiency of academic resources and intellectual property, knowledge transfer through patenting, licensing, and incubation, entrepreneurial mind-set, international competitive focus, less state dependency, regional development and transdisciplinary and interdisciplinary work (Etzkowitz 2008; Wissema 2009).

Table 1 Characteristics of an entrepreneurial university

Characteristic	Supporting literature
Entrepreneurial orientation and mindset	• A strengthened steering core (Clark 1998) • A stimulated academic heartland (Clark 1998) • An expanded development periphery (Clark 1998) • Entrepreneurial mindset (Etzkowitz 2008) • Multicultural organisations (Wissema 2009) • A culture of innovation (Meyers and Pruthi 2011) • An integrated entrepreneurial culture (Clark 1998) • Placing culture ahead of structure (Thorp and Goldstein 2010) • Leadership and Governance (European Commission [EC] and Organization for Economic Cooperation and Development [OECD] 2012) • Organisational Capacity, People and Incentives (EC and OECD 2012) • Strategic vision and academic leadership (Etzkowitz 2008) • University mission, essential documents, strategy (Olearnik and Pluta-Olearnik 2015) • Top-down vision, strategy and leadership (Meyers and Pruthi 2011) • Thriving on big problems (Thorp and Goldstein 2010) • Managerial orientation (Olearnik and Pluta-Olearnik 2015)
Knowledge transfer	• Experiential learning and knowledge-transfer opportunities (Meyers and Pruthi 2011) • Clearly defined entrepreneurship learning objectives that drive the curriculum (Meyers and Pruthi 2011) • Entrepreneurship development in teaching and learning (EC and OECD 2012) • Usage of marketing tools (Olearnik and Pluta-Olearnik 2015) • New undertakings and syllabi (Olearnik and Pluta-Olearnik 2015)

(continued)

Table 1 (continued)

Characteristic	Supporting literature
Creation of added value	• Exploitation of know-how and entrepreneurial activities (Wissema 2009) • Knowledge transfer through patenting, licensing, and incubation (Etzkowitz 2008) • Pathways for entrepreneurs (EC and OECD 2012) • Business and investment projects (Olearnik and Pluta-Olearnik 2015) • Monitoring the paths of the graduates; relations with employers (Olearnik and Pluta-Olearnik 2015) • Innovation and execution values (Thorp and Goldstein 2010)
Interdisciplinarity	• Transdisciplinary or interdisciplinary, creativity as a driving force (Wissema 2009) • Flexible and dynamic university curricula (Olearnik and Pluta-Olearnik 2015) • Recognition that liberal arts education has fuelled American innovation (Thorp and Goldstein 2010) • Autonomy of staff (Clark 1998)
Interaction and engagement	• Network universities, collaborators (Wissema 2009) • Robust internal and external networks (Meyers and Pruthi 2011) • University-business/external relationships (EC and OECD 2012) • Partnerships (Olearnik and Pluta-Olearnik 2015) • Encouragement of partnerships between academics and entrepreneurs (Thorp and Goldstein 2010) • International competitive focus (Wissema 2009)
Independence	• A diversified funding base (Clark 1998; Olearnik and Pluta-Olearnik 2015) • Control over academic resources and intellectual property (Etzkowitz 2008) • Less state dependency (Wissema 2009) • Diversified sources of funding; annual financial statements; balance sheet value (Olearnik and Pluta-Olearnik 2015)

This indicates that universities are incorporating innovative teaching and research practices, university-business cooperation and development of creative concepts, methods, and tools for societal and industrial challenges. Those are reflected in the exploitation of know-how through entrepreneurial activities, networks of collaborators, multicultural organisations, and working with multiple stakeholders (Etzkowitz 2017; Wissema 2009).

Most importantly, engagement and partnerships need to meet the different and multiple expectations of stakeholders. For example, students search for improvement of their learning experience and skills, as well as having more employment opportunities after their graduation (Davey et al. 2011). Governmental organisations

demand an innovative and entrepreneurial spirit in education and training, so that innovation could be fostered (European Commission 2018) and supports regional and national development, employability, productivity, and other social improvements (Davey et al. 2011). Companies expect receiving new knowledge and insights in terms of how to improve their business practices (Davey et al. 2011).

Having identified six main characteristics of entrepreneurial universities, we will analyse in the next section whether the current rankings reflect and measure such characteristics. We do so as we believe that university rankings should capture the performance, activities and expected outcomes of these specific characteristics to appropriately address the third mission.

Third Mission in the Global Rankings

According to International Ranking Expert group [iREG] (2018), there are 45 recognised university rakings, including global rankings (17), global sub-rankings (4), global rankings by subject (5), regional rankings (9), business school rankings (8) and national higher education system rankings (2).

We explore eight of the recognised university rankings, seven correspond to the global university ranking and one sub-ranking, as shown in Table 2. Six of the global rankings (ARWU, THE, QS, U-Multirank, CWTS Leiden, Reuters Top 100) have been chosen since they are the most influential and most established ones (Millot 2015). The other two rankings chosen correspond to one global ranking and one sub-ranking (QS Graduate Employability and MosIUR) that have been included as they claim to have a specific focus on third mission activities (Moscow International University Ranking [MosIUR] 2017).

Table 2 Ranking included in the analysis

Ranking name	Origin and year	Type
The Academic Ranking Of World Universities, ARWU	China, 2003	Global ranking
Times Higher Education World University Ranking, THE	United Kingdom, 2010	Global ranking
Quacquarelli-Symonds World University Rankings, QS	United Kingdom, 2010	Global ranking
QS Graduate Employability Rankings	United Kingdom, 2015	Global sub-ranking
U-Multirank	Germany, 2011	Global ranking
CWTS Leiden	Netherlands, 2007	Global ranking
Reuters Top 100	United States	Global ranking
Moscow International University Ranking, MosIUR	Russia, 2017	Global ranking

We classified the indicators used in each ranking in terms of the three university missions to reveal how they address each mission, i.e. education, research and third mission, Table 3.

Table 3 Global rankings and indicators for each mission

Ranking	Education indicators	Research indicators	Third mission indicators
Category 1: no third mission reflection			
ARWU	• Alumni (10%) • Award (20%) • PCP (average of indicators per staff—10%)	• Highly cited researchers (20%) • Papers in nature and science (20%) • Paper indexed in SCI (20%)	–
Category 2: narrow third mission reflection			
THE	• Reputation (15%) • Staff to student ratio (4, 5%) • Doctorate to student ratio (2, 25%) • Doctorates awarded to staff ratio (6%) • Institutional income (7, 5%) • International outlook (2, 5%)	• Reputation (18%) • Research income (6%) • Research productivity (6%) • Citations (30%)	• Industry income (2.5%)
CWTS Leiden[a]	–	• Publications • Citations	• Co-authored publications with industry • Co-authored publications with universities and other organisations
Reuters Top 100	–	• Patent citations (11.1%) • Patent citation impact (5.6%) • Percent of patent cited (5.6%) • Patent to article citation impact (11.1%) • Total web of science core collection papers (11.1%)	• Patent volume (11.1%) • Global patents (11.1%) • Patent success (11.1%) • Industry collaborative articles (11.1%) • Industry article citation impact (11.1%)

(continued)

Table 3 (continued)

Ranking	Education indicators	Research indicators	Third mission indicators
QS	• Faculty student ratio (20%) • International faculty ratio (5%) • International student ratio (5%)	• Academic reputation (40%) • Citations per faculty (20%)	• Employer reputation ratio (10%)
MosIUR	• Education (45%) • Wins in international student contests by students • International students • Budget to student ratio • Student to academic staff ratio	• Research (25%) • List awards won • Citation Impact Scopus, Web of Science (global and national level) • Research income per academic staff member	• University and society (30%) • Online courses • Website • Alumni with Wikipedia articles • Twitter • Scientific cooperation with non-academic organisations • Partnerships with employers • Research commercialisation of R&D results
Category 3: broader third mission reflection			
QS Graduate Employability Rankings	–	–	• Employer reputation (30%) • Graduate employment rate (10%) • Partnerships with Employers per Faculty (25%) • Alumni outcomes (25%) Employer/student connections (10%)
U-Multirank[a]	• General (13 indicators) • Teaching and learning (37 indicators) • International orientation (14 indicators)	• Research (19 indicators)	• Knowledge transfer (14 indicators) • Regional engagement (12 indicators)

[a]The ranking does not provide any weight or percentage to the indicators. See appendix for a detailed list of indicators

Our classification is subjective and posed some difficulties as there is not a clear cut for some indicators regarding the mission they reflect. Four main issues were subject of debate (Marhl and Pausits 2011); however, for the scope of this paper and building on our perspective, we define:

- First, are patents considered outcomes of the second mission (research) or as part of the third mission? The three generic steps of a patent (filing, grant decision, and commercialisation, through spin-off, licensing, etc.) can be considered manifestations of entrepreneurial behaviour. Although, both the filing and grant stage do not automatically indicate exploitation of knowledge, they nonetheless show an intention to further utilise it. In other words, they provide an indication of the attitude and mind-set of the academics who stand at the epicentre of building an entrepreneurial university (Clark 1998; Etzkowitz 2008). Therefore, we consider patents as third mission indicators.
- Second, are alumni activities considered an outcome of the first mission (education) or an activity of the third mission? We include alumni activities in the third mission if indicators reflect some level of engagement with the external context. We emphasise on the engagement aspect more than in alumni activity per se.
- Third, are publications co-authored with industry part of research or the third mission? We include industry co-authorship of research papers in the third mission as they reflect external engagement, a key aspect of entrepreneurial universities.
- Finally, employability is considered an outcome of the first mission (education) or as part of the third mission? We included employability in the third mission if indicators reflect engagement with employers to better address their current and future needs. Compared to this, reputation of an HEI based on traditional education is not considered third mission.

With this, we acknowledge the interconnection of the missions and that indicators can span across these missions. Figure 1 aims to position the four above discussed aspects and highlights graphically that activities can contribute to more than one mission.

We categorised the rankings into three groups according to our classification of the indicators, see Table 3. Note that these categories are discussed in relative terms, not absolute ones and only reflect our perspective. The first category contains rankings that have no indicators related to entrepreneurship or engagement. The second category refers to those rankings that reflect the third mission through a narrow spectrum of indicators (e.g. purely based on patents, or publications). The third category includes rankings presenting a broad spectrum of third mission indicators.

As we consider the third mission integrates a variety of entrepreneurship and engagement activities, we classified the rankings based on the spectrum of activities covered by the indicators, rather than the number of indicators or the percentages allocated to each of them by the ranking bodies.

Category 1—No third mission reflection: one of the most recognised rankings, ARWU, has not yet developed indicators for the third mission.

- **ARWU**. This ranking relies heavily on academic performance and award factors to evaluate universities. Thus, results are often biased towards large and traditional

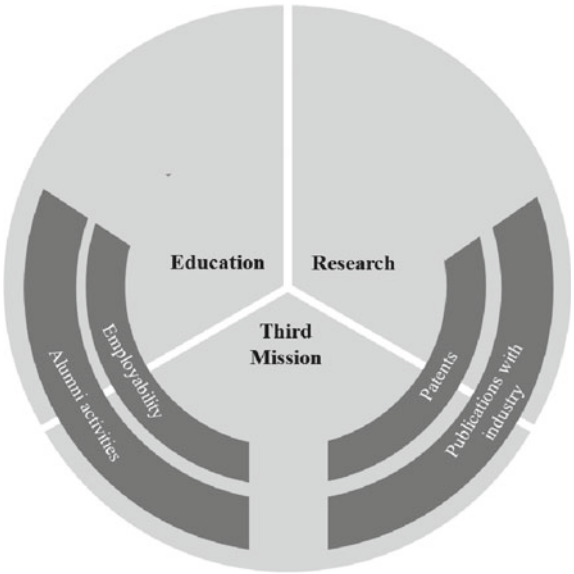

Fig. 1 Interconnection of university missions

research-focused universities (Daraio et al. 2015). The ranking has no direct or indirect indicator to assess universities' entrepreneurial activities and outcomes, and thus does not reflect any third mission activity. In terms of alumni, ARWU focuses on those students "winning Nobel Prizes and Fields Medals" (IREG 2018, p. 4) which does not represent direct engagement with society.

Category 2—Narrow third mission reflection: five rankings include indicators related to the third mission, however, only a narrow set of activities is reflected.

- **THE**. This ranking introduced one indicator on knowledge transfer. The 'industry income' indicator seeks to capture knowledge transfer activity by looking at the income gained from research activities with industry.
- **CWTS Leiden Ranking**. This ranking includes two indicators (co-authored publications with industry; co-authored publications with universities and other organisations) that assess university collaboration with industry, however, only taking a research view, namely in terms of scientific publications.
- **Reuters Top 100**. This ranking has a strong focus on patents with seven out of 10 indicators falling into this category. The ranking aims to distinguish universities for their innovative capacity and achievements (Top 100 Innovative Universities 2017) mainly through the volume of patent applications filed and granted both nationally and internationally. Although this does not directly show the exploitation of knowledge or societal impact, it shows intentionality and commitment. Reuters Top 100 argues that application filing to international organisations is resource

intensive and hence can be considered as a proxy of entrepreneurial attitude of the HEI.

- **QS**. This ranking has only one indirect indicator on university engagement and entrepreneurship through the 'Employer reputation' indicator. Its aim is to reveal how successful HEIs prepare students for their future careers by asking employers to identify those institutions that have prepared the most competent, innovative and effective graduates (QS 2018).
- **MosIUR**. This new ranking claims to better address the third mission, reflected in the dimension 'interaction with society' (Moscow International Ranking 2017). Even though they attribute a higher percentage (30%) to these indicators (compared to most other rankings), the spectrum of entrepreneurship activities and outcomes covered does not comprehensively reflect the third mission as understood in this chapter. The indicators included only reflect digital engagement (social media, web presence, online courses offered) as educational outreach and communication as part of its third mission.

Category 3—Broader third mission reflection: Two rankings, U-Multirank and QS Graduate Employability Ranking, have indicators that reflect a broader spectrum of third mission activities.

- **U-Multirank**. This index embodies the third mission in the knowledge transfer and regional engagement dimensions. The dimension on knowledge transfer includes 14 indicators (see Annex) that reflect collaboration with industrial partners, exploitation of knowledge and income derived thereof. The dimension regional engagement with 12 indicators (see Annex) reflects efforts to collaborate specifically with regional partners and the benefits derived. It is worth to mention that the ranking has additional indicators in education and research that evidence the entrepreneurial and engaged profile of universities, for example practical experiences offered to students, innovative forms of teaching, and interdisciplinarity (Meerman and Kliewe 2017). However, due to the indicators' focus on teaching and learning and research, these have been allocated to the first and second mission of universities.
- **QS Employability**. Through the lens of employability, this indicator accounts for a spectrum of activities and outcomes that an entrepreneurial university undertakes to boost the employability of its graduates. Five major indicators are incorporated in the ranking system to directly and indirectly measure the engagement of the university with the industry including the reputation of the institution among employers, cooperation with employers, alumni activities, graduate employability rate and employer-student connections. The clear limitation of this ranking is that it fails to account for other entrepreneurial aspects such as spin-offs and regional engagement.

Our classification into the three categories allows us to identify to what extent third mission activities and outcomes have been taken into account in university performance assessment rankings. We conclude that rankings have slowly introduced some aspects of third mission activities as a way to assess quality and performance of

HEIs, however in a varied and fragmented way. From these results, we conducted a deeper analysis of the indicators that are still needed to better reflect the third mission as a performance measure. The next section will further elaborate on that by using the entrepreneurial characteristics introduced in the previous section.

Identifying Third Mission Indicators

Following the classification of global university rankings according to the indicators in each mission, we analyse the third mission indicators through the lenses of the characteristics of an entrepreneurial university. Using the frame developed earlier in this chapter, we aim to assess to which extent the existing indicators reflect the entrepreneurial characteristics of HEIs. We defined three categories (Table 4): (1) characteristics not reflected in third mission indicators, (2) characteristics partly reflected in third mission indicators, and (3) characteristics well reflected in third mission indicators.

Table 4 Existing indicators classified by entrepreneurial characteristics of HEIs

Characteristics	Existing third mission indicators	Ranking
Characteristics not reflected in third mission indicators		
Entrepreneurial orientation and mindset	–	–
Interdisciplinarity	–	–
Characteristics partly reflected in third mission indicators		
Knowledge transfer	Online courses	MosIUR
	Knowledge transfer indicators (co-publication and co-patents, publications cited in patents, patents awarded)	U-Multirank
Independence	Industry income	THE
	Knowledge transfer (income from private sources, income from professional development)	U-Multirank
Characteristics well reflected in third mission indicators		
Creation of added value	Knowledge transfer indicators (spin-offs, graduate companies)	U-Multirank
	Patent success	Reuters Top 100
	Research commercialisation of R&D results	MosIUR
	Alumni outcomes	QS Graduate Employability

(continued)

Table 4 (continued)

Characteristics	Existing third mission indicators	Ranking
Interaction and engagement	Regional engagement (regional student internships, thesis, publications, graduates working, partnerships)	U-Multirank
	Co-authored publications with industry Co-authored publications with universities and other organisations	CWTS Leiden
	Industry collaborative articles	Reuters Top 100
	Employer reputation ratio Employer/student Connections	QS
	Employer reputation Graduate employment rate Partnerships with employers per Faculty	QS Graduate Employability Rankings
	Twitter, website Alumni with articles in Wikipedia Scientific cooperation with non-academic organisations Partnerships with employers	MosIUR

Non Included Characteristics

Entrepreneurial orientation and mind-set

This characteristic refers to the mission, vision and strategic stand that a university takes on their entrepreneurial profile (Etzkowitz 2008; EC and OECD 2012; Meyers and Pruthi 2011; Olearnik and Pluta-Olearnik 2015). Also, it reflects the mind-set of all the internal stakeholders, i.e. staff, students, academics, and the initiatives the university takes to promote this mind-set (incentives, culture, leadership) (Clark 1998; Etzkowitz 2008; EC and OECD 2012).

Existing indicators

Our analysis reveals that there are no third mission indicators addressing this entrepreneurial dimension. Despite some of the indirect measures employed such as patent volume, direct measures are largely missing to show the entrepreneurial orientation of universities. Especially those activities undertaken in order to foster entrepreneurial behaviour such as incentives, technical and financial support and culture are overlooked.

Key challenges

In the lenses of feasibility, this type of indicator might pose certain difficulties as strategic orientation tends to be part of the internal and confidential data of universities. Also, the documents in which it might be reflected (e.g. vision, mission,

university strategy) could be out of date and hence may not correspond to the current situation of an institution. What is more, some of the aspects such as culture are difficult to quantify and hence pose great operational challenge. Lastly, the fact that incorporating all these elements into the evaluation system is a highly resource-intensive process makes it challenging to implement.

Ideas for improvement

A better representation of this entrepreneurial dimension calls for a change in perspective that embraces both input and process of entrepreneurship. Examples of input could include measures of the budget allocated to third mission activities as compared to education and research, whereas examples of process include the existence of boundary spanning units and the academic and staff autonomy to experiment with new ideas and take risks.

This also calls for a change in the way data is collected. In this regard, enriching and triangulating the self-reported data institutions provide through a survey could be considered. For example, perception of internal stakeholders on mind-set and initiatives undertaken by HEIs can be measured through surveys.

Interdisciplinarity

This dimension refers to the collaborative work across disciplines in an HEI for third mission purposes (Wissema 2009). An interdisciplinary approach in all the missions is increasingly considered as one of the essential ingredients of innovation as it facilitates cross fertilisation of ideas.

Existing indicators

Despite the clear advantage of interdisciplinarity, our analysis reveals that none of the current rankings include indicators in this dimension for third mission. There are some indicators for interdisciplinarity in research; however, its impact on society is not yet reflected in third mission indicators.

Key challenges

Similar to the strategic dimension, this type of indicators would be based on internal data of an HEI which might not be easy or desirable to collect.

One of the main challenges is the fact that rankings follow an output-based approach, while largely ignoring activities and resources used in the process, such as internal collaborations. Additionally, the outcomes of interdisciplinary activities are not easy to measure as they are only one of the many contributing factors of successful entrepreneurial initiatives. Inputs and processes generally strengthen innovative potential but do not automatically guarantee greater entrepreneurial outcome. This lack of clear empirical connection to tangible outcome limits the overall usability of interdisciplinarity within the existing ranking systems.

Ideas for improvement

Advances in empirical research can contribute to understanding how interdisciplinarity leads to knowledge utilisation, and therefore develop indicators accordingly. Also,

like the previous dimension discussed, this dimension will benefit from a holistic approach that gives attention to the entire process of entrepreneurship and engagement rather than only on the end products.

Incipient Developed Characteristics

Knowledge transfer

This dimension refers to external activities related to knowledge transfer and the application of knowledge in diverse contexts, as well as the internal use of new knowledge as a tool for teaching, learning and training (EC and OECD 2012; Etzkowitz 2008; Wissema 2009).

Existing indicators

According to our classification, MosIUR and U-Multirank include indicators reflecting this dimension. In the case of MosIUR, online courses as an indicator show the university's activity in massive open on-line courses. The ranking argues that "the more courses published on global online platforms, the wider is the knowledge transferred by the university via the internet, and the more significant a university's contribution to education affordability worldwide is" (MosIUR 2017, p. 6).

U-Multirank provides indicators in the dimension of knowledge transfer (U-Multirank 2018) related to collaboration for knowledge creation and exchange (co-publication and co-patents, publications cited in patents, patents awarded).

Key challenges

Rankings mainly focus on publications and patents as a measure of knowledge transfer, given that both publications and patents are easily measurable. However, limiting rankings to these indicators also means that a limited scope of the third mission is accepted. Therefore, a key challenge exists in going beyond publications and patents and integrating more sophisticated measures of knowledge transfer.

As part of knowledge transfer, innovative pedagogical approaches are not yet an integral part of most of the existing ranking systems. Other than MosIUR which considers "online courses" and U-Multirank which has one sub indicator for "Innovative forms of teaching and assessment", the use of new knowledge to advance educational innovation is unaccounted for.

Capturing this dimension has operational difficulties. New learning tools or methods are difficult to establish i.e., they require test and validation before they get wider acceptance. Also, the utilisation of knowledge is mostly a complex process with some qualitative and tacit aspects. As such it is challenging to accurately gauge. Lastly, this measurement process is resource intensive for the ranking institutions.

Ideas for improvement

Identifying knowledge transfer activities that have an impact on society is the first step to improve indicators in this dimension. For example, contract research, consulting to industry and licensing could better reflect this dimension. In terms of innovative learning, broadening the perspective of the rankings towards a process focus to account for the effort of HEIs in nurturing innovative pedagogical practices could be considered. Data collection can be driven by supporting institutional self-evaluation report with other data sources.

Independence

This dimension refers to activities that diversify the funding base of HEIs (Clark 1998; Olearnik and Pluta-Olearnik 2015). The diversification of the funding base is especially important for entrepreneurial universities as it reduces state dependency and provides them with the autonomy to explore new areas and pathways (Clark 1998).

Existing indicators

Two of the rankings considered, THE and U-Multirank, have included indicators on generating income from external sources.

Equally important is the autonomy and independence universities internally afford their staff to allow them to experiment and test their ideas None of the rankings considered in this paper considers this internal aspect of independence.

Key challenges

Independence is a subjective construct, both externally and internally. For instance, despite the amount of diversified funds, the university's agenda might be shaped by funding bodies and the community at large.

Secondly, the information pertinent for this aspect might be considered confidential by some of the institutions. Lastly, similar to the previous dimensions, it is resource intensive to compile and report.

Ideas for improvement

An essential step is to recognize that diversification of funding sources would be translated into independence when academics and staff have the autonomy to prototype and test new ideas. Hence, indicators addressing both aspects of independence should be considered. Also, triangulation of methods and data sources might prove helpful in reducing the subjectivity associated with the construct.

More Developed Characteristics

Creation of added value

This dimension refers to activities related to exploitation of knowledge that lead to generating income for the university (Etzkowitz 2008; Olearnik and Pluta-Olearnik 2015; Thorp and Goldstein 2010; Wissema 2009).

Existing indicators

Three of the analysed rankings include indicators showing this type of activities. U-Multirank focuses on generating income through spin-offs and regional and international collaborations (U-Multirank 2018). Similarly, THE attempts to capture innovations with industry, inventions and consultancy. Lastly, Reuters Top 100 aims to address this aspect through patents that have been successfully granted. However, it should be noted that although we consider patents as an important step in the value creation process it does not show specifically the commercial exploitation of knowledge. In other words, a more robust evaluation of added value such as the amount of licensed patents, the revenue of start-ups and the number of jobs created is missing.

Another way to show value added is to measure alumni interaction and impact on society. MosIUR shows alumni articles on Wikipedia and QS Graduate Employability assesses different outcomes of alumni in terms of most innovative, creative, wealthy, entrepreneurial, and/or philanthropic individuals (MosIUR 2017; QS 2018).

Key challenges

The main challenge is that some of the data could be considered confidential by HEIs. For instance, HEIs might be reluctant to disclose the details of their licensing agreement with external parties. Similarly, they may also want to protect their innovative ideas by limiting the amount of information they share.

In terms of alumni, the collection of data might be problematic as some HEIs simply do not have a system of storing information about the initiatives of their current and former students and staff.

Ideas for improvement

The development of additional indicators that show more directly the ability of the university to exploit its knowledge base through value creation is essential. More robust indicators such as the number of licensing agreements, start-ups, jobs created and income from private sources could be considered.

Interaction and engagement

This dimension reflects relationships, partnerships and networks created, managed or participated in by an HEI to conduct its activities and reflect the efforts on building external interactions with different stakeholders (Wissema 2009; Thorp and Goldstein 2010; Olearnik and Pluta-Olearnik 2015).

Existing indicators

Our analysis reveals that this is the most well represented third mission dimension, as most of the rankings analysed have either a direct and/or indirect indicator to measure it. Specifically, seven of the eight rankings considered seem to have a focus on interaction and engagement, however, from different perspectives and to a different degree. U-Multirank, which appears to provide the most comprehensive representation, includes student and alumni activities as well as research and income generating indicators that are held both in the region and internationally (U-Multirank 2018). Some of the indicators include contact with work environment (i.e., work placements, lecture by industry experts, theses with regional partners, and community service learning), strategic research partnerships, income from regional and international sources (i.e. industry, private organisations, charities), international joint publications, co-publications with industrial partners and co-patents with industry (U-Multirank 2018). In the same line, CWTS and Reuters Top 100 measure interaction through the lens of joint publications with industrial partners. Lastly, THE focuses in the international aspect of interaction and collaboration.

QS and QS Graduate Employability rankings focus on employability. While both of them measure the reputation of the institution among employers, the latter provides additional measure to account for the ways in which the institution actively tries to create employer student interaction and the effort to address industry needs.

MosUIR takes a slightly different approach to interaction and engagement by focusing on online courses, and social media presence.

Key challenges

A large variety of interaction and engagement forms exist in universities, ranging from simple forms such as a joint supervision of a thesis, guest lectures or small scale student projects, to more complex forms such as join research labs or strategic alliances. The challenge is therefore to decide which aspects to focus on and how to prioritize them to develop a robust ranking system.

Ideas for improvement

The evaluation of the level and quality of interaction and engagement of an HEI can be suggested. For example, customer satisfaction surveys among university partners could generate such data, which however can be expected to be difficult to capture.

Suggestions for Improving Third Mission in Global Rankings

The above analysis is our own interpretation of the existing indicators. However, it is important to note that the entrepreneurial profile of an HEI has a complex nature for which indicators might reflect more than one characteristic at the same time. There is no clear cut in categorising such indicators, for example knowledge transfer

indicators can represent knowledge transfer, interdisciplinarity, creation of value added and independence, depending on the perspective of analysis.

We believe that our interpretation provides an initial framework for discussion and further development of the indicators. In this direction, we suggest some new indicators that could be taken into account when reflecting the third mission of HEIs in global rankings, Table 5.

The identification of these indicators is not intended to propose only one path for development of rankings. It is rather revelatory in showing how the development

Table 5 Suggested third mission indicators for each characteristic

Characteristics	Suggested third mission indicators
Entrepreneurial orientation and mind-set	• Budget allocated specifically for innovative activities • Boundary spanning units • University structure (reflecting autonomy) • Perception of university mindset • Project/problem based educational programs/courses • Entrepreneurship programs
Interdisciplinarity	• Interdisciplinary courses/programs • Interdisciplinarity of the university bodies (committees, etc.) • Interdisciplinary collaborations with industry and communities
Knowledge transfer	• Open online resources (OERs) such as freely accessible tools, podcasts and other content • Massive open online courses (MOOCs) • The number of copyrighted material shared through the creative common agreement • Social media engagement (i.e., LinkedIn, Twitter, Facebook and other channels) • Tailor made training and consultancy programs provided to regional partners • Start-ups incubated/entrepreneurs trained • Policy briefs developed
Independence	• Resources generated from third stream activities as a percentage of the universities budget • The autonomy of staff and students measured through a survey
Creation of added value	• Licensing agreements • Start-ups and spin offs • Jobs created • Capital raised • Annual turnover/number of customers served by the start-ups • Innovative pedagogical approaches developed

(continued)

Table 5 (continued)

Characteristics	Suggested third mission indicators
Interaction and engagement	• Participation of industry and/or community in university board • Staff exchange and secondments with regional partners (i.e. companies, government offices and civil society organizations) • Guest lecturers from the industry • Work placements for students • Regional and international partners • Collaborative projects with regional and international partners • Alumni engagement activities • Social media presence

is at its early stages and can take multiple ways. These indicators require a deeper analysis in terms of feasibility and importance, in a way that rankings and universities would be willing to make the effort in data collection and analysis. Our proposal corresponds to a content-wise analysis that aim to spark the jointly development of a better measurement system.

Conclusions and Implications

This chapter investigated how the three university missions are currently reflected in some of the most well-known global rankings, with a focus on the third mission. The aim was to capture to what extent the third mission, especially from an entrepreneurial perspective, is reflected as part of university quality and performance. We scrutinised the current indicators under the entrepreneurial characteristics of a university, and conclude that the third mission has been scarcely included, not properly acknowledged the third mission and the contribution of universities to the society (Boulton 2011; Daraio et al. 2015).

The traditional use of rankings has been to attract the best academics to improve education and research quality, and the best students to place them in jobs while creating high income for the university. Based on the evolution of the role of universities and the relevance gained by the third mission and the entrepreneurial university, we challenge this traditional approach to rankings and argue that global league tables underestimate the importance of universities in society (Moed et al. 1985). We see a change in rankings moving towards the reflection of societal impacts of universities to respond to the needs of traditional and other new stakeholders. For example, students and industry actors would demand universities with more positive impact in society, and other stakeholders such as governments and social organisations would expect more activities in that field.

Rankings are dominated by teaching and research metrics, largely because they follow an outcome approach that is easier to measure and reflect the well-known traditional roles of universities. One main challenge to include third mission indicators in rankings is the difficulties to capture these activities in quantitative measures (Daraio et al. 2015). Special efforts are required to broaden towards a process-oriented approach that includes new and appropriate indicators. Rankings are challenged by the need to develop indicators that capture the performance of the university and that, at the same time, are feasible to collect. Universities are also called to support these data collection process by improving their own internal information systems in the identified areas.

Our proposal of new indicators is a first attempt to develop third mission reflection in global university rankings. It is not a comprehensive list; rather it is a starting point to discuss the feasibility and desirability of broadening the approach from an outcome to a process perspective. This demands a more comprehensive and detailed data collection with reliable and up-to-date data sources; some of the information might be confidential in HEIs for what it is important to include universities in the debate.

To conclude, we call all involved stakeholders to critically contribute to what is desirable and useful to know. Rankings measure the quality and relevant performance factors of HEIs according to the demands and interest of their stakeholders. Thus, the debate pivots towards how important the third mission is in our society and, from there, how an entrepreneurial university needs to be reflected and communicated to stakeholders in a way that promote that role of universities in society.

Annex

Ranking	Third mission indicator	Description
U-Multirank	*Regional engagement*	
	Student internships in the region	Out of the students who did an internship, the percentage where the internship was with a company or organisation located in the region
	BA theses with regional organisations	Degree theses of bachelor graduates done in cooperation with organisations (industry, public, non-profit organisations) in the region
	MA theses with regional organisations	Degree theses of master graduates done in cooperation with organisations (industry, public, non-profit organisations) in the region

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Ranking	Third mission indicator	Description
	Regional joint publications	The percentage of department's research publications that list at least one co-author with an affiliate address in the same spatial region (within a distance of 50 km from the university)
	Income from regional sources	The proportion of external research revenues—apart from government or local authority core/recurrent grants—that comes from regional sources (i.e. industry, private organisations, charities)
	BA graduates working in region	The percentage of bachelor graduates who found their first job (after graduation) in the region where the university is located
	Student internships in region	Out of all the university's students who did an internship, the percentage where the internship was with a company or organisation located in the region
	Regional joint publications	The percentage of the university's research publications that list at least one co-author with an affiliate address located in the same spatial region (within a distance of 50 km)
	Income from regional sources	The proportion of external research revenues—apart from government or local authority core/recurrent grants—that comes from regional sources (i.e. industry, private organisations, charities)
	MA graduates working in region	The percentage of masters graduates who found their first job (after graduation) in the region where the university is located
	Graduates employment in the region	Percentage of graduates working in the region 18 month after graduation
	Strategic research partnerships in the region	The number of strategic research partnerships with partners in the region as a percentage of the total number of strategic research partnerships
	Knowledge transfer	
	Income from private sources	Research revenues from private sources as a share of total external research income

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Ranking	Third mission indicator	Description
	Co-publications with industrial partners	The percentage of a department's research publications that list an author affiliate with an address that refers to a for-profit business enterprise or private sector R&D unit (excludes for-profit hospitals and education organisations)
	Patents awarded	The number of patents assigned to (inventors working in) the university over the period 2001–2010
	Co-patents with industry	The percentage of the number of patents assigned to (inventors working in) the university over the period 2001–2010, which were co-applied with at least 1 applicant from the industry
	Publications cited in patents	The percentage of the department's research publications that were cited in the reference list of at least one international patent (as included in the PATSTAT database)
	Income from private sources	Research revenues and knowledge transfer revenues from private sources (incl. not-for profit organisations), excluding tuition fees. Measured in €1,000 s using Purchasing Power Parities. Expressed per academic staff
	Co-publications with industrial partners	The percentage of the university's research publications that list an author affiliate with an address referring to a for-profit business enterprises or private sector R&D unit (excludes for-profit hospitals and education organisations)
	Patents awarded (size-normalised)	The number of patents assigned to (inventors working in) the university over the period 2002–2011 (per 1,000 students)
	Industry co-patents	The percentage of the number of patents assigned to (inventors working in) the university over the period 2002–2011, which were co-applied with at least 1 applicant from the industry
	Spin-offs	The number of spin-offs (i.e. firms established on the basis of a formal knowledge transfer arrangement between the institution and the firm) recently created by the institution (per 1000 academic staff)

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Ranking	Third mission indicator	Description
	Publications cited in patents	The percentage of the university's research publications that were mentioned in the reference list of at least one international patent (as included in the PATSTAT database)
	Income from continuous professional development (CPD)	The percentage of the university's total revenues that is generated from activities delivering Continuous Professional Development courses and training
	Patents awarded (absolute numbers)	The number of patents assigned to (inventors working in) the university (over the period 2002–2011)
	Graduate companies	The number of companies newly founded by graduates per 1000 graduates
QS Graduate Employability Rankings	Employer reputation (30%)	Based on over 40,000 responses to the QS employer survey
	Graduate employment rate (10%)	Proportion of graduates (excluding those opting to pursue further study or unavailable to work) in full or part time employment within 12 months of graduation
	Partnerships with employers per faculty (25%)	Usage of Elsevier's Scopus database to establish which universities are collaborating successfully with global companies to produce citable, transformative research. In addition, it considers work placement-related partnerships that are reported by institutions and validated by the QS research team
	Alumni outcomes (25%)	QS identifies the alma maters of those individuals featuring in over 150 high-achievers lists, each measuring desirable outcomes in a particular walk of life
	Employer/student connections (10%)	Number of individual employers who have been actively present on a university's campus over the past twelve months, providing motivated students with an opportunity to network and acquire information
QS Rankings	Employer reputation ratio (10%)	Based on over 40,000 responses to the QS Employer Survey
MosIUR [university and society (30%)]	Online courses	The number of online university courses published on the biggest online global platforms

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Ranking	Third mission indicator	Description
	Website	Total pages of a university's website indexed by the leading search engines
	Alumni with Wikipedia articles	Number of the university's graduates with an individual article on Wikipedia
	Twitter	University's followers on social media
Reuters Top 100	Patent success (11.1%)	The ratio of patent applications to grants over the assessed timeframe. This indicates the university's success in filing applications that are then accepted
	Industry collaborative articles (11.1%)	The percentage of all articles of a university that contain one or more co-authors from a commercial entity. This indicator shows the percentage of research activity that is conducted in collaboration with industry, suggesting potential future economic impact of the research project jointly undertaken
	Industry article citation impact (11.1%)	Article-to-article citations are an established indicator of influence and research impact. By limiting the citing articles only to those from industry, this indicator reveals the influence and impact that basic research conducted in an academic setting has had on commercial research
CTWS Leiden	Co-authored publications with industry	P(industry) and PP(industry). The number and the proportion of a university's publications that have been co-authored with one or more industrial organizations. All private sector for profit business enterprises, covering all manufacturing and services sectors, are regarded as industrial organizations. This includes research institutes and other corporate R&D laboratories that are fully funded or owned by for profit business enterprises. Organizations in the private education sector and private medical/health sector (including hospitals and clinics) are not classified as industrial organizations
	Co-authored publications with universities and other organisations	P(collab) and PP(collab). The number and the proportion of a university's publications that have been co-authored with one or more other organizations

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Ranking	Third mission indicator	Description
THE	Industry income (2.5%)	A university's ability to help industry with innovations, inventions and consultancy has become a core mission of the contemporary global academy. This category seeks to capture such knowledge-transfer activity by looking at how much research income an institution earns from industry (adjusted for PPP), scaled against the number of academic staff it employs
ARWU	None	–

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The Entrepreneurial University: Linking Endowed Chairs to Regional Economic Development

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Abstract Endowed chairs and foundation professorships are considered essential bridges between industry and science as they represent a form of knowledge transfer and thus presumably a contribution to regional development. Literature reports a definite impact of knowledge transfer and University-Business Cooperation to companies' success. This chapter links the concept of endowed chairs to regional development. The majority of endowed chairs are located in economically strong regions. This leads to the thesis that there is a relationship between established endowed chairs and regional economic power. In turn endowed chairs can also accelerate scientific innovation in university departments by incorporating input from industry. Amongst other, these arguments support the strategic implementation of endowed chairs. The paper examines this connection between endowed chairs and regional economy by comparing the relative performance of two regions in Germany and one region in the US. Key regional development factors are identified and related to the kind and number of endowed chairs. Building on this information, the findings reveal, that there is clearly a connection—yet not evidence on a statistical correlation level.

Keywords Entrepreneurial university · Endowed chairs · Foundation professorships · UBC · University-business cooperation · Technology/knowledge transfer · Regional development

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Introduction

> "The function of the endowed chair was never more important than it is today. It serves as a financial resource for attracting brilliant and creative minds to explore both old and new spheres of learning and pass their knowledge on to posterity." (Schaeffer and Papalia 1966, p. 506)

Today, 50 years later, this quote about endowed chairs and their importance in terms of knowledge transfer is still relevant. While the Anglo-Saxon area exhibits an established tradition of endowed chairs, these were only introduced in Germany's higher education sector in the form of foundation professorships in the early 1970s (Frank et al. 2009). Scientifically, the term 'endowed chairs' is more common than its German analogue 'foundation professorships' and with regards to consistency, this paper will use the more common term 'endowed chairs'. Besides the verbal differences the two terms can be considered synonyms which will be displayed in the literature review. This literature review also tries to display the current state of research on endowed chairs which hints at a correlation between their establishment and regional economic development. But so far, no researcher could clearly prove this thesis or define which of the two components is triggering the other.

Therefore, this paper will examine if there is a connection or even a correlation between regional economic power and endowed chairs. For this purpose, three regions will be compared to identify the relative performance of regional development factors. Afterwards, there will be a comparison of the regions regarding endowed chairs and the extend of cooperation with industry. Towards the end of the chapter findings will be critically reflected to the hypothesis that a connection between regional development and the establishment of endowed chairs can be assumed. Research's limitations as well as further research close the chapter.

Literature Review

The similarity between the above mentioned foundation professorships and endowed chairs becomes obvious when looking at the concepts' characteristics: A holder of an endowed chair or a foundation professor is an academically successful professor who is engaged in teaching and research activities as well as performing services to external professionals (Rezaee et al. 2004). For both positions the funding is raised through third parties like enterprises, associations or individuals and is often directly linked to particular areas, such as industry sectors, special research topics or concrete purposes (Rezaee et al. 2004; Frank et al. 2009). Therefore, they are a good example of how entrepreneurial universities foster the creation, exchange and commercialization of innovative information, which is a key role of the entrepreneurial university (Corsi and Prencipe 2016). The only difference known here is that the financing of endowed chairs is secured in the long-term, whereas the funding of foundation professorships is

Table 1 Types of endowed chairs (Frank et al. 2009)

Type	Explanation
5 year-financed endowed chair	Becomes part of the universities budget later
Temporary endowed chair	Is not retained after 5 years of sponsorship
Guest endowed chair	Means an additional chair for up to 5 years
Junior endowed chair	Established for a period of 6 years to qualify a junior professor for inheriting a regular Chair, after the 6 years it is not retained
Junior endowed chair with Tenure-Track	After 6 years the chair becomes entirely part of the universities budget
Research endowed chair	Focusing on research for generally 5 years, financed by sponsors, professor still member of the university but does not get a salary
Co-professorship	A professorship is staffed in double contingent in the case of a chair replacement

secured temporarily finite (Frank et al. 2009). The greatest proportion of the sponsors (75%) is attributed to the enterprises (41.4%), the endowments (26.6%) and the research associations (8%) (Frank et al. 2009).

There are also distinct types of endowed chairs (Table 1).

The focus of endowed chairs is the importance of cooperation between academia and industry. This partnership arose from a new orientation of universities leaving the field of traditional teaching methods and heading towards a greater interest in economic structures, a focus on entrepreneurship and the new role as a facilitator for regional economic development and innovation (Galvão et al. 2018; Guerrero et al. 2016; Markkula and Kune 2015; Sam and van der Sijde 2014). For this rather new type of university the term "entrepreneurial university" arose in science around the end of the 20th century (Corsi and Prencipe 2016; Etzkowitz 1983). As Davey (2015) mentions, this newer educational character represents a movement towards the third generation university[1] (Davey 2015). Through the creation of more entrepreneurial universities and stronger ties with industry, universities have become anchor institutions in the regional setting and key drivers of innovation through university business cooperation as well as increasing the entrepreneurial spirit of students (Davey et al. 2018, Davey 2015; Galvão et al. 2018). This innovative impulse leads to more entrepreneurship, stronger business growth and also fosters the creation of synergistic effects (Bergman 2010; Davey 2015; Frank et al. 2009; Katz 2004). Those synergistic effects positively impact a company's performance and strengthen its competitive advantages which impacts regional development (Ketchen et al. 2016). In other words, the innovative structures fostered by entrepreneurial universities are regarded as indicators for regional economic development. Some others classified

[1]In the development of universities, the first-generation university is only known as a 'house of education' and the second generation became more modern already starting to embrace the role of research. Davey (2015).

more than 20 different types of universities which all contribute to the regional prosperity in one or the other way (Gjerding et al. 2006). A systematic literature review (Mascarenhas et al. 2017) underlines that universities are increasingly dedicated to the commercialization of knowledge.[2] This includes and refers to three types of Entrepreneurial Universities: 1 "Entrepreneurial Universities" focusing on changes in the university paradigm, 2 "Academic Entrepreneurship" referring to the commercialization of knowledge and 3 "Creation of Technology-Based Companies" focusing on spin-off creation (Mascarenhas et al. 2017).

Further, the Triple Helix thesis supports the importance of interactions between the university, industry and government (Davey 2015; Etzkowitz and Leydesdorff 2000; Markkula, and Kune 2015). It conducts that innovation and "economic development in a knowledge society lies in a more prominent role for university and in the hybridization of elements from university, industry and government […]" (Gibson et al. 2014; Ranga and Etzkowitz 2013). This view is supported by Corsi et al (2016) who as well point out that today's universities take over a new role in the economic processes and the innovative diffusion of know-how towards the places where it is needed (Corsi and Prencipe 2016). In this context, "[endowed chairs] are by no means the only but [nevertheless] an important instrument for strengthening this innovation factor 'cooperation' between science and industry." (Frank et al. 2009) This indicates that endowed chairs can be essential bridges between industry and science. Fostered through the existence of the entrepreneurial university which puts special focus on innovation and entrepreneurship, endowed chairs help to generate essential knowledge transfer (Guerrero et al. 2016). Therefore, universities are considered key agents in the entrepreneurship and innovation context as they are located on the intersection of education, research, and transfer of knowledge (Corsi and Prencipe 2016; Guerrero et al. 2016). The fact that the majority of endowed chairs are located in the economically strongest German states (Hamburg, Bremen, Bavaria, Baden-Wurttemberg) leads to the thesis that there is a certain linkage between regional economic power and endowed chairs (Baaken and Baaken 2017; Frank et al. 2009; Statistisches Landesamt Baden-Württemberg 2018). Back and Fürst (2011) support this thesis by stating that endowed chairs can contribute to the regional development which Hamm and Jäger (2013) also highlight. They found a correlation and bilateral benefit of endowed chairs for both the institutions as well as the industry (Back and Fürst 2011; Hamm and Jäger 2013). Back and Fürst (2011) also state that an effect of the transfer and networking in this context are spill-over-effects. As endowed chairs are direct linkages between industry and academia and thus a symbol for (regional) networking, endowed chairs generate spill-over-effects which have a positive impact on regional development (Back and Fürst 2011). Another advantage of endowed chairs are the scientific impulses which they give to higher education institutions from which the knowledge transfer to industry benefits and from which greater

[2]The literature review has been limited to regional development AND endowed or foundation chairs. Thus some fields in Regional Development have been left out: e.g. Innovation Districts (see for example Katz and Wagner 2014) or RIS3/ Regional Innovation Strategies (see for example Carayannis and Rakhmatullin 2014) because this has not created further relevant knowledge on the addressed topic.

economic strength might evolve (Hamm and Jäger 2013; Schuster and Elstermann 1990). Furthermore, endowed chairs can lead to accelerated scientific innovation in sundries university departments (Schuster and Elstermann 1990). All these findings are supported by the definition of Guerrero et al. (2016) regarding the tasks of an entrepreneurial university making the point that especially a university with this orientation contributes to innovation, competitiveness and economic growth which are essential requirements for creating wealth in the globalized and competitive society (Guerrero et al. 2016). Apart from others, these arguments justify installing endowed chairs against the critics who proclaim restrictions in the freedom of teaching and excoriate the operating of contract research (Frank et al. 2009).

Summarizing the literature review, a relation of economic development and university business cooperation is proven by scientists in this field. Yet one type of such cooperation between universities and industry are endowed chairs and this connection has not been verified so far. In the following the research framework will be outlined and the regions for exemplarily analyzing the topic are chosen. Afterwards, each region will first be investigated regarding specific regional development factors and second regarding the situation of endowed chairs and higher education in this region to shed a light on the relevance of endowed chairs in the context of regional economic development.

Framework and Selection of Regions

Framework of the Research

As mentioned before, the main component of this research's analysis is the connection between regional economic development and the establishment of endowed chairs. In literature, some authors assume that endowed chairs are beneficial for the development of a region, but it could not be related to further details how this connection is expressed. Is it a mutual interconnection and a strong economic development also leads to more endowed chairs in the region or do only the endowed chairs benefit from deep cooperation with industry? To add a deeper understanding to the existing literature, this research will use a comparison method. At first, three pre-defined regions are compared according to a set of economic factors. Afterwards, the same regions are analyzed towards their higher education institutions and the number of endowed chairs they hold. By comparing these findings, the aim is to understand whether a certain connection of the two subjects can be supported (Fig. 1).

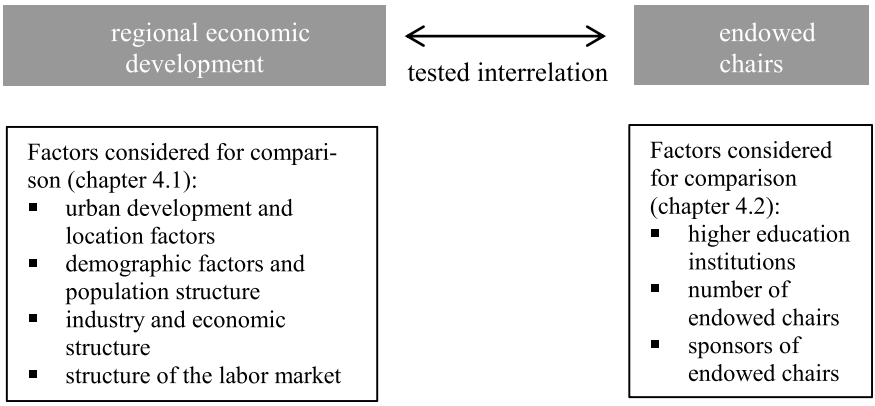

Fig. 1 Conceptual framework

Defining Three Regions for Comparison

For the analysis of the thesis "endowed chairs and the regional development may interfere", the focus in this paper will lie on the two German regions, namely Southern Lower Saxony (SLS) and Ingolstadt region (IR), as well as South Carolina (SC) in the US. Since Bavaria is among the strong economies in Germany it might be a good example for testing the thesis (Statistisches Landesamt Baden-Württemberg 2018). SLS will be added for comparison as well, to show the situation in a state which is economically ranked in the middle (Statistisches Landesamt Baden-Württemberg 2018). In case the findings are significantly different, this also adds to the hypothesis. In contradistinction to the German states, the boarders of regions are not generally applicable. There are 4 statistical regions in Lower Saxony, but either of them is divided into several sub-regions (Eichhorn et al. 2007). Based on a map of the journal "Wissens-Region Göttingen", SLS is defined by the five rural districts Göttingen, Northeim, Osterode am Harz, Goslar and Holzminden (Cassing 2014). SLS is a special region because the emigration variance between 1990 and 2013 is the highest throughout Lower Saxony. Only the county seat Göttingen succeeds in keeping the population on a relatively constant level. However, until 2035, the development is predicted worse. The whole region will lose more than 10% of its population compared to 2013, including the county seat Göttingen (Grünheid 2015). Another problem of SLS is the demographic change; this particularly applies to the rural district Goslar which has one of the highest numbers of senior citizens nationwide (Eichhorn et al. 2007). But the whole SLS region's population is higher and equal to 44.8 years which also represents the population with the highest age throughout Lower Saxony (Landesamt für Statistik Niedersachen 2016). Due to this, it is even more important for the region SLS to establish linkages between industry and academia to enhance regional development.

The second region being discussed in this paper is the Ingolstadt region, which represents one out of 18 regions of the federal state Bavaria in Germany. The regions in Bavaria are strictly fragmented. Ingolstadt region is subdivided into 4 rural districts; Eichstätt, Ingolstadt, Neuburg-Schrobenhausen and Pfaffenhofen a.d. Ilm (Bayrisches Landesamt für Statistik und Datenverarbeitung 2012). In contrast to SLS, IR will have a population growth of 7.5% or more until 2034 compared to 2014 (Bayrisches Landesamt für Statistik 2015b). It is also significant that the average age of people amounts 42.3 years which is 2.5 years under the average in SLS (Bayrisches Landesamt für Statistik 2015a). As of 31 December 2015, IR had 480,025 citizens and the county seat Ingolstadt 132,438 which is comparable to the number of citizens in SLS (665,522) and to the county seat Göttingen (117,665), which is one reason why IR is taken into account in this paper (Bayrisches Landesamt für Statistik 2015c; Landesamt für Statistik Niedersachen 2016). Another reason for considering IR is its location in Bavaria which boasts the highest number of endowed chairs throughout Germany and also shows a strong regional development (Frank et al. 2009). This means that the IR represents a region in Bavaria which may be economically strong and thus contributes to a distinct result of investigating the hypothesis and comparing the two regions.

For adding a more diverse perspective to the research question, insights from a foreign region will be added to the comparison of the German picture. The country chosen for comparison are the United States. Here, the concept of endowed chairs has enormously grown in importance and is predicted to continue this development in the future. Further, the distance to Germany and therefore also the contrast in the economic and business environment is higher than in comparison to another European state (Katz 2004). This offers good conditions for adding to the German findings and come to a more general conclusion in this paper. Since endowed chairs in the US, just as foundation professorships, also foster the cooperation between universities and companies and are showing same characteristics, it is assumed that the information given in the US American context can be compared to the German foundation professorships. The region chosen for comparison with Germany is the US State South Carolina (SC) which is in the southeastern part of the country and is defined by its state borders. Although it is geographically one of the smallest states in the US, South Carolina is characterized as strongly populated and known for good economic activity, including also start-up activity, as well as a rapid growth of the job market and is currently ranked third best state for doing business in (Desjardins 2018; Kiersz 2018; U.S. News & World Report L.P. 2018). Adding an economically strong foreign region to the comparison can add to the thesis that the linkage between economic power and endowed chairs exists. Although South Carolina is not the strongest economic power in the US, it is repeatedly mentioned that it currently features one of the fastest increases in investment. Furthermore, especially the increase in the labor market is noticeable when compared to the size of the state (Buss 2018; Kiersz 2018). The population level of SC is regarded as densely populated and steady growth is predicted by an annual growth rate of 1.28% (World Population Review 2018b). Comparing the population of 2010 with the predicted population in 2020, South Carolina will gain a total of 12.81% more inhabitants which is higher than

the growth rate in IR for example (World Population Review 2018b). The average age is 37 years which is relatively young compared to both German regions showing average ages above 42 years minimum. Whether the difference in age influences the situation of endowed chairs might not be statistically relatable, however, a young population can be the trigger for more innovation leading to sustainable economic growth (Wagner and Compton 2015). In this context, concepts such as endowed chairs and university business cooperation gain even more importance as they foster the development of innovative ideas. Further information on the regional development will be given in the paragraph below. Still, this generally strong economic position within the US justifies the choice of South Carolina as a comparable region. Moreover, endowed professorships play a significant role in SC. They introduced a specific program dealing with university business cooperation and endowed chairs, the SmartState Program. Having a closer look at this initiative helps to examine the existence of endowed chairs in SC as well as the potential influence on the regional development which is another reason why South Carolina was chosen for comparison.

In the following abstract, regional development factors (structure of urban development, the economic structure as well as the population development and the employment market) of the SLS region, IR as well as SC will be analyzed with the objective of investigating the economic power within the regions and being able to compare them. All mentioned factors constitute determinants for development (Domhardt et al. 2009). Hence, a conclusion about the economic situation can be drawn which is then put into relation with the topic of endowed chairs in the regions.

Results and Discussion

Highlighting the Region's Economic Development

Structure of Urban Development and Location Factors

There are several location factors, like the structure of urban development, which are at the same time dimensions for gauging regional living conditions—these correlate with the regional development (Ahlke et al. 2012). Due to a relation between the regional resources, location factors, and the "firms' innovation ability and competitiveness" economics does not only focus on the people but on locations and places like urban development (Isaksen 2016). Another aspect that delivers insights about the urban development is the population density of an area (Table 2).

It can be summarized from the table that the urban development differs within all the regions' districts. Especially the existence of rural up to urban regions illustrates the difficulties the regional politics must cope with. Concerning the settlement structure, Göttingen and Ingolstadt are the regional metropolises of SLS and IR and a special focus is relied on them. The state of South Carolina consists of 46

Table 2 Urban structure and population density in the regions. (DeStatis 2014; Landesamt für Statistik Niedersachen 2016; Regionaler Planungsverband Ingolstadt 2016; South Carolina Association of Counties [SCAC] 2018; World Population Review 2018a, b, c)

Location	Urban structure	Population density
Ingolstadt	Urban	
Pfaffenhofen a.d. Ilm	Densely populated, urban	
Neuburg-Schrobenhausen	Rural	
Eichstätt	Rural	
IR		169 citizens/km^2
Bavaria		
Göttingen	Densely populated, urban	224 citizens/km^2
Osterode am Harz	Rural	
Holzminden	Rural	
Northeim	Rural	
Goslar	Densely populated, urban	
SLS region		138 citizens/km^2
Lower Saxony		
Germany		227 citizens/km^2
Columbia	Urban	380 citizens/km^2
SC region		61 citizens/km^2
US		35 citizens/km^2

smaller counties ranging in population from roughly 10,000 inhabitants up to around 400,000 people (SCAC 2018). As it can be seen in the figures, most people settle in the larger cities like Columbia where the population density is high. Compared to Germany, the total area of the region is by far larger than the ones chosen for comparison which makes the overall population density lower than the German average. But especially in the capital city the calculated density shows how populated South Carolina's metropolis is in comparison to the metropolises in the German regions.

Demographic Factors and Structure of Population

Demographic change is considered a long and global process where the population is shrinking, people are living longer and changes in population structure appear, thus these changes are and will rather be incremental than radical (Grünheid 2015; Weber 2010). The reasons for demographic change (in Europe) are mainly low fertility rates, increasing life expectancy and a restrictive migration policy; whereas of course regional disparities exist (Bausch 2016). Another dimension of the demographic change constitutes the old age dependency ratio, the number of persons aged 65 years and higher calculated per 100 persons aged 20–64 years. This figure indicates how

Table 3 Regional population development and demographics (Ahlke et al.2012; Bayrisches Landesamt für Statistik 2015c; File and Kominski 2009; Grünheid 2015; Landesamt für Statistik Niedersachen 2016; World Population Review 2018b)

Location	Impact of demographic change	Old age dependency	Population development
IR	No sustainability problems predicted	***29***	Population growth of 10–20% from 1990 until 2013 and same growth rates until 2025
Bavaria		**33**	
SLS region	Severely affected		10% loss between 1990 and 2013 and another 10% loss until 2035
Lower Saxony		**36**	
SC region	No severe consequences predicted but assumed that the population above 65 years will exceed national average by the time of the next census	***22***[a]	Steady annual growth of ~1% p.a. in the last 10 years (calculated 15%) and further 12% growth until 2025

[a] *Data from 2009*

many old people who mostly do not work and therefore do not contribute to the economic wealth anymore, are dependent on the working society (Table 3).

Because of the strongly decreasing population in the SLS region, the sustainability of infrastructural facilities is highly endangered both now and in the future, this is rather unusual for the former Western German states (Ahlke et al. 2012). In contrast, IR currently does not have and will neither have future sustainability problems with infrastructural facilities (Ahlke et al. 2012). When putting focus on SC again, the natural growth rates are staying extremely healthy (World Population Review 2018b). Compared to the German figures, the situation in SC seems to be more positive, with less elderly people being dependent on the younger ones.

Industry and Economic Structure

The gross domestic product (GDP) per inhabitant is a measure for economic activity in the respective regions but it cannot be used as a measure for prosperity as commuter flows influence the result heavily (Bayrisches Landesamt für Statistik 2015c). Municipal debts are another factor for indicating the economic structure and the Gini-Index represents a third factor since it is used for showing economic inequality by measuring the income distribution among a population[3] (International Labour Organization 2016).

[3]The Gini Index can range from 0, when all residents would have the same income, to 1, meaning that one resident in the country earned all the income while everyone else earned nothing.

As the figures in Table 4 show, the center of economic activity in IR is clearly the city of Ingolstadt. The average GDP per inhabitant in Lower Saxony is well below the average of the Bavarian state which shows the economic differences between the German regions. The center of economic activity in the SLS region is as well the county seat Göttingen. Looking at the GDP, SC is sorted between the two German regions and is economically better situated than SLS although it is mentioned in various sources that the GDP per capita is a weak point in SC economy being one of the lowest among all US states (Kiersz 2018) However, since 2008 South Carolina's GDP experiences a steady growth (Countryeconomy.com, n.a.). Taking also the municipal debt rates into account, IR is still evincing very low debts which supports its strong economic status. Also, SC shows very low debts which adds to a positive economic picture. Conversely, Lower Saxony has an average debt per inhabitant which is much higher than the other regions. Here one can easily recognize the differences within the regions. The Gini-Index is calculated by states in Germany, so Lower Saxony and Bavaria are representing the two German regions. They show that the income structure in Germany is rather equal. Looking closely at the figures it is seen that the values stayed constant for more than 10 years which indicates an established income situation within the German states. For SC the Gini Index stayed more or less constant in the last 7 years but in comparison with the other US states SC is at rank 33 with Alaska having the lowest Gini Index of 0.408 (United Health Foundation 2018). As stated by the Organization for Economic Cooperation and Development (OECD), most developed European states and Canada show Gini Indices between 0.22 and 0.38 striving towards higher income equality (United Health Foundation 2018). Considering the German figures, the OECD's statement of higher income equality in developed European states can be supported (Statistische Ämter des Bundes und der Länder 2017). SC's index in contrast shows that here income distribution is more inequal (United Health Foundation 2018).

Table 5 gives an overview of the industries representing each of the compared regions.

Most of the economic activity is based in the regions' capital cities and county seats. In this aspect, all three regions show a certain expertise is their industrial fields. It will be explained in greater detail later that some of the most prominent companies driving the regions' economies are engaging in the cooperation with universities.

It can be summarized for industry and economic structure that every region shows a high density of well-established companies. The GDP average in SLS as well as in SC is lower than the IR but the significance of this information is limited because the purchasing power parity is not considered. The debts in the SLS region are much higher than in IR. SC is sorted among the least indebted regions and overall, cuts a good figure in this abstract.

Table 4 Indicators for the region's economic structure (Bayrisches Landesamt für Statistik 2015c; Countryeconomy.com, n.a.; Landesamt für Statistik Niedersachen 2016; Norcross and Gonzalez 2017; Statistische Ämter des Bundes und der Länder 2017)

Location	GDP/ inhabitant	Municipal debts	Gini-Index
Ingolstadt	€123.014	€134	
Pfaffenhofen a.d. Ilm	€34.949		
Neuburg-Schrobenhausen	€30.707	€442	
Eichstätt	€28.123		
IR			
Bavaria	**€41.646**	**€815**	**0.29**
Göttingen	€31.330	€713	
Osterode am Harz	€28.295	€1.509	
Holzminden	€27.786	€472	
Northeim	€24.372	€1.151	
Goslar	€24.632	€759	
SLS region			
Lower Saxony	**€31.135**	**€1.083**	**0.28**
Germany			**0.29**
SC region	**€37.987** ($44.162)	**€546** ($635)	**0.474**

Table 5 The region's industry structure (Regionaler Planungsverband Ingolstadt 2016; Regionalverband Südniedersachen e.V. 2016; South Carolina Department of Commerce 2018)

Industry IR	Industry SLS	Industry SC
• Automotive (Audi) • Aerospace (Airbus) • Food production (HIPP) • Electrical retailer (Media-Saturn Group) • Construction and mechanical engineering (Bauer Group) • Oil processing industry	• Optoelectronics (Qioptiq Photonics) • Production measurement technology (Mahr) • Orthopedics (Otto Bock) • Pharmaceutical and lab equipment supplier (Sartorius) • Plant breeding and biotech (KWS) • Logistics (PEMA) • Electronic (Stiebel Eltron) • Joining technique (KAMAX)	• Advanced manufacturing (Samsung, GE, Husqvarna) • Advanced materials (Cytec, Teijin, Sigmatex) • Aerospace (Boeing, GKN Aerospace) • Agribusiness (Kraft Heinz, Starbucks, McCall Farms) • Automotive (BMW, Bridgestone, Magna, Volvo, Mercedes Benz) • Distribution and logistics (Amazon, Dollar Tree, Walmart) • Life science (Bausch + Lomb, nephron) • Shared services (Lash Group, Comcast, red ventures)

Structure of the Labor Market

In Germany, the central indicator for the labor market is the unemployment rate. It has been found that regions with a low rate attract young people whereas regions with a high unemployment rate promote emigration (Ahlke et al. 2012) (Table 6).

While SLS region shows figures above the German average unemployment rate, the situation in IR is quite different, highlighting the better economic situation of IR which could be seen in other aspects as well. Concerning the structure of the labor market in South Carolina, the assumption that regions with low unemployment rates attract young people might not be supported for SC in the first hand. Still, South Carolina's attractivity as job location is undoubtedly given because it is ranked relatively high in economic activity, there are many attractive industries operating in the state and it experiences an increase in jobs (Desjardins 2018; U.S. News & World Report L.P. 2018).

All in all, the employment structure in IR is the healthiest one in this comparison whereas SLS shows indicators for a worse economic structure again.

Before comparing the three regions in terms of the engagement in endowed chairs and university industry cooperation, the previous chapter will be summarized. The table below shows the three above-mentioned economic categories and each region is evaluated according to the economic strength that can be assumed from the findings. Hints at a string economy are classified ++ whereas – indicates which region is ranked least in the comparison (Table 7).

Table 6 Unemployment rate in the regions (Ahlke et al. 2012; Bundesagentur für Arbeit Statistik, Arbeitslosigkeit, Unterbeschäftigung und gemeldetes Stellenangebot 2016a, b; Bureau of Labor Statistics 2018; Center for American Progress 2018)

Location	Unemployment rate
Ingolstadt	3.0%
Pfaffenhofen a.d. Ilm	1.7%
Neuburg-Schrobenhausen	2.0%
Eichstätt	1.3%
IR	***2.0%***
Bavaria	**3.2%**
Göttingen	5.8%
Osterode am Harz	
Holzminden	
Northeim	5.8%
Goslar	
SLS region	***6.4%***
Lower Saxony	**5.8%**
Germany	**5.8%**
Columbia	
SC region	***4.2%***
US	**3.8%**

Table 7 Key economic categories of the respective three regions

	IR	SLS	SC
Urban development and location factors	+	–	+
Population structure and demographics	++	–	+
Industry and economic structure	++	–	+
Labor market	++	–	+

All in all, it can be said that SLS shows the weakest economic position in the comparison of the three regions. It has the lowest density of a population which will even be affected severely by demographic change. Further, the unemployment rate in this region is the highest among the compared ones and the region is highly indebted. Regarding the GDP it is comparable to SC, but this does not make up the difficult situation in other areas. In contrast, the overall figures of SC and IR are better in all mentioned categories. Especially IR shows a high GDP, very low debts and a low unemployment rate. Also, the demographic situation is supposed to be stable in the future. Therefore, IR has been set on rank one in the comparison followed by SC which also presents a stable economy and SLS on rank three.

Highlighting Endowed Chairs and Higher Education Institutions in the Regions

In SLS and IR the important types of endowed chairs are the junior endowed chair with Tenure-Track, the research endowed chair and the temporary endowed chair. Most of the endowed chairs in Germany are located in universities and only a fourth is located in universities of applied sciences (Frank et al. 2009). To analyze if there is a correlation between the economic development and endowed chairs it is suitable to see if sponsors are situated in the region or if there are also supra-regional sponsors. As mentioned above, the most important institution regarding endowed chairs in SC is the SmartState program founded by the government in 2002 (Smart State 2017). This supports the scientific context that governments all over the world assign a new role to the entrepreneurial universities by pushing them to be more entrepreneurial wherever this is possible (Corsi and Prencipe 2016). The SmartState program funds each of its 'Centers of Economic Excellence' which are industry focused and include the development of endowed chairs with the aim to foster an advancement of South Carolina's economy (Smart State 2017). Many companies located in SC are engaged in the program which leads to a large investment in research and a lot of science business cooperation with many jobs attached to it. As stated by the program website, SmartState "has been a true catalyst for economic development" (Smart State 2017) assuming the existence of a correlation between endowed chairs and regional economic development in South Carolina. This practical finding supports Corsi et al. that a region's innovative capability, named as one factor for economic development, is

Table 8 Higher education institutions in the regions

	Higher education institutions	Inhabitants per one higher education institution
IR	• Catholic University Eichstätt-Ingolstadt • Technical University Ingolstadt	240,000
SLS	• Georg-August-University (incl. Medical Center) • University of Applied Sciences Göttingen • University of Applied Sciences and Arts (HAWK) • Technical University Clausthal • University of Cooperative Education Göttingen	110,000
SC	• Clemson University • Medical University of South Carolina • University of South Carolina	1,674,789

extremely benefiting from academic entrepreneurship, e.g. through endowed chairs (Corsi and Prencipe 2016).

Number and Character of the Institutions in the Three Regions

The table below illustrates which higher education institutions operate in the three regions. The calculation of number of inhabitants per one institution can be an indicator for how well a region is able to satisfy the demand for research and teaching (Table 8).

In SLS the institutions character is mixed, showing both universities and universities of applied sciences. In IR as well as SC there are only universities among the higher education institutions. For SC the three universities have been considered which form part of the SmartState program and use the funds raised to create research and endowed chairs (Smart State 2017). It is mentioned that the SmartState Program and its innovation potential helped the universities to attract high class scientists from Harvard, Georgetown, New York, Pennsylvania and other high-class universities to take over an endowed chair and change SC's economic development (Smart State 2017).

Number and Subject of Endowed Chairs in the Three Regions

In every region, several active endowed chairs could be found (Table 9).

Compared to the number of active endowed chairs in Germany, South Carolina offers many more endowed chairs which might be referred to the larger size of the state and its research institutions. Also, bundling all endowed chair activities in a

Table 9 Active endowed chairs at the institutions (Smart State 2017)

		Active endowed chairs
IR	• Catholic University Eichstätt-Ingolstadt • Technical University Ingolstadt	3 6
SLS	• Georg-August-University (including Medical Center) • University of Applied Sciences Göttingen • University of Applied Sciences and Arts (HAWK) • Technical University Clausthal • University of Cooperative Education Göttingen	6 2 2 – –
SC	• Clemson University • Medical University of South Carolina • University of South Carolina	13 33 25

large state raised program might eventually lead to more third-party engagement, greater amounts of financing and the chance to create more endowed chairs from it (Table 10).

The SLS and Ingolstadt regions both exhibit a particularly high number of endowed chairs per inhabitant in relation to the German mean value. This can be explained since Bavaria is ranked the German state with the highest number of endowed chairs and Lower Saxony is at rank 6 (Frank et al. 2009). Adding South Carolina to the comparison of German endowed chairs per inhabitant, SC is located above German average but below the average in the other two regions. Therefore, the apparently high number of endowed chairs is not too large compared to the number of people living in SC. The total number of endowed chairs in the US was not added for comparison since there is no source displaying all endowed chairs in an overview. The effort to count each endowed chair from each American university would have been too large compared to the result it had delivered in this paper.

The content of endowed chairs is often directly linked to the sponsors as it can be seen in the examples displayed in the appendix. This direct linkage might be explicable through the fact that a positive research outcome is expected, and the sponsors would like the chairs to be useful for their own context. But there are

Table 10 Number of endowed chairs per million inhabitants (Servicezentrum Stiftungsprofessuren 2016; Smart State 2017)

	Endowed chairs	Inhabitants (mio)	Endowed chairs/ inhabitants (mio)
Germany	1000	82	12.19
SLS	10	0.65	15.38
IR	9	0.48	18.75
SC	71	5.03	14.12

also endowed chairs where the linkage between sponsor and professorship is not too obvious, for example the endowed chair "law" and the Evangelical Church in Germany, which would require further information about the content of the lectures. Most often the sponsors also form part of the central industries in the regions although there are also exceptions here when a company is not located in the region but still sponsors university business cooperation and regional research.

It can be summarized that the region IR proportionally offers most endowed chairs per inhabitant and per higher education institution. The SLS region also registers more endowed chairs than the German average, but in contrast to IR, there are higher education institutions which exhibit no endowed chair at all. Both regions have in common, that the regional sponsors of endowed chairs are crucial for the regional economic industry. The comparison to SC shows that the large companies in the region are also active in the field of endowed chairs and that not only the research institutions but also the state's government are focused on such cooperation. The overall aim is to strengthen the regional development of South Carolina and build a strong competitive position in emerging high-growth industries (Smart State 2017).

Conclusion and Further Research

The aim of this chapter was to identify if there are connections between economic development and the engagement of entrepreneurial universities in establishing endowed chairs. For this purpose, comparisons in different fields have been made. The structure of urban development and quantifiable location factors are nearly the same in the two German regions. Regarding SC, the geographical size of the state and the population density in the capital cities show a difference to Germany. Nevertheless, the rural and urban structures might be comparable in their appearance.

All in all, it was shown that the economic structure in IR is very developed and above German and even Bavarian average. SC region can also be regarded as economically strong. Although some of the measures are below US average, especially the regional development can be regarded as healthy and is more comparable to IR than to SLS which has obviously been the weakest economic region in this comparison.

Nevertheless, SLS showed activities in the development of endowed chairs and works with a variety of sponsors to foster university industry cooperation. Therefore, this region is a special case in terms of the hypothesis that a well-developed economic situation interrelates with the appearance of endowed chairs. In SLS, the economic development is considered average or slightly below, but the number of endowed chairs is higher than the German average, not as high as in IR but still high. The findings for IR suggest supporting the assumption that endowed chairs do have an impact on regional economic development. The region is very well developed, and the number of endowed chairs is well above German average. This also holds true for South Carolina. If a healthy economic development and, at the same time, the existence of a considerable number of endowed chairs deliver a hint for the assumed correlation between the two, SC's figures help to support the hypothesis.

Nevertheless, the scientific proof for this interconnection is very vague and should be examined further. A thorough analysis of many regions (in Germany) must be made to see if the hypothesis is defensible or not. Especially the question whether the region's economic development influences the creation of endowed chairs or vice versa could not be answered scientifically. However, this paper suggests a correlation between the crucial industries in the regions and the sponsorship and subjects of the established endowed chairs. In this context, the directors of the SC SmartState Program exclaim that since the development of the program, regional and economic growth could be generated. The quote that the cooperation program SmartState "has been a true catalyst for economic development" has to be highlighted again (Smart State 2017). Lastly, the term entrepreneurial university should be pointed out again. Based on the findings it must be assumed that the presence of endowed chairs and university business cooperation in the regions is dependent on the entrepreneurial orientation of the universities here. Probably a region could not exhibit such a noticeable number of research cooperation if the universities did not develop this innovative and entrepreneurial character. These assumptions lead the discussion into a possible direction and open potential for building further research hypotheses upon the basis laid by the paper at hand.

As a limitation of this paper the availability of literature must be mentioned since the topic endowed chairs has so far hardly been researched. There is no official registration and precise governmental definition of endowed chairs neither in Germany nor the US. Another limitation was the restriction to the factor regional development due to the capacity of the paper. It could be possible that regional development is one out of many factors correlating with endowed chairs but extending the research in his paper to other topics could not be realized. Still, this paper adds considerably to the current literature on endowed chairs and opens new directions for further research in the field of their correlation with regional economic development.

Appendix: Foundation Professorships in the 3 Regions

Higher education institution: Catholic University Eichstätt-Ingolstadt Total no. active: 3
• **Foundation professorships in the past (sponsor)**
– Junior foundation professorship "Qualitätsentwicklung und Evaluation in Einrichtung des Gesundheits- und Sozialbereichs", bis 2016, (n.s.)
• **Active foundation professorships (sponsor)**
– Foundation professorship "bioethics" (does not want to be mentioned)
– Junior foundation professorship "didactics of ethics" (Katholische Militärseelsorge)
– Foundation professorship "Heisenberg professorship for catholic theology" (Deutsche Forschungsgemeinschaft)
• **Upcoming foundation professorships (sponsor)**
– Foundation professorship Prinz Max von Sachsen "Theology christian orient" (not yet known)
Higher education institution: Technical University Ingolstadt Total no. active: 6
• **Active foundation professorships (sponsor)**
– Research foundation professorship " vehicle safety and signal processing" (AUDI AG)
– Foundation professorship "procurement management and another subject in business administration" (AUDI AG)
– Foundation professorship "system technology in safety-oriented applications" (EADS Deutschland)
– Other 3 foundation Professorships n.s.
Total number of foundation professorships in IR: *9*
Higher education institution: Georg-August-University Total no. active: 6
• **Active foundation professorships (sponsor)**
– "Technical methodology Chinese" and "East Asian studies/China" (Hanban, NOTCFL)
– "Modern China with a focus on global historical perspectives" (Volkswagen AG). May be related to their corporate archive or the Volkswagen site in China
– "Cognitive neurology". (Hermann and Lilly Endowment). The funder is also a residential and nursing home and the research they sponsor is linked to dementia research
– "Agricultural law with the focus on Law of rural areas". (Rentenbank). The Rentenbank is an agency for agribusiness

(continued)

(continued)

Higher education institution: University of Applied Sciences Göttingen Total no. active: 2
• **Active foundation professorships (sponsor)**
– "Business administration, especially entrepreneurship and finance". (Otto Bock)
– "Business administration, especially tourism management and controlling". (TUI AG)
Higher education institution: HAWK Total no. active: 2
• **Active foundation professorships (sponsor)**
– "Green building, especially building technology". (Stiebel Eltron)
– "Entrepreneurship". (Sparkasse Hildesheim)
Total number of foundation professorships in SLS: 10
Higher education institution: Medical University of South Carolina Total no. active: 33
• **Active foundation professorships (sponsor),** e.g.
– Endowed chair in stroke (REACH stroke network)
– AT&T distinguished endowed chair in cancer equity
– Endowed chair in medicinal chemistry (n.s.)
Higher education institution: Clemson University Total no. active: 13
• **Active foundation professorships (sponsor)**, e.g.
– Endowed chair in optical fibres (J.E. Sirrine)
– Michelin endowed chair in vehicle electronic systems integration (NSF, DARPA, ARO, etc)
– Endowed chair in urban ecology and restoration (n.s.)
– Other 3 foundation professorships n.s.
Higher education institution: University of South Carolina Total no. active: 25
• **Active foundation professorships (sponsor)**, e.g.
– Endowed chair for polymer Nano-composite Research (National Science Foundation, U.S. Department of Energy, BASF)
– Endowed chair in advanced materials and nuclear power (Duke Energy, SCE&G, Westinghouse)

Total number of Foundation Professorships in SC: 71
(visit the source for information on other chairs)
Source Own Survey (n.s. = not stated); (Smart State** 2017**)

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Part III
The Relationship Perspective

The Engaged and Entrepreneurial University: A Model for Success for Smaller Programs

Stephen C. Betts and Michael D. Santoro

Abstract In this chapter we offer a model for the development of engaged and entrepreneurial relationships from the university's perspective, where we concentrate largely on smaller university programs and their partners. We start by describing engaged and entrepreneurial universities and then move on to how they build relationships with outside partners. Many of the processes driving the formation of dyadic relationships between universities and firms are often inefficient and unclear (Calcagnini et al. in Small Bus Econ 46(1):31–43, 2016). We therefore utilize the general stages of group development (Tuckman in Psychol Bull 63(6):384–399, 1965) which have been examined and explored as a building block for our proposed process model for university-industry collaborative relationships. Following Santoro and Chakrabarti (Res Policy 31:1163–1180, 2001) typology, we focus on industrial firms that are considered 'Targeted Players'; small firms, often with limited resources that need problems specific to their business solved within a relatively short time horizon. We then discuss process spanning issues and conclude with implications for theory, practice and future research.

Keywords Engaged universities · Entrepreneurial universities · Tuckman model · I/U collaboration · Targeted players

Introduction

Significant attention has been paid to the formal and informal networks that universities and their industrial partners form and operate within. The importance of these networks along with maintaining a balance between competition and cooperation has long been recognized (Carayannis and Alexander 1999). However specific outcomes of university-industry relationships (which will now be referred to as U/I

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relationships) occur at the dyadic level between specific researchers and external constituents. Thus, many recent calls stress the need to shift towards examining the underlying dyadic partnerships (Lakpetch and Lorsuwannarat 2012) and the small groups that actually create these partnerships and conduct the collaborative efforts.

Research has concentrated on large research programs with a focus on big projects and initiatives (Link and Rees 1990). However many smaller programs exist and many schools wish to participate in entrepreneurial activity at a limited level. There are also small industrial partners that would be interested in the benefits of collaborative relationships with universities (Acs et al. 1994; Santoro and Chakrabarti 2002). The processes by which these university programs of limited size and scope establish and maintain relationships with smaller industrial partners is the focus of this chapter. We also address the concept of engagement as one form of entrepreneurial activity that is particularly suitable for smaller university programs and their industrial partners.

We therefore offer a model for the development of engagement relationships between smaller university programs and their partners. We will include various types and scopes of activities employed by engaged and entrepreneurial universities and the partners that they work with to carry out these activities, where our main focus of attention is at the small team level within specific interfirm dyads. We know that using a set of established procedures to build teamwork accelerates progress (Burnside and Witkein 2008), yet often, no such set of procedures is available and the underlying process in forming dyadic relationships between the firm and university is unclear or inefficient (Calcagnini et al. 2016). We therefore propose a process model for forming, maintaining, and renewing relationships that will help U/I partners identify sticking points, develop appropriate protocols, and set mutually beneficial objectives. Our model will take into account the idea that researchers use different definitions of success that lead to micro strategies (Bjerregaard 2009). Unfortunately there is often great difficulty in measuring the performance of research collaborations (Philbin 2008), as a result we will identify general approaches and delineate various circumstances where different objectives and measures can be employed. We use the terms partners and collaborators interchangeably referring to university-industry dyadic relationships.

Moreover, contingencies and process spanning issues must also be considered. We will explore ways in which universities align with these contingencies and their constituents and how these intersect with the value-creating activities these collaborative U/I ventures undertake. For example, prior research indicates that communication facilitates the identification of common needs and interests, particularly for university and industry relationships (Dueñas Quintero and Oliva 2015; Frasquet et al. 2012) since it helps facilitate trust and commitment (Frasquet et al. 2012). Geographic Proximity (Garcia et al. 2013), openness to new ideas (Moilanen et al. 2015), cultural fit, the role of champions (Plewa and Quester 2008), as well as institution size, mission, funding level, and history (Santoro and Chakrabarti 2002). These are also considered in our overall treatise.

In the following sections of this chapter we begin by describing engaged and entrepreneurial universities, we then offer our proposed process model of U/I Team Development, and conclude with implications for theory, research, and practice.

Engaged and Entrepreneurial Universities

Academic engagement and entrepreneurship suggests an emphasis on the value-added contributions of a university to the business community and to society at large (Chia 2014). Although there is great current interest in this area, this notion is not entirely new. Many universities were founded long ago with strong community and local business ties (Decter 2009) where the emphasis has always been the "practical and direct contribution of university research to society" (Shibayama 2012). In the entrepreneurial university "there is a strong emphasis on academic (i.e., theoretical) knowledge to be used more effectively as a source of innovation and renewal in industry." (Styhre and Lind 2010) and these objectives be achieved through commercialization (Jonsson et al. 2015). However many universities, referred to as engaged universities, accomplish these contributions not by commercialization but where some combination of professors, students, and members of supporting/supported organizations engage in the delivery of different services to external constituents such as consulting work to solve business problems and research projects to develop and exploit new technologies (Ramos-Vielba and Fernadez-Esquinas 2012).

Engaged Universities

Few universities below the top 25 will earn significant revenue from entrepreneurial activities (Turk-bicakci and Brint 2005), however U/I ties that do not bring the university direct revenue might be providing much needed and appreciated service to the community. This is the essence of our notion of engagement. Hikins and Cherwitz (2010) describe engagement as "productive coupling of the academy's intellectual resources with the enterprise of generating solutions to current real-world challenges."

Engaged universities certainly look to disseminate knowledge however for the most part they are not very involved with commercialization (Jonsson et al. 2015). Rather, they support their communities with other activities such as joint research projects, commissioned work, consulting, and training (Ramos-Vielba and Fernández-Esquinas 2012). The university can use the community as a lab to test out new ideas, especially those involving social causes and economic goals (Breznitz and Feldman 2012) and in turn, this type of community based service learning (Hamner et al. 2002) can serve to benefit both students and outside stakeholders. Another advantage of being involved with their communities is that engaged universities can work in 'regional science'. In this way they can have an impact on society by addressing real-world problems (Deller 2015) by responding to regional, domestic, and global needs (Schiller 2006). Such approaches are becoming more and more popular where for example at Simon Fraser University there is an office of community engagement that handles many of these various activities (Rossi 2015).

Entrepreneurial Universities

Entrepreneurial universities build relationships with industry partners to create value for the various university stakeholders (Frasquet et al. 2012). Universities are increasingly adopting an entrepreneurial model due to a variety of reasons including reduced government funding and the possibility of gaining revenue from the commercialization of university research.

Industry is also becoming more and more interested in working with research universities (Blakeslee 2012). No longer is there a narrow focus on the commercialization of the haphazard output of research institutions (Etzkowitz 2013). There currently are many models of university entrepreneurial activities (Aranha and Garcia 2014). Many believe that future business strategies will rely greatly on 'co-opetition', where a combination of cooperation and competition (Carayannis and Alexander 1999) can work as long as universities and industrial partners have compatible outcome goals (Henderson et al. 2006).

Muddied interpretations of intellectual property rights can result in conflicts between researchers, university, and industrial partners (Andersen and Konzelman 2008). As university-industry collaborations develop there is always the possibility of conflict of interests. However, most are resolved in a way acceptable to all parties and most university researchers adopt an "entrepreneurial ethos" which is compatible with their academic values and philosophies (Crespo and Dridi 2007).

Another concern is that the traditional role of 'open science' will be minimized. Science that is not easily commercialized might become marginalized in favor of research for potential revenue gain. Although these concerns are frequently repeated, there is significant evidence that entrepreneurial activities have not had a negative effect on the production or view of open science (Shibayama 2012).

Process Model of University/Industry Team Development

How can a university select meaningful projects and community partners? How does an industrial partner seek help from the university? We draw upon the team development literature to provide a model that we have adapted to fit the development of U/I relationships formed by small university programs.

Following Santoro and Chakrabarti (2001), we concentrate on industrial firms that are considered 'Targeted Players'. Targeted players are small firms, often with limited resources that need problems specific to their business solved within a short time horizon. They often make up about a third of industrial partners in U/I collaborations with larger research programs. We propose that they would make up the majority of partners for engaged universities.

Smaller companies use U/I relationships for problem solving in essential areas central to the business (Santoro and Chakrabarti 2002), but are also better able to exploit U/I relationships to generate innovations than larger firms (Acs et al. 1994;

Link and Rees 1990). The smaller firms' advantage in generating innovations and technological change often result from their more organic, flexible organizational structures (Rothwell 1989) and in contrast to their larger firm brethren, the smaller firms' willingness to undertake R&D risks (Santoro and Chakrabarti 2001). Because of their ability and willingness to implement innovation, it seems to suggest universities might want to work closely with smaller companies; the challenge for universities is in how best to develop these relationships with the appropriate partners.

Teamwork

Academic interest in teamwork has had peaks and valleys in the literature. Groups and group processes were investigated extensively in the 1950s and 1960s by both psychology and organization studies researchers (Hare 1976). After their theories were developed, tested and validated empirically relatively no new theories emerged and interest in the area diminished. After some limited development of the field throughout the 1970s and 1980s, consisting of minor modifications of existing models (Rousseau et al. 2006; Morgan et al. 1993) for the most part the study of groups and group processes waned. With the technology driven changes in the workplace of the 1990s, and its subsequent widespread use of teams for task accomplishment, researchers once again focused their attention on teamwork (Smith 2001) as many well established advantages and disadvantages of using teams in the workplace were illuminated (Nurmi 1996). For example, when the task is complex, groups outperform individuals, who are inevitably bounded by their intellectual processing abilities (March and Simon 1958) since diverse groups have the advantage of being able to draw on a wider set of ideas and experiences (Ray and Bronsein 1995) and decision quality is generally better than those made by independent individuals on average. Conversely decisions by individuals are much faster, partly due to the increased use of heuristics (Allison 1971; March and Simon 1958) while expert individuals make better decisions than groups of non-experts.

Engaged universities frequently form teams with organizations that have traditional command and control structures. Even in organizations dominated by command and control hierarchies there is a call for self-organizing teams or 'pockets of excellence' (Brodbeck 2002). Self-leading work teams are a group of interdependent, highly skilled employees collectively responsible for planning, organizing, directing and controlling the work that they do (Ray and Bronstein 1995). As technology improves and socio-cultural forces encourage it, there will be more reliance on virtual teams, which present their own set of advantages and challenges (DeRosa et al. 2004). Therefore projects now taken on by engaged universities and their industrial partners are often comprised of individuals close to the problem with a good chance that meetings will be virtual rather than physically face-to-face.

Stages of U/I Collaborative Process Development

Functional teams do not simply materialize rather teams can form and become functional by unique dynamic processes where a set of established procedures will accelerate the process compared to taking a haphazard approach (Burnside and Witkein 2008). Unfortunately, processes driving the formation of dyadic relationships between university and firms are often inefficient and unclear since university and industrial firm actors often are driven by different agendas, missions, objectives, and time frames (Calcagnini et al. 2016; Santoro and Chakrabarti 2001). As a result, we propose taking a step back and utilizing the general stages of group development which have been examined and explored as a way to help improve this process. The general model utilized by many practitioners and researchers for more than four decades is Bruce Tuckman's four stage model of small group development (Miller 2003; Tuckman and Jensen 1977; Tuckman 1965). The four stages—forming, storming, norming and performing are shown in Fig. 1 and further described in Table 1. In the decade following the model's first introduction, the literature collectively suggested a final phase be added. Jensen modified the model with a fifth stage—adjourning (Tuckman and Jensen 1977). We have included one additional stage that was later proposed by Morgan et al. (1993) which they called 'preforming'. It comes both before the forming stage for new teams and between performing and forming for when a relationship experiences a renewal.

Implementation of the model can be initiated by either prospective industry or university partners. The teams from industry can be seeking either general opportunities in the areas of research of the university or can approach the university with potential projects. In a similar way, universities can seek out companies that have an interesting problem that needs to be solved or have new technologies that can be exploited and commercialized. In doing so, support from the management of both organizations involved along with assigning champions that can establish trust and facilitate the process are essential (Santoro and Betts 2002).

Preforming

For research arrangements involving commercialization of discoveries, the key success factor is having flexible intellectual property rights policies (Betts and Santoro 2011). Engaged universities doing collaborative research are not working to cash in on research, they are more interested in solving problems. Therefore instead of

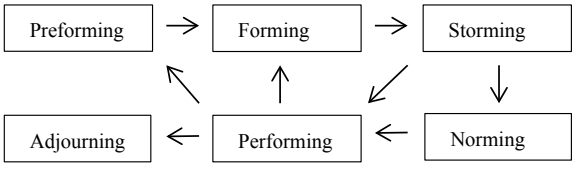

Fig. 1 U/I collaborative project process [Based on Tuckman (1965), Tuckman & Jensen (1977), Morgan, Salas and Glickman (1993)]

Table 1 Stages of U/I collaborative process development[a]

Stage	Group structure The pattern of interpersonal relationships; the way members act and relate to each other	Task activity The content of interaction as related to the task at hand
Preforming:[b] Preparation, investigation, exploration	Lack of clarity on group membership; Preliminary establishment of goals	Seeking partners Relationships are being formed or reformed
Forming: Orientation, testing, dependence	Testing and dependence, clarification of group membership	Orientation to the task
Storming: Resistance to group influence and task requirements	Intragroup conflict Conflicting goals and purposes Conflicting roles	Emotional Response to task demands Resistance to others goals and motives
Norming: Openness to other group members	In-group feeling and cohesiveness develop; new standards evolve and new roles are adopted	Open exchange of relevant interpretations; personal opinions are expressed
Performing: Constructive action	Roles become flexible and functional; structural issues have been resolved; structure can support task performance	Interpersonal structure becomes the tool of task activities; group energy is channeled into the task; solutions can emerge
Adjourning:[c] Disengagement	Anxiety about separation and termination; sadness; feelings toward leader and group members	Self-evaluation, transition into setting up new groups

[a]Adaptation of 'stages of group development' from Tuckman (1965), as presented in Betts and Healy (2015)
[b]As suggested by Morgan et al. (1993)
[c]A later addition to the Tuckman (1965) model (Tuckman and Jensen 1977)

flexible IPR policies, universities and industrial partners must have compatible outcome goals to successfully collaborate (Henderson et al. 2006). The critical time to assess compatibility is before the team is formed (Morgan et al. 1993) while determining the appropriate partner and project could require significant vetting. Although we consider goal compatibility as the key success factor, there also is a role for trust and the existence of a champion. Trust will be more important than communications because effective communications channels take time and resources to develop and have not been established yet (Betts and Santoro 2011). A champion, especially in the industrial firm can help further drive a successful process especially in the early stages until the lines of communication and trust are further established (Santoro and Betts 2002).

Forming

During forming a number of things must happen. Determining the composition of the team is the most important. If the partners are successful in aligning outcome goals in the preforming stage, then choosing appropriate team members is much easier. Setting preliminary goals, project timelines, budgets and setting up the protocols and procedures are also important. Trust and champions remain important for the same reasons as during preforming (Santoro and Betts 2002).

Storming

It is important to get through this phase with minimal damage, but not without any conflict. A complete lack of conflict can be a precursor to social loafing and to group think. A champion at both the firm and university can help keep the conflict constructive and positive. Leaders often emerge in this stage and coalitions form within the team. Differences in the understanding of the team's goals will lead to competing micro-strategies being proposed and argued (Bjerregaard 2009). Measures of performance for the group will be discussed, but are particularly difficult to agree upon (Philbin 2008) especially where goals, incentives and time horizons may vary between the university and the firm (Santoro and Chakrabarti 2001).

Norming

Reaching agreement dominates the norming phase and communications are the key to reaching agreement. Openness becomes particularly important at this point (Moilanen et al. 2015). Communication is important for defining the set of common needs, interests and goals (Dueñas Quintero and Oliva 2015; Frasquet et al. 2012) which again can vary between the university and the firm. Besides agreed upon goals and defined procedures, this is the phase where trust and commitment are built. Without goals, procedures, trust and commitment the process ends at this point or is forced to cycle back to a previous phase.

Performing

The efficient operation of the project team and implementation of the plans and procedures are greatly facilitated by the trust and communication established earlier (Dueñas Quintero and Oliva 2015; Frasquet et al. 2012). Cultural fit is an important consideration that will help teams stay on track because of mutual adjustment is easier when team members have common philosophies and assumptions which can often be a challenge since universities and industrial firms often have different agendas and motivations (Plewa and Quester 2008).

Adjourning or Return to Preforming

When the objectives have been reached (or abandoned) by the work team, the team can then disband. If the team was successful, it is often difficult for members to disengage. If the team was not successful, the feelings are quite different as team members are hesitant to work on similar projects or with similar groups in the future (Tuckman and Jensen 1977). Instead of minimizing this phase and having team members just go their separate ways, it is a time where reflections and discussion could identify what worked and what did not. If the organization is able to learn about the process, it can increase the odds of success in the future.

Success in the project often inspires either or both partners to continue to use U/I teams to solve business problems (Santoro and Chakrabarti 2001). Reflection and learning becomes even more important if there is a possibility of continuing the relationship or forming new ones. There is also an opportunity to share the 'best practices' developed and further examine any problems or issues that the team uncovered.

Process Spanning Issues

Institution and program size, mission, and funding levels are all key considerations in successful U/I collaborations (Santoro and Chakrabarti 2002). The process above might apply to larger, more resource rich programs that can yield greater monetary results for the commercialization of intellectual property. However, this process is offered with the opposite in mind—small, resource poorer programs that are more interested in solving business problems than making money. Champions from the university or an outside agency can play a great role in recruiting small businesses that can benefit from U/I collaboration. They also can supervise the process in an ongoing basis. There are a number of ways to structure U/I collaborations between small programs and small businesses (Hamner et al. 2002; Lakpetch and Lorsuwannarat 2012). For example, a 'student consulting' model is one way to approach such relationships. There are many variations to this type of interaction, but the essential elements are a group of qualified students spend a set amount of time (usually a semester) solving a 'real life' problem that a small business is currently encountering. The student consulting team will begin the project by meeting with the firm's top managers or owners to get a sense for the nature of the issue and expected deliverables. After the initial meeting, the student team will provide the firm with a formal plan on what will be accomplished and when. To ensure consistency among all the student teams and participating firms, the process is often facilitated by outside agencies like the Small Business Development Center Network.

Engaged universities can also help smaller firms by working closely with the firms to understand their various human resource needs. Here, engaged universities are knowledgeable of each individual firm's needs with respect to functional responsibilities and corresponding skill sets and provides dossiers of current students and recent graduates that could potentially fill these needs on either a part-time or

full-time basis. In doing so, the university provides access to its many students and recent graduates which could streamline the recruiting and hiring process for these firms.

Conclusions, Implications, and Future Research

There are many smaller universities with smaller-focused programs who actively participate in entrepreneurial activities with industry. However, in addition to those small industrial partners that are engaged in these kinds of U/I relationships, there are a host of others not currently engaged but would be interested in the benefits of collaborative relationships with universities. The processes by which these university programs of limited size and scope establish and maintain relationships with smaller industrial partners was the focus of this chapter where we address the concept of engagement as one form of entrepreneurial activity that is particularly suitable for smaller university programs and their often smaller-sized industrial partners. This chapter provides both theoretical development and practical applications. The theory regarding team development is advanced by adapting the existing team development models to a context that had not been addressed before. Having team members come from a combination of different organizations, each bringing different resources, knowledge, skills and abilities, and also different motives and objectives are important considerations that had not previously been explored. The clarity of the model and identification of key issues allow for practical application of the model.

Following the notion that "Targeted Players" (Santoro and Chakrabarti 2001), that is, small firms, often with limited resources that need problems specific to their business solved within a short time horizon can often benefit most from entrepreneurial and engaged activities with universities, we proposed a process model for collaborative U/I activities. Our model suggests six stages of interactions that can help not only the smaller universities focused on targeted players but can also be thought of in more general terms having import to a wider range of U/I relationships. Thus, our model can be used by university and industry partners to help establish, nurture, and maximize U/I relationships. With the addition of the preforming stage, our model can help advance theory and research in the group dynamics literature since engaged and entrepreneurial universities frequently form teams with industrial firms that have traditional command and control structures yet evident in such institutions are many self-leading team based project and work groups. With technological advances and changing social forces there is a need to further examine the role of group dynamics in these venues. Our proposed model can assist in this inquiry.

With respect to policy and practical implications, Audretsch (2014) suggests that in the current entrepreneurial-focused society universities have a role to play that go well beyond the traditional notion of patenting, licensing and new venture start-ups. Rather, entrepreneurial universities engage in a broader array of activities that encourage entrepreneurial thinking, entrepreneurial values, and entrepreneurial capital. The notion of entrepreneurial universities is now a more heterogeneous concept that

includes the traditional research-intensive universities and the smaller, more teaching and service-focused institutions that help facilitate innovation and entrepreneurship particularly for smaller sized firms at the regional level. Recent research suggests that engagement in specific problem solving activities from academics having a broad range of experience with different backgrounds while involvement in patenting, licensing and start-ups benefit most from academics with a narrower set of experiences (Abreu et al. 2016). This has implications on the types of universities and the affiliated faculty that firms seek to engage with in order to address their specific problems and challenges and the lines of inquiry that these faculty pursue as they intermingle and integrate their research agendas into their engagement with industrial partners as problem solvers.

A major advantage of our model as presented here is its generalizability however on the flip side its major limitation is its relative lack of specificity. Although presented in the context of U/I relationships between smaller university programs and their smaller sized industrial firm partners, we acknowledge that each U/I collaboration will be different due to the idiosyncratic nature of each situation. A dual approach to both overcoming this limitation and furthering the field is to take time to do the proper analysis at the early part of each phase, and reflect on the dynamics and outcomes at the transition to the next phase. By doing so, it will then be possible to refine the model for each specific relationship by identifying key success factors and potential problems that correspond to different types of collaborative endeavors with different types of projects.

In focusing on entrepreneurial and engaging activities in addition to economic outcomes we believe that universities can successfully contribute to all three missions of research, teaching, and service by expanding their knowledge dissemination and exchange via industry-university collaborative relationships which will further encourage and stimulate value added outcomes to a whole host of constituents.

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The Dynamics of Managing Evolving University-Industry Linkages

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Abstract Linkages between university and industry are known to facilitate economic development on a national level as well as render benefits to universities and industry. As a result, there has been growing attention on the success factors of such collaborations. Despite such prominence, our understanding of the evolution of these factors in university-industry relationships remains limited. Building on extant research, this study contributes to our theoretical and managerial understanding by examining the interplay between relationship characteristics (trust, understanding and communication) and relevant outcome variables across three relationship phases (initiation, engagement and maintenance). The results indicate a consistent yet complex web of interactions, with characteristics in each phase impacting not only the outcome in that phase but also the respective characteristics in the following phase. Similarly, in later states of the evolution of the relationship, the outcomes in each phase directly fosters the relationship characteristics and outcomes of the following phase. The paper concludes with key managerial implications and future research directions.

Keywords University-industry linkages · University-industry relationships · Evolution · Dynamics · Commercialisation · Trust · Understanding · Communication · Structural equation modelling

Introduction

Recent years have shown an increased recognition of the role linkages between university and industry, also labelled university-industry linkages (UILs), play in

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open innovation and innovation ecosystems (Carayannis and Campbell 2009; Sharif and Tang 2014). Not only do UILs drive economic growth (Geoghegan et al. 2015; Tuunainen 2005), they also provide multiple benefits to both universities and industry partners (Mora Valentín 2000). Specifically, by collaborating with industry partners, universities can supplement their public research funding, gain a better public image, increase their research outputs (Hemmert et al. 2014) and enrich the educational experience for their students (Plewa et al. 2015). Similarly, industry partners can tap into universities' resources (e.g. specialised research expertise and knowledge base) that are complementary to their internal R&D, thereby saving costs in developing or acquiring those resources (Plewa et al. 2013b). Moreover, by engaging with universities for knowledge transfer, firms can achieve better innovation performance (Lasagni 2012) and gain a strategic advantage over competitors (Bruneel et al. 2010).

However, despite the recognition of these apparent benefits, it remains challenging for universities and firms to work together due to goal conflicts and discrepancies in expectations and working practices (Bruneel et al. 2010; Johnson and Johnston 2004). While scholars try to address this problem by gaining a better understanding of the interaction between universities and industry (Burrington 1993) as well as of the relational factors that are crucial to UIL success (Bruneel et al. 2010; Hemmert et al. 2014), extant studies fail to take into account the complex and dynamic nature of relationships (Benneworth and Jongbloed 2010). Indeed, a major limitation of previous studies is that they only offer a snapshot of UIL relationships. Very few studies have empirically investigated the development process between individual relationship characteristics and outcomes across different phases of the relationship (Plewa et al. 2013a), or considered the likely differences in the nature of relationship characteristics at various stages of relationship evolution (Goldring 2010). This constitutes a major gap in the literature as there is insufficient understanding on how relationship characteristics evolve over time (Akrout 2015; Hadjikhani and LaPlaca 2013; Jap and Anderson 2007; Mollering 2006).

Consequently, the purpose of this study is to examine the interplay among relationship characteristics and their impact on outcome variables in various phases of UIL relationship development. We focus on three relationship characteristics, namely trust, understanding, and communication, as these have been shown to be vital for relationship success in the innovation and technology management literature (D'Este and Patel 2007; Estrada et al. 2016; Hemmert et al. 2014; Mora-Valentin et al. 2004). While there is consensus on the importance of these factors, little is known about how they evolve in the relationship (Akrout 2015; Ekici 2013; Hemmert et al. 2014; Seppänen et al. 2007). We fill this gap by investigating the impact of relationship characteristics (as manifest in different forms in each phase) on the development of corresponding relationship characteristics in subsequent relationship phases, as well as on the outcome of each phase. Findings of this research are important for a range of stakeholders including university technology transfer managers; government departments with mandates for innovation; and technology executives from firms involved in collaboration with university in building and sustaining effective relationships with their innovation partners.

Theoretical Background

There is a growing body of knowledge on UIL within the innovation and technology management literature. Otherwise referred to by terms including triple helix or government-industry-university relations (Carayannis et al. 2000; Etzkowitz and Leydesdorff 2000; Geoghegan et al. 2015), academic entrepreneurship (Abreu and Grinevich 2013), university-industry technology transfer (Siegel et al. 2001); university technology transfer (Harmon et al. 1997), university-industry knowledge transfer (Rossi 2010) and university industry collaboration (Bruneel et al. 2010; Lind et al. 2013; Petruzzelli 2011; Scandura 2016), UIL involves partnerships between university, business and government to achieve shared innovation outcomes (Rampersad et al. 2009). In general, the focus of the UIL literature has included a range of mechanisms such as patenting, technology licencing, contract research, consulting, joint R&D, new firm spinoffs, and sitting on advisory boards (D'Este and Patel 2007; Rampersad 2015). It has also examined a range of individual and organisational factors driving UIL outcomes (Perkmann et al. 2013), predominantly from the perspective of industry rather than university (Abreu and Grinevich 2013; Harryson et al. 2007). There are some notable exceptions of studies that have examined determinants of academic involvement in UILs (D'Este and Patel 2007; Ding and Choi 2011; Louis et al. 1989). However, the majority of these studies have focused on models of formal intellectual property protection rather than the development of the underlying relationship between partners (Abreu and Grinevich 2013; Owen-Smith and Powell 2001; Shane 2004).

Thus, while significant research has focused on various models of UIL as well as individual and organisational drivers from the perspective of commercial partners, more research is needed on the process of relationship development of UILs from the perspective of academic partners (Abreu and Grinevich 2013; Rampersad et al. 2009). This is important given the evolving university landscape and the challenges presented due to the changing role of universities from predominantly teaching and research to an entrepreneurial emphasis. This means that the success of universities increasingly depends on its ability to develop commercially viable management practices in contributing to industrial technology programs as well as its ability to compete globally for R&D investments by large multinationals (Philbin 2008).

Various phases are pertinent as UILs develop through initiation, engagement and maintenance (Akrout 2015; Lewicki and Bunker 1994; Plewa et al. 2013a). The initiation phase is essential in establishing a positive working relationship between parties and entails agreement on the scope of work to be undertaken by each collaborator, contract terms and the establishment of governance systems for collaboration (such as advisory boards or steering committees in large projects) (Philbin 2008). This phase usually results in the identification of the aims, scope of work, milestones, deliverables, time line, budget and responsibilities (Ayers et al. 1997). The engagement phase involves actively working on a specific project, the development of interdependence, as well as acceptable satisfaction with project specific deliverables (Akrout 2015; Plewa et al. 2013a). Consequently, the key outcome measure

of this phase is the acceptance of project deliverables (Bansal et al. 2004). During the maintenance phase, each party purposely sustains their commitment to ensure that the relationship continues in a consistent and durable manner (Akrout 2015; Dwyer et al. 1987). Outcomes of this phase are marked by continued value beyond completion of a specific project and positive referrals or word of mouth (Fink et al. 2008).

While the innovation and technology management literature has examined the impact of trust, understanding and communication on relational success (D'Este and Patel 2007; Estrada et al. 2016; Hemmert et al. 2014; Mora-Valentin et al. 2004), research remains limited on the changes of these factors throughout relationship evolution (Akrout 2015; Ekici 2013; Hemmert et al. 2014). The manifestation and impact of these relational factors across various phases of UILs will be discussed in the following section.

Hypothesis Development

Prolific research has identified trust as an important antecedent to relationship success (Bruneel et al. 2010; Philbin 2008), recognising its strong effect on cooperation (Palmatier et al. 2006), satisfaction, and long-term orientation (Geyskens et al. 1998). Broadly defined as the expectancy and belief in the partner, the concept of trust is rooted in various disciplines including social psychology, sociology, economics and marketing (Akrout 2015). For example, in the context of financial services, Chen et al. (2016) find that if the firm can gain customers' initial trust, then the customers are more likely to be involved in the new product development process and find the firm reliable at later stages. This is consistent with process-based trust, an understudied phenomenon in relationship marketing which proposes that trust develops over time when the firm demonstrates their trustworthiness through appropriate actions (Akrout 2015; Seppänen et al. 2007). As universities and industry partners need to work closely together in each phase, we extend extant research by examining trust across all phases of relationship evolution.

H1.1: Trust is positively associated with relationship outcomes in the (a) initiation phase, (b) engagement phase, and (c) maintenance phase.

In addition to trust, research has confirmed the impact of understanding on relational evolution and success (Plewa et al. 2013a). Understanding involves familiarity with goals, expectation, procedures and routines in synchronising actions towards mutual benefit (Estrada et al. 2016). Specifically, Abrahamsen et al. (2012) argue that relationship dynamics depend on a partner's ability to influence or shape a common role understanding with collaborators. Marketing scholars have long examined role understanding in the sales context (Chonko et al. 1986; Rizzo et al. 1970; Singh and Rhoads 1991). More specifically, B2B marketing researchers have applied the concept of role understanding to examining interorganisational relationships (Heikkinen et al. 2007). Despite the predominance of the role understanding concept in the B2B

marketing literature, there is little attempt by role theorists to link roles with outcomes (Rampersad et al. 2008). Yet, drawing on such literature and building on Barnes et al. (2002), it can be argued that mutual benefits in the context of knowledge exchange and research-oriented relationships require parties to understand each other, each other's roles, needs, environment and characteristics. Hence, we hypothesise,

H1.2: Understanding is positively associated with relationship outcomes in the (a) initiation phase, (b) engagement phase, and (c) maintenance phase.

Profound research has established the impact of communication on relationship outcomes (Holden and Otoole 2004; Mohr and Nevin 1990). Communication refers to the transparency, credibility, and codification or shared meaning of the information that is being exchanged (Rampersad et al. 2009). The influence of communication on relationship success has also been supported in the context of UILs (Rampersad et al. 2009). Akrout (2015) argues that communication is necessary in the initiation phase in setting goals, determining expectations and negotiating the agenda for the collaboration. In the engagement phase, she suggests that communication may be useful in adapting to changing environments while in the maintenance phase, it is important in sustaining the achievement of goals for each stakeholder in the collaboration. In order to test this phenomenon through time, we hypothesise that communication influences relevant outcomes across all three phases of relationship evolution.

H1.3: Communication is positively associated with relationship outcomes in the (a) initiation phase, (b) engagement phase, and (c) maintenance phase.

There is a growing call for empirical research to examine the evolution of trust in relationship development (Akrout 2015; Mollering 2006). While the temporal and dynamic nature of trust has been discussed in the literature (Mayer et al. 1995; Walter and Georg Gemünden 2000), there is a paucity of empirical research on how trust can be developed and sustained over time (Hadjikhani and LaPlaca 2013; Seppänen et al. 2007). While Akrout (2015) examined the evolution of trust during three phases of relationship evolution, it was conducted in a B2B context. The study suggests that in the initiation phase, trust is based on calculation, sanctions and reputation. This in turn influences trust in the engagement phase which is based on cognition or the ability to predict behaviours of the other party. Subsequently, trust from the engagement phase impacts on trust in the maintenance phase which is more affective and based on empathy with the partner's needs and wishes. To test the evolution of trust in the UIL context, it is hypothesised that:

H2.1a: Trust in the initiation phase is positively associated with trust in the engagement phase.
H2.1b: Trust in the engagement phase is positively associated with trust in the maintenance phase.

Understanding from previous interaction leads to increased familiarity, decreased social distance, decreased transaction costs and increased knowledge transfer (Kim 2009). Hence, understanding around goals, expectations and risk evaluations in the initiation phase should lead to improved understanding in the engagement phase

where managers have to adapt, adjust and reintegrate their goals in light of a changing environment (Huang and Wilkinson 2013). In turn, this flexibility and adaptation in understanding during engagement should lead to improved understanding in the maintenance phase which would then involve less disagreement around changes as deliverables materialise (Akrout 2015). We therefore hypothesise:

H2.2a: Understanding in the initiation phase is positively associated with understanding in the engagement phase.
H2.2b: Understanding in the engagement phase is positively associated with understanding in the maintenance phase.

In their study on knowledge creation in UILs, Johnson and Johnston (2004) suggest that knowledge transfer begins with individuals socialising with each other (e.g. via brainstorming sessions and face-to-face meetings). This is followed by externalisation, in which knowledge is shared explicitly through metaphors and analogies. Knowledge is then combined (e.g. when two or more concepts combined to create a new concept) and finally internalised. The underlying assumption of the knowledge creation process, as reflected by the construct measurements in Johnson and Johnston's (2004) study, is that partners communicate with each other in the socialisation and externalisation stages. However, the nature of communication is likely to change over time, as communication norms and mechanisms develop (Mason and Leek 2012). Specifically, we expect that open, complete and accurate communication in the early stages of the relationship will help establish bilateral dialogues once the collaborative work commences (Akrout 2015). Furthermore, the better the project-specific bilateral discourse throughout the engagement phase, the more likely partners will engage in discussions that go beyond current projects in later phases of relationship development.

H2.3a: Communication in the initiation phase is positively associated with communication in the engagement phase.
H2.3b: Communication in the engagement phase is positively associated with communication in the maintenance phase.

Corresponding to the previous discussion about trust, the relationship outcome in one phase is expected to positively impact the outcome of the following phase. That means, better defined and mutually understood goals, timelines and responsibilities initially provide a solid foundation for the engagement of partners and the development of detailed role expectations. Drawing on role theory, clarity regarding the roles all actors play in the relationship is likely to diminish the likelihood of role conflict and ambiguity (Dabholkar et al. 1994), known to negatively affect relationships. Thus, a better definition of project details improves the likelihood of project deliverables being achieved at the end of phase two. This satisfactory result then allows for partners to look beyond specific projects, opening opportunities for the creation of broader relationship value.

H3a: The relationship outcome in the initiation phase is positively associated with relationship outcome in the engagement phase.

H3b: The relationship outcome in the engagement phase is positively associated with the relationship outcome in the maintenance phase.

Finally, in line with research showing satisfaction (Selnes 1998) and evidence of service quality (Coulter and Coulter 2002) as a driver of trust, a positive outcome in one relationship evolution phase is likely to foster the development of trust in the subsequent phase. Specifically, the achievement of clearly defined project details in the initiation phase strengthens confidence in the individuals involved in the process. Furthermore, the actual achievement of project deliverables reinforces the perceived potential to rely, not only on the individual but on the relationship as a whole. This leads to the following hypotheses.

H4.1a: The relationship outcome in the initiation phase is positively associated with trust in the engagement phase.
H4.1b: The relationship outcome in the engagement phase is positively associated with trust in the maintenance phase.

Furthermore, in university-industry relationships, outcomes such as prototypes, proof of concepts and pilot studies from early phases clarify understanding in subsequent phases. This reflects a feedback process inherent in relationship evolution (Ford et al. 2002). Thus, we hypothesise outcomes from earlier phases to lead to a greater understanding in later phases.

H4.2a: The relationship outcome in the initiation phase is positively associated with understanding in the engagement phase.
H4.2b: The relationship outcome in the engagement phase is positively associated with understanding in the maintenance phase.

Similarly, outcomes from one phase may affect communication in subsequent phases. Mason and Leek (2012) argue that managers continuously evaluate, interpret and reinterpret the relational atmosphere through time as a basis for communication. They discuss that outcomes from communication may be reinterpreted based on new situational contexts which may shape future communication. Furthermore, role theory can be applied in that positive outcomes within a relationship may reduce role stress and, in turn, ease communication between partners (Dabholkar et al. 1994). Thus, we hypothesise that relationship outcomes in one phase influence communication in the following phase.

H4.3a: The relationship outcome in the initiation phase is positively associated with communication in the engagement phase.
H4.3b: The relationship outcome in the engagement phase is positively associated with communication in the maintenance phase.

Figure 1 shows the conceptual framework of this research.

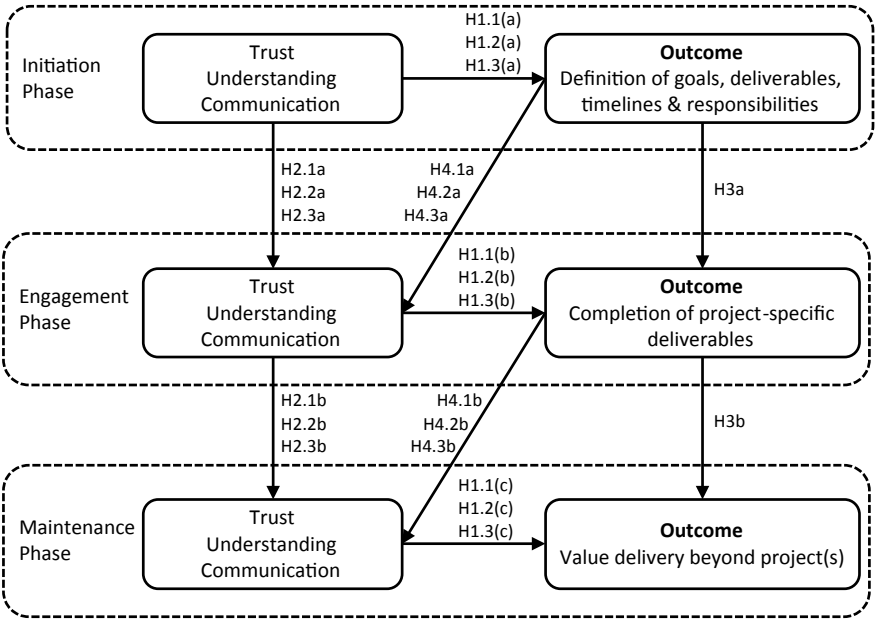

Fig. 1 Conceptual framework

Method

Data was collected by means of an online survey, sent to Australian university researchers that were identified as working with at least one industry partner. Obtaining responses from researchers was important as the existing UIL literature is skewed towards the perspective is commercial partners and under-represent the views of academic partners (Abreu and Grinevich 2013; Rampersad et al. 2009). The sample frame included 714 researchers who were reported as having received funding for collaboration with an industry partner through a national grant scheme for projects funded over an eight-year period as well as 474 researchers identified by three universities in two Australian States as working with industry. It should be noted that a potential overlap could neither be avoided nor assessed. While 217 completed responses were recorded, only 132 were utilised in this study as the remaining responses were not able to report on three relationship phases.

Due to challenges of longitudinal data collection, particularly with small initial sample frames, respondents were asked to retrospectively assess their relationship by reporting on relationship characteristics and outcomes for each relationship phase. Limitations relating to such an approach are acknowledged (Tikkanen and Tuominen 2000), for example the potential for respondents to interpret previous occurrences through a current lens. To reduce this drawback, specific tenses were used where relevant and respondents were continuously reminded of the phase upon which they should focus.

The nature of relational factors is likely to differ depending on the phase in which the relationship is examined (Larson 1992), so that measurements of trust, understanding and communication were altered for each phase. Given limited personal experience with a potential partner, expertise or reputation are commonly engaged as a foundation for trust initially (Larson 1992), with personal contact throughout the first project (engagement phase) allowing for trust to develop (Doz 1996; Dwyer et al. 1987). Ongoing engagement may then lead to more affective trust in the relationship of "trusted partners" (Akrout 2015; Larson 1992). Similarly, measurements of understanding reflect changes that are likely to emerge with changes in interaction patterns, ranging from an understanding of the partner's needs in the initiation phase to intimacy with the company once parties engage. The maintenance phase is characterised by a type of understanding that reflects a close integration between partners. Communication measures ranged from general communication quality, and thus its perceived accurateness, adequacy, completeness and credibility, to bi-directional communication and communication beyond the scope of existing projects in the subsequent phases. All measurement items and related sources are outlined in the Appendix: Measurement Items.

Relationship outcomes specific to UILs were chosen based on extant research (Plewa et al. 2013a), including the clear definition of project goals and deliverables in the initiation phase, the completion of project-specific deliverables during engagement and value delivery beyond specific projects for the maintenance phase. All constructs were shown to be reliable, with Cronbach alpha and construct reliability scores between .78 and .94 (Cronbach 1951; Fornell and Larcker 1981). Convergent and discriminant validity were also assured, with average variance extracted (AVE) scores ranging from .63 to .83 and a higher AVE than respective highest squared correlation for each construct (Fornell and Larcker 1981).

Results

The data was analysed separately for each relationship characteristic, following Structural Equation Modelling principles using AMOS 19. Hence, the results are presented separately for trust, understanding and communication, followed by a combined discussion. Due to moderate non-normality, analysis entails the Normed Fit Index (NFI), Comparative Fit Index (CFI) (Lei and Lomax 2005) and the Bollen-Stine bootstrapping technique (Bollen and Long 1993). Results are provided in Table 1 and discussed in depth in the following section.

The model investigating dynamics of trust showed a good fit (χ^2: $p > .05$, χ^2/df = 2.033, GFI = .97, AGFI = .90, CFI = .98, RMSEA = .09, TLI = .94, NFI = .96). All hypotheses except for one (H3b) were supported. In particular, as expected, trust was shown to positively impact outcomes across all phases (H1.1a–c). As proposed, if a trusting relationship is reported early in the relationship, the likelihood of trust in later phases is higher (H2.1a, b). Furthermore, the better the definition of project deliverables and goals, the more likely project outcomes are achieved in the

Table 1 Results of path analysis and hypotheses testing—trust

Hyp	Independent variable	Dependent variable	Stand. effect	Critical ratio	Support
H1.1a	Trust phase 1	Outcome phase 1	.19	2.26*	Yes
H1.1b	Trust phase 2	Outcome phase 2	.68	10.95***	Yes
H1.1c	Trust phase 3	Outcome phase 3	.47	4.91***	Yes
H2.1a	Trust phase 1	Trust phase 2	.30	3.66***	Yes
H2.1b	Trust phase 2	Trust phase 3	.62	7.61***	Yes
H3a	Outcome phase 1	Outcome phase 2	.15	2.36*	Yes
H3b	Outcome phase 2	Outcome phase 3	.05	.55 n.s.	No
H4.1a	Outcome phase 1	Trust phase 2	.18	2.17*	Yes
H4.1b	Outcome phase 2	Trust phase 3	.18	2.23*	Yes

Initiation phase—phase 1
Engagement phase—phase 2
Maintenance phase—phase 3
***$p < .001$
**$p < .01$
*$p < .05$

engagement phase (H3a). However, no significant association emerged between the positive project evaluation in the engagement phase and broader value creation in the maintenance phase (H3b). Finally, the successful completion of one relationship phase significantly improves trust in the following phase (H4.1.a, b).

A good model fit also emerged when testing the dynamics of understanding throughout UIL evolution (χ^2: $p > .05$, $\chi^2/df = 1.66$, GFI = .98 AGFI = .92, CFI = .98, RMSEA = .07, TLI = .94, NFI = .95). As shown in Table 2, the general results mirror those of the trust model, with one difference. In particular, hypotheses H1.2a–c were confirmed with understanding in each phase shown to positively impact respective outcomes. As expected, the greater the understanding in one phase, the more likely it is that the level of understanding grows in the following phase. Hence, results confirm H2.2a, b. While a positive outcome in the first project (engagement phase) fosters the integration of the partners in their continuing engagement (H4.2b), the definition of goals and milestones in the initiation phase is not significantly associated with the understanding when engaging in the first project (H4.2a). Finally, in line with the results discussed before, while defining characteristics of the project initially strengthens the likelihood that a positive project evaluation can be achieved in the following phase (H3.2a), such positive evaluation is not significantly associated with broader value creation in the relationship (H3.2b).

When analysing communication dynamics (Table 3), model fit was not confirmed by all indices. While the results for the GFI and CFI were above the required .9, the p value is significant and the normed chi-square, AGFI, TLI and RMSEA scores are all outside the appropriate range (χ^2: $p >= .016$, $\chi^2/df = 3.56$, GFI = .95, AGFI = .83, CFI = .95, RMSEA = .14, TLI = .86, NFI = .93). Hence, following modification indices, a path between communication phase one and outcome phase two was added

Table 2 Results of path analysis and hypotheses testing—understanding

Hyp	Independent variable	Dependent variable	Stand. effect	Critical ratio	Support
H1.2a	Understanding phase 1	Outcome phase 1	.27	3.14**	Yes
H1.2b	Understanding phase 2	Outcome phase 2	.42	5.35***	Yes
H1.2c	Understanding phase 3	Outcome phase 3	.55	7.41***	Yes
H2.2a	Understanding phase 1	Understanding phase 2	.45	5.75***	Yes
H2.2b	Understanding phase 2	Understanding phase 3	.27	3.11**	Yes
H3.2a	Outcome phase 1	Outcome phase 2	.20	2.63**	Yes
H3.2b	Outcome phase 2	Outcome phase 3	.13	1.72 n.s.	No
H4.2a	Outcome phase 1	Understanding phase 2	.13	1.63 n.s.	No
H4.2b	Outcome phase 2	Understanding phase 3	.27	3.02**	Yes

Initiation phase—phase 1
Engagement phase—phase 2
Maintenance phase—phase 3
***$p < .001$
**$p < .01$
*$p < .05$

to the model, leading to a good model fit (χ^2: $p > .05$, $\chi^2/df = 1.05$, GFI = .99 AGFI = .95, CFI = .99, RMSEA = .02, TLI = .99, NFI = .98). The results have many similarities to the previous discussion, as communication in each phase positively impacts the respective outcome measures (H1.3a–c), and communication in each phase strengthens communication in the following phase (H2.3a, b). However, it is shown that none of the relationship outcomes depend on the outcome of the previous phase, rejecting H3a, b. Similarly to the results relating to understanding, while the definition of project goals and milestones is not significantly associated with bi-directional communication in the engagement phase (H4.3a), a positive evaluation of the first project (engagement phase) fosters communication in the following phase (H4.3b).

Discussion

This study provides a valuable contribution to the innovation and technology management literature, and in particular the UIL research stream by uncovering the dynamics among the different relationship characteristics and outcomes in three relationship phases (initiation, engagement and maintenance). Considerable overlap of findings between the three characteristics tested across three separate models emerged, granting weight to the findings. Presenting an initial quantitative investiga-

Table 3 Results of path analysis and hypotheses testing—communication

Hyp	Independent variable	Dependent variable	Stand. effect	Critical ratio	Support
H1.3a	Communication phase 1	Outcome phase 1	.36	4.47***	Yes
H1.3b	Communication phase 2	Outcome phase 2	.51	7.34***	Yes
H1.3c	Communication phase 3	Outcome phase 3	.71	10.50***	Yes
H2.3a	Communication phase 1	Communication phase 2	.44	5.33***	Yes
H2.3b	Communication phase 2	Communication phase 3	.26	2.48*	Yes
H3.3a	Outcome phase 1	Outcome phase 2	.05	.72 n.s.	No
H3.3b	Outcome phase 2	Outcome phase 3	.02	.32 n.s.	No
H4.3a	Outcome phase 1	Communication phase 2	.14	1.69 n.s.	No
H4.3b	Outcome phase 2	Communication phase 3	.28	2.76**	Yes
add	Communication phase 1	Outcome phase 2	.30	4.14***	Yes

Initiation phase—phase 1
Engagement phase—phase 2
Maintenance phase—phase 3
***$p < .001$
**$p < .01$
*$p < .05$

tion of the interplay between relationship characteristics and outcomes over time, the results indicate the need for researchers to not only identify the relationship phases and measures they use to investigate relationship characteristics but to clearly place their findings within the broader context of relationship evolution.

The results confirm the phase-specific types of trust, understanding and communication as positively associated with the relationship outcomes measured in each phase. Interestingly, results relating to both understanding and communication show increasingly higher standardised path coefficients from the initiation to engagement and maintenance phase. While these characteristics are thus relevant at all times, based on the measurement in this study, their importance for the respective outcome strengthens over time. For the relational factor of trust, by far the strongest association emerged for the engagement phase and thus for the time during which partners first actively engage together to deliver project outcomes. That means, while trust based on the potential partner's credibility and reputation significantly impacts outcomes in the initiation phase, trust based on direct experience with the partner, most commonly tested in the literature, provides significantly stronger effects on project-specific satisfaction and broader value creation over time.

Investigating the interrelationships of outcome variables across phases, it appears that the better project deliverables and goals are defined, the more likely that satisfaction with project deliverables can be achieved, specifically in the model investigating trust and understanding. The clarity around each actor's roles that is

provided serves as a solid foundation for engagement (House and Rizzo 1972). This is likely to be of particular importance in UILs, as they imply an integration of actors with differing goals and backgrounds and are shaped by the emergent nature of research (Christiansen and Vendelø 2003) and the understood uncertainty in related investment (Blomqvist et al. 2005). The communication model provides further insight into the interrelationships of outcomes. Here, the satisfaction with project outcomes following the first collaborative project does not rely on the actual definition of deliverables and goals at the completion of phase one but instead on the communication quality throughout the initial discussions. While agreements can provide tangible evidence of agreed project details, they can only ever present a fraction of the information that was exchanged during the actual communication process.

In relation to later phases, no significant association emerged between satisfaction with the outcome of the first project and the non-project specific value creation in the maintenance phase. This finding appears contradictory to the relationship literature, with meta-analyses suggesting that satisfaction positively impacts longer-term outcomes such as expectations of continuity, loyalty and cooperation (Palmatier et al. 2006), as well as loyalty (Geyskens et al. 1999). The fact that successful project completion may not lead to value creation beyond existing projects may be due to the research context. UILs may develop with a particular technology or research study in mind, with research groups or individual researchers seeing little prospect of value creation beyond the existing area of engagement.

Finally, fulfilling a particular aim of this study of interrelationships between relationship characteristics and outcomes across multiple phases of relationship evolution, the results show some confirmation of the proposed link between the successful completion of one relational phase and the subsequent development of relationship characteristics. In particular, an association between engagement phase success and relationship characteristics in an ongoing relationship emerge consistently across models. That means, satisfaction with actual project outcomes not only strengthens the actors' integration as a team in ongoing collaborative work but also encourages actors to share information that may go beyond the actual projects for which collaboration is agreed upon. Similarly, satisfaction with project outcomes, which are likely to depend on a team of individuals and a range of relational behaviours and norms, advances trust in the broader relationship/partner. However, the outcome-characteristic interaction across phases could only be confirmed for trust in early stages of relationship development. That suggests that the initial determination of project specifics fosters trust in the individual once actors start working together on a project, as it proves to the partner that the person involved in the negotiations contributed to successfully completing an important part of the process. The mere written documentation of project specifics, however, neither enhance one actor's understanding of the other, nor does it promote bilateral communication during actual collaborative work.

Managerial Implications

The study offers important implications for managers seeking to facilitate engagement between university and industry. These include technology transfer commercialisation offices, research and development corporations, government research centres, universities and firms participating in collaborations between higher education institutions and industry. In particular, individuals engaged in the management or facilitation of university-industry relationships may benefit from these results, which not only provide an insight into the specific strategies needed in particular relationship phases but also indicate the need to closely monitor specific outcome measures due to their impact on subsequent development.

Adopt Strategies to Build and Develop Trust Through Time

Partners should mould and invest in building trust in an appropriate manner within each relational phase. This resonates with suggestions in the existing literature (Akrout 2015; Lewicki and Bunker 1994) and is also confirmed by findings in this study. Given that trust is more calculative in the initiation phase, strategies are needed to build credibility and reputation in this phase and it is important that partners articulate their expertise, capabilities, experience and skills that they can contribute to the partnership. In the engagement phase, trust is more cognitive in nature and therefore, it is important that collaborators deliver on the relationship to ensure a satisfactory experience. Having a key identifiable representative within the organisation to manage the relationship with the partner organisation is important to ensuring continuity and reliability. Within the maintenance phase, trust is more affective and therefore collaborators should demonstrate their interest of the partner in mind and that they can be counted on to act with integrity.

Ensure Effective Understanding as the Relationship Evolves

Relationships are not static but rather evolving. Therefore, ensuring continued understanding is paramount. As partners face new experiences, opportunities and challenges, their perspectives may change. It is important to stay in tune with the needs and changes of partners. It is essential to ensure that partners have common role understanding as the relationship evolves. In the initiation phase, our results revealed that the better project deliverables and goals are defined, the more likely that satisfaction with project deliverables can be achieved. In the engagement phase, understanding can be developed by becoming familiar with the capabilities, operation and interests of partner organisations. A number of mechanisms can be used to build this understanding, for instance joint problem solving, secondments of university researchers in industry or vice versa, and collaborative committees with representa-

tives from each partner organisation. During the maintenance phase, a further degree of integration can foster continued understanding stimulated by more frequent interactions and closer strategic alignment.

Apply Appropriate Communication Mechanisms Within Each Relationship Phase

Strategies can be applied to deepen the effectiveness of communication as relationships evolve. In the initiation phase, steps should be taken to ensure accurate, adequate, complete and credible information. In the engagement phase, rapport is needed and investing time for two-way professional exchange and dialogue is essential. Within the maintenance phase, more informal communication is valued beyond the specifics of projects at hand.

Monitor Outcomes Relevant to Each Phase to Ensure Success in Subsequent Phases

During the initiation phase, goals, priorities, deliverables and responsibilities should be clearly defined. Within the engagement phase, mechanisms should be implemented to monitor results against initial expectations and to ensure that there is mutual benefit for partners. For the maintenance phase, routines should be in place to discuss project issues while leeway given to recognise wider contribution and opportunities beyond existing projects.

Conclusion

This study contributes to our understanding of how to manage evolving UILs by analysing the dynamics of relationship characteristics and relevant outcomes. While past literature recognised the significance of trust, understanding and communication for relational success (D'Este and Patel 2007; Estrada et al. 2016; Hemmert et al. 2014; Mora-Valentin et al. 2004), research was scarce on the dynamics among these factors through relationship evolution (Akrout 2015; Ekici 2013; Hemmert et al. 2014). This research thus makes an important theoretical contribution by building on and extending UIL literature through providing an empirically tested model on the interaction between relationships characteristics and outcomes through various phases of relationship evolution, namely, initiation, engagement and maintenance.

Furthermore, unlike past studies that have mainly discussed relationship evolution in the context of private sector organisations (Abreu and Grinevich 2013; Rampersad et al. 2009), this study offers vital insights into UILs from the perspective of academic partners. This perspective is important given the changing role of universities from a predominant focus on teaching and research to the incorporation of a third mission around entrepreneurship, innovation and the contribution towards regional economic outcomes (Etzkowitz and Leydesdorff 2000). The effective management of UILs is therefore critical to achieving this third mission.

Despite its benefits, there are notable research directions. Due to limitations such as a small sample size and a specific context, future research should replicate and extend this study using a larger sample. Additionally, the analysis of multiple characteristics and multiple phases simultaneously would allow for a more comprehensive and realistic analysis of relationship dynamics. In summary, this study is a vital step in our attempt to better understand and manage dynamic UILs by empirically testing the evolution and interaction of three relationship characteristics, namely trust, understanding and communication and respective outcomes, through different UIL stages.

Appendix: Measurement Items

Variable	Items used (all measured on 7-point Likert scales)
Trust	
Initiation phase (Newell and Goldsmith 2001)	The partner had extensive experience in their field
	The partner had great expertise
	The partner was skilled in what they do
	The partner did not have much experience (R)
Engagement phase (Bansal et al. 2004)	I felt that I can trust our contact person at the partner organisation completely
	S/he was truly sincere in her/his promises
	S/he treated me fairly and justly
	I felt that s/he could be counted on to help me when I need it

(continued)

(continued)

Variable	Items used (all measured on 7-point Likert scales)
Maintenance phase (Ganesan 2018; Doney and Cannon 1997; Morgan and Hunt 1994)	I feel that I can trust this partner completely
	I trust this partner to consider our best interests
	This partner can be counted on to act with integrity
Understanding	
Initiation phase (Smith and Barclay 1997)	We understood the partner's needs
	We understood the environment in which the partner operates
	The partner could count on our ability to adapt to their culture
Engagement phase (Aaker et al. 2004)	I was familiar with the capabilities of the partner organisation
	I had become very knowledgeable about the partner organisation
	I understood how the partner organisation operates
	I was familiar with the partner organisation's interests
Maintenance phase (Song and Parry 1997)	There is a high degree of integration between us and the industry partner
	The collaboration is stimulated by frequent interactions between us and the industry partner
	The industry partner and us are one team
Communication	
Initiation phase (Mohr and Soho 1995)	Inaccurate/accurate
	Inadequate/adequate
	Incomplete/complete
	Not credible/credible
Engagement phase (Fisher et al. 1997)	We had great dialogues
	We had great professional exchange
	There was a lot of two-way communication between the partner and us

(continued)

(continued)

Variable	Items used (all measured on 7-point Likert scales)
Maintenance phase (Li and Dant 1997)	We often exchange information informally
	We often exchange information beyond what is required by our agreements
	We often just talk without reference to the project
Outcome	
Initiation phase (Ayers et al. 1997)	Project goals and priorities were clearly defined
	Deliverables were clearly defined
	Timeline and/or milestones were clearly defined
	Responsibilities of all parties involved were clearly defined
Engagement phase (Bansal et al. 2004)	We were satisfied in general with the project
	Project results covered the initial expectations
	The project results provided balanced results for partners
Maintenance phase (Fink et al. 2008)	We routinely discuss issues which go beyond the project
	What we offer each other goes beyond our project(s)

R = reverse coded

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Part IV
The Organisational Perspective

Universities and Science Parks: Engagements and Interactions in Developing and Attracting Talent

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Abstract Many studies have shown that they have ceased to be mere facilitators of physical spaces to become important providers of services and resources to their tenants. Universities situated in or next to them play a key role in getting engaged in the development and the attraction of talent to Science Parks, to their tenant firms as well as to the region. Considering that skilled professionals are one of the resources that companies seek the most, Science Parks have dedicated numerous activities and means to become even more attractive to talented individuals, who can especially be found in entrepreneurial universities. In this study, we review the literature regarding the interactions existing between Science Parks or their tenants and their local universities. Talent attraction and entrepreneurship issues are addressed as the building blocks of these interactions. We strive to identify types of interactions that could differ in function of the maturity levels of the firms since their aims are not the same: at an early stage, firms tend to focus more on growth, whereas at a later stage, they tend to focus more on their development. We then point out policy implications, concerning both entrepreneurial or engaged universities and Science Parks.

Keywords Entrepreneurial university · Engaged university · University-industry collaboration · Science Park · Talent · Human capital

Introduction

Universities' ability to generate both knowledge and empowered individuals positively influences regional outcomes (Florida 1999; Gibb and Hannon 2006). In this sense, Charles (2006) highlights the important role of universities 'in the formation of human capital through the education of students as well as training activities for people already in work' (ibid, p. 119). Universities thus need to evolve along with their economic environments over time to not only survive but also better meet the

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needs of these environments. Etzkowitz (2003) states that the assignment of the university has been evolving, assuming a new role in economic and social development. Back in the 17th century, in their first years of existence, even star universities, such as Harvard, did not have a real economic impact, as the economy was based on the combination of physical labour and financial capital only (Audretsch 2014). Later, in the 19th century, the emergence of applied sciences seems to shift the role of universities: knowledge began to play a major role in the economy (Youtie and Shapira 2008). During the world wars, research results proved to be useful for the American army in particular (Audretsch 2014). From then on, some universities have become 'entrepreneurial' (Uyarra 2010, p. 1230). The research university seems to have been transformed to encompass the concept of entrepreneurship, changing into 'a teaching, research and economic development enterprise' (Etzkowitz 2003, p. 110). Processes of the entrepreneurial university lead to the creation of firms to bring research results into the market, to the transfer of technology, but also to the improvement of university's internal processes and structure (Kesting et al. 2014)—in short, to the use of spill-over mechanisms in order to diffuse their knowledge to their economic environment (Audretsch 2014).

In this context of evolving economic environments, Science Parks work as facilitators stimulating and supporting the growth of companies of all maturity levels (Rothaermel et al. 2007). Today's Science Parks are the result of transformations and evolutions of the first parks that began to operate in the second half of the 20th century in the United States (Colombo and Delmastro 2002; National Research Council 2009). US policy initiatives, such as the Bayh-Dole Act and the National Cooperative Research Act in the late 1970s and early 1980s, allowed universities and companies to form partnerships to market the results of university research (Link and Scott 2006). New US Parks have emerged in this scenario of university-industry collaboration and have become a model for other countries to develop their Science Parks (Westhead 1997). Regional development was the first driving force for the creation of Science Parks, fostering the revitalisation of local industries, mainly through the transfer of knowledge and technology from the university (Vásquez-Urriago et al. 2016).

The partnership with the university is relevant to Science Parks due to its ability to produce and distribute human capital (Mellander and Florida 2011), and to the influx of students (Etzkowitz and Klofsten 2005) and researchers with advanced ideas and skills (Cadorin et al. 2017). Considering the university as a 'provider of talent' (Florida 1999, p. 68), graduate students, alumni, researchers, and professors are all examples of talent in this study. Their knowledge and skills are the driving forces behind the growth of park companies as well as the development of new business in a Park. In this partnership, universities can be considered entrepreneurial, since the commercialisation of research is part of the regional economic development, and/or engaged, to the extent that they seem to get involved in the social development of their regions, for instance, through a role of 'workforce development' (Breznitz and Feldman 2012, p. 145). Moreover, because qualified people are a sought-after resource, Science Parks carry out different activities on their own or in collaboration

with stakeholders to attract talent typically found in higher education institutions, such as universities.

University-industry interactions have been discussed extensively over the past few decades. Perkmann et al. (2013), for instance, review the literature on university-industry relations. They study 36 scientific articles published between 1989 and 2011 that deal mostly with knowledge transfer through the application of research. A focus is made on 'academic engagement' that occurs both in formal and informal ways (Perkmann et al. 2013, p. 1). However, in this large panel of references, Science Parks are mentioned only three times (Clarysse et al. 2005; Phan et al. 2005; Van Dierdonck et al. 1990), and neither talent nor attraction is ever introduced, as the teaching role of universities does not seem to be the focus of the literature review. Academic publications dealing with university—Science Park interactions for talent recruitment have been reviewed in this chapter. Research often seems to deal with both the issues of talent recruitment and of university—Science Park interactions separately (Florida 1999; Zhu and Tann 2005). It also seems to address talent attraction to the Science Park rather implicitly (Radosevic and Myrzakhmet 2009; Schiavone et al. 2014). The objective of this study is to study both issues of talent attraction and university—Science Park interactions in an explicit manner.

This study contributes to the research on entrepreneurial and engaged universities by addressing the role of universities in the economic and social development of their regions. It aims to identify the types of interactions and engagements occurring between Science Parks and their nearby universities, understanding and qualifying the university's role in developing and attracting talent that firms in Science Parks can recruit later on. In addition, this study also recognises and points out policy implications, concerning both entrepreneurial and engaged universities and Science Parks.

In particular, the following research questions are addressed: (i) What kinds of university—Science Park interactions aiming at attracting and developing talent are discussed in the literature? (ii) How do the formal and informal interactions between universities and Science Parks contribute to the attraction and development of talent for park firms related to their maturity levels?

Method and Data

The literature review aims to identify different types of interactions between universities and Science Parks regarding talent development and attraction to a Science Park, thus addressing our first research question. The analysis of the interactions found in the literature leads to the development of a theoretical model that suggests an answer to our second research question. Finally, some cases are highlighted that aim to illustrate how university—Science Park interactions may enable the attraction of talent into the Science Park.

We searched the databases Google Scholar, Scopus, and Web of Science by using a list of keywords (Table 1), as well as queries associating some of these different

Table 1 List of keywords used to search databases

Attract	Collaboration
Cooperation	Engagement
Entrepreneur	Incubator
Innovation	Interaction
Recruit	Research Park
Retain	Science Park
Skill	Talent
Technology park	Technopark
University	

keywords to specify our requests. In addition, we used references' lists of the selected papers to widen our collection of readings. We thus proceeded to an iterative process that comprised the following steps: (i) the collection of a set of articles; (ii) the adjustment of the collection with the rejection of some studies; (iii) the completion of the sample with the use of sources cited in the selected articles; (iv) a new adjustment of the sample with the rejection of some studies; (v) until the stage where the whole set of relevant cited sources in our sample had been explored. The search for new sources ended when the new references obtained by our interactive search process were either already in our set of articles or did not really contribute to the research. We initially determined that a minimum of 30 articles would be required, mainly covering the last 20 years of publication on the subject. A study was rejected from our collection if that study was not explicitly discussing—in the theory or through an example—at least one relationship that was (i) occurring between a university and a Science, Technology or Research Park; or (ii) dealing with human capital. This literature review is thus the result of the collection and the study of a final sample of 37 academic papers that explicitly discuss relationships between universities and Science Parks regarding the development or attraction of talent.

We chose to study some interactions occurring between Linköping University (LiU) and Science Park Mjärdevi (SPM) to illustrate our findings from our study of the literature. Three main reasons motivate the choice of these descriptive cases: (a) their relevance, since LiU has been characterised as 'entrepreneurial' (Svensson et al. 2012, p. 1) and the relationship between LiU and SPM focusses not only on the commercialisation of university knowledge but also on the attraction and development of talent (Cadorin et al. 2017); (b) the accessibility and the amount of data available, since SPM has had a close relationship with LiU for more than 30 years (Etzkowitz and Klofsten 2005); and both LiU and SPM share geographical, social and cognitive forms of proximity (Boschma 2005); (c) the possibility to illustrate a broad spectrum of activities and connections that can contribute to the engaged university.

In order to build the cases, we first conducted an in-depth study on the websites of both institutions to identify interactions that would potentially result in talent attraction. Once we had identified the areas involved on both sides, we scheduled

meetings or sent questionnaires via email to the persons in charge of these areas. Semi-structured interviews were conducted with two representatives from Science Park Mjärdevi: the former CEO that was involved since the creation of the Science Park and had managed it for 30 years; and the current manager of community and employer branding. In addition, we met one of LiU Innovation Office's advisors, as well as one senior advisor of Demola. A follow-up interview was held with the SPM's Community and Employer Branding Manager to supplement the information collected during the first meeting, but also to obtain information about a new activity, and to test our theoretical model. In total, three questionnaires were sent by electronic mail, and four face-to-face interviews were conducted, that lasted between 30 min and 1 h each. In the end, we presented the written cases to each respondent to validate the information, and we brought the necessary adjustments according to the feedback received from them.

University—Science Park Interactions to Attract Talent: A Review of the Literature

In the literature, Science Parks are described in different ways, for example, research parks, technology parks or science and technology parks (Hommen et al. 2006). The inconsistency in definitions can express political or financial issues, which emphasise certain individual characteristics of each park. In the end, this lack of uniformity makes it difficult to apply the term consistently and broadly. Definitions from international associations, such as IASP (2017) and UKSPA (2017), point out that parks should stimulate and provide the required support for university-generated knowledge to flow appropriately to park companies in addition to offering high-quality business services and a prestigious location. Colombo and Delmastro (2002) and Westhead (1997) state that the establishment of connections with universities is an essential pillar for Science Parks to achieve their objectives. Moreover, Science Parks mainly aim to nurture the relationship between universities and industry (Minguillo et al. 2015), promoting proximity among them in several ways, such as in geographical, technological, and organisational ways (Vásquez-Urriago et al. 2016). The result is an environment that fosters innovation.

According to Audretsch, universities' roles are evolving to become 'broader and more fundamental—to provide thinking, leadership and activity to enhance entrepreneurship capital' (Audretsch 2014, p. 320), driven in large part by external expectations (Pavlin et al. 2016). In addition to research applications, a new focus is indeed made on 'creating entrepreneurial thinking, actions, institutions', collectively 'entrepreneurship capital' (Audretsch 2014, p. 319). This focus seems to be in line with the new 'engaged' mission of universities (Uyarra 2010, p. 1230), where knowledge sharing is dependent on social capital and relational involvement (Charles 2006; Clauss and Kesting 2017). Uyarra indeed defines engaged universities as 'enablers of regional development', that provide 'adaptive responses' to 'regional

needs' through a 'contribution of higher education to social, cultural and environmental development' (Uyarra 2010, p. 1238). Gibb et al. (2013, p. 1) also state that the 'societal engagement' of universities is a way for them to behave entrepreneurially.

The recruitment of graduates from the university to Science Parks is frequently mentioned in the literature (Hommen et al. 2006; Löfsten and Lindelöf 2002; Vedovello 1997; Walcott 2002) and confirms the definition of the university as a 'provider of talent' by Florida (1999, p. 68). The recruitment of graduates of a nearby university can thus be considered as talent attraction. It, of course, can be made without the help of a university, once the training of the graduate is completed: the process can happen with exchanges occurring only between the graduate and the hiring company. However, the recruitment can also be a real interactive process between the Science Park and the student, through the implementation of internship programmes, for instance (Hommen et al. 2006; Huffman and Quigley 2002; Walcott 2002). This process enables the company to spot talent that could be worth attracting later on to develop the company and also enables the student to build skills during an internship by acquiring know-how. This practice is more and more frequent, all the more as some universities now demand a certain amount of time spent working for an organisation as a requirement for graduation. Another way for companies to detect talent is to get students involved in their projects (Vedovello 1997). In the framework of a course, for instance, the application of theory is made through a semester project that is physically conducted at least partially within the university by students, with professors as advisors, but for a client, that is the company that brought the project. Some tenant firms having spotted talent even proceed to grant scholarships in exchange for signing a contract of employment after graduation (Huffman and Quigley 2002).

Direct recruitment, job fairs to present the company on campus and conducting interviews are also often used to attract talent (Hommen et al. 2006; Huffman and Quigley 2002), as well as headhunting (Zhu and Tann 2005). Headhunting can be practised by several actors: the hiring firm in the Science Park, the Science Park management office, or a headhunting company, that could also potentially be a member of the Science Park. The formality of these interactions is justified by the signature of a written contract: internship agreements in the case of internships, signed by the student, the firm and the university; an agreement between the firm and the university to define the boundaries of the partnership and of the project for which students work for free in the framework of their training; an agreement for the job fair, in order to fix eventual fees and to clarify the support provided by the university (such as space or material); and headhunting can also imply an agreement between the headhunting organisation and the university or a part of the university (such as an alumni organisation) to exchange contacts or to publish advertisements. Firms having a higher level of maturity do these interactions with universities looking for talent to renew their business know-how (Klofsten and Jones-Evans 1996).

However, there are also interactions mentioned in the literature that deal with on-park firms with a lower level of business maturity, most of them being new companies emerging from universities or other park firms. Overall, Science Parks enable a conducive environment for innovation (Cadorin et al. 2017), engaging in

different activities, such as organising events to create an arena where researchers can encounter innovators and entrepreneurs. In this sense, Science Parks bring industry and universities closer together, inspiring them to participate in regional economic development; they are one example of regional innovation systems (Coenen 2007). In such systems, universities spread their knowledge through education and training programmes (Klofsten and Jones-Evans 2013; Vedovello 1997). These programmes target students, providing them resources to become self-employed (Huffman and Quigley 2002), but they also focus on entrepreneurs from Science Parks, in the form of formal courses or more original forms, such as breakfast seminars (Klofsten and Jones-Evans 2013). But universities can go beyond their role of qualifying individuals through the commercialisation of their research results (Cai and Liu 2015; Coenen 2007), and they can behave entrepreneurially by relying on their incubators to support entrepreneurial students (Huffman and Quigley 2002), providing facilities (Walcott 2002; Westhead and Storey 1995) and services needed to operationalise their new firms (Cadorin et al. 2017). This kind of interaction represents a formal link between universities and Science Parks.

The lack of financial resources is a common problem in the initial stages of a firm that entrepreneurs need to overcome. To help them through this challenging period, universities and Science Parks work together by promoting competitions where students present their business plans to a panel of judges and the winners receive funding from participating companies (Huffman and Quigley 2002).

The geographic proximity is the most perceived way of Science Parks and universities interacting for talent attraction. It is informal to the extent that the university is seen as a prestigious scientific institution, thus conferring a positive image to companies of all levels of maturity that choose to be located in its surroundings (Felsenstein 1994; Mellander and Florida 2011; Quintas et al. 1992; Tan 2006; Vásquez-Urriago et al. 2016). The physical proximity within a cluster triggers the existence of informal information networks (Tan 2006). Strengthened by personal contact (Cadorin et al. 2017) through for instance an alumni network (Huffman and Quigley 2002), it can enable the flow of information concerning the need for or the availability of talent, but also the mobility of human resources for the creation of new firms (Dahlstrand 1997), or for the transmission of knowledge and skills (Tan 2006; Zhu and Tann 2005). Companies can also convey the needs of technology users and can guide university research according to market demands through these informal networks of information (Martínez-Cañas and Ruiz-Palomino 2010). Moreover, as universities internally support the entrepreneurship spirit of its students and researchers (Bienkowska et al. 2016; Díez-Vial and Montoro-Sánchez 2016; Etzkowitz and Klofsten 2005; Klofsten and Jones-Evans 2013; Klofsten and Lundmark 2016; Martínez-Cañas and Ruiz-Palomino 2010), the physical proximity enables entrepreneurs from universities to use the facilities of Science Parks informally (Cadorin et al. 2017).

Talented individuals are known to be attracted to ‘progressive environments’ (Florida 1999, p. 71), with a high quality of life, infrastructures, employers, and other talent, which is what Science Parks seem to embody. In general, Science Parks do not need formal contracts with the university to create such environments, even though the involvement of the university in the park ownership or management

certainly implies one, making it a formal interaction (Albahari et al. 2013). However, the image of the Science Park and its brand (Cadorin et al. 2017) are crucial to attracting talent, and the informal interaction between the Science Park and the university lies in their mutual enhancement of image, through individual initiatives—for instance, academic publication of quality for the university—but also joined initiatives, such as research partnerships or co-organisation of events. Moreover, the interactions can be made directly by the Science Park management office (Löfsten and Lindelöf 2002; Martínez-Cañas and Ruiz-Palomino 2010; Phillimore 1999; Vedovello 1997), without implying the writing and signature of agreements each time.

The use of the Internet (social media, newsletters) by the Science Park, its tenant companies (Cadorin et al. 2017), the university, but also by mixed organisations owned by both the university and the Science Park are also informal interactions to be noted; they are useful in sharing needs for skills and particular profiles as well as events, successes, and a positive image of the environment; in other terms, to attract talent to the Science Park. Thus, the importance of social networks should not be underestimated; not only the virtual but also real ones, such as alumni networks (Huffman and Quigley 2002; Walcott 2002) that are precious resources to search for talent for the Science Park and the region, especially from their nearby university. Apart from alumni, the staff of the university can also use its network to observe the labour market of the Science Park. A case is described by Huffman and Quigley (2002, p. 407): 'a staff member of Berkeley's Haas School of Business Recruiting Office spends one day a week in Silicon Valley, marketing the business school directly to selected firms and collecting information on Silicon Valley hiring trends'.

Informal interactions between universities and Science Parks seem to occur more spontaneously and more easily to implement to the extent that formal agreements are costly (in time, money and human resources) to set up.

Informal and Formal Interactions to Attract Talent Depending on the Firm Maturity Level

The interactions collected from our literature review seem to be characterised by two dimensions: a degree of formalism and the alignment with a strategic aim, according to the maturity level of a firm or a new venture idea involved in the interaction. In this section, we present a model built on our collection of interactions collected in the literature given above. Our model (Table 3) displays common aims for the interactions sharing the same dimensions, which are in fact intermediary objectives of the interactions towards the attraction of talent in the Science Park.

The model proposed in this study is based on the motivations of the engaged university to interact with the Science Park or its tenants and vice versa in talent issues. The literature suggests that the university acts as a 'provider of talent, knowledge, and innovation' (Florida 1999, p. 68), and it feeds the region with a steady flow

of talent (Etzkowitz and Klofsten 2005). This process occurs first in the attraction of renowned scientists and engineers, who in turn attract talented students who are potential inventors and entrepreneurs as well as future skilled labour for park companies (Florida 1999), suggesting that the university plays both an entrepreneurial role by taking part in the local economic development and an engaged role by being involved in the social development of its region.

On the one hand, entrepreneurial universities and Science Parks interact both to assist the creation of new knowledge-intensive enterprises (Klofsten and Lundmark 2016) as well as to support the business growth of the park's tenant companies (Klofsten and Jones-Evans 2013). In this way, the purpose of the interactions and the way in which they occur are directly dependent on the maturity level of the companies involved, as well as the entrepreneurial behaviour of the university; and the attraction of talent to the park's companies is one of the desired results.

The level of maturity of companies varies within a spectrum that has its beginning in small firms in their initial phase of establishment, traversing to the companies that already have experienced management teams and well-established development programmes (Klofsten and Jones-Evans 2013).

University students and researchers, or even corporate employees, are potential entrepreneurs who can create new ventures, leading them through the early stages of the enterprise development. In order to adequately support new entrepreneurs, the universities can offer (i) training courses and programs to develop entrepreneurship; (ii) consulting with business advisors; and (iii) incubator facilities and services (Harper and Georghiou 2005; Klofsten and Lundmark 2016)—making it itself entrepreneurial. Interactions of the entrepreneurial university with well-established companies in the park occur, among other forms, through technology transfers, consultancies of specialised university personnel, or training of company employees or hiring researchers or graduate students by the companies involved (Harper and Georghiou 2005).

On the other hand, the existence of formal and informal links between university and industry was first mentioned in 1981 by the OECD, and for example, Löfsten and Lindelöf (2002) used this terminology in their research. However, our literature review has a much narrower focus, as it deals with Science Park-university interactions in order to attract talent for the Science Park. As we have been reviewing the literature concerning interactions between Science Parks or their tenants and their nearby universities, we have been guided by the proposition of a taxonomy of links that can occur between on park firms and the universities as proposed by Vedovello (1997). In this taxonomy, three categories of links are defined: formal links, informal links and human resources links. '[…] formal links […] presuppose the establishment of formal contracts between the partners, with both the commitment and the payment of fees previously established' (Vedovello 1997, p. 494). Informal links and human resources links do not require formal contracts. What differentiates these two categories is that 'human resources links' deal specifically with informal individual relations whereas 'informal links' concern material and knowledge exchanges. This taxonomy was found relevant and used by other authors, such as Phillimore (1999) for his study on the Western Australian Technology Park, and Bakouros, Mardas,

and Varsakelis (2002) study of Greek Science Parks. We also chose to use this categorisation; however, we chose not to keep the 'human resources links' (Vedovello 1997, p. 494). In our case, the attraction of talent for the Science Park is the aim of the interactions, so human resources issues should be considered as aims rather than as interactions. Thus, we define:

- Formal interactions as interactions implying a written agreement or contract between the Science Park or its tenants and the engaged university that can but does not necessarily involve a money transaction;
- Informal interactions as all the other interactions that are not determined by the establishment of a formal contract between the Science Park or its tenants and the engaged university.

Defining those two descriptive dimensions of the interactions collected in the literature, as showed in Table 2, enabled us to create our classification of interactions, all aiming at attracting and developing talent for the Science Park.

We observe that within each category, the interactions tend towards a common objective that is a step towards their ultimate goal of attracting talent for the Science Park. Indeed, we observe that:

- for firms or new venture ideas with a lower level of business maturity:
  - formal interactions tend to support talent creating their own businesses, resulting in the integration of talent in the Science Park;
  - informal interactions tend to create meeting places so that talent can find inspiration and resources to settle their business in the Science Park;
- for firms with a higher level of business maturity:
  - formal interactions tend to support businesses in spotting talent in the university, to be able to attract them after graduation;
  - informal interactions tend to create an attractive environment where businesses can spread their need for skills and meet talent.

The categorisation proposed in this paper based on two dimensions, i.e. degree of formality and degree of maturity, is summarised in Table 3 and further explored through the use of illustrative cases in the next section.

Illustrative Cases of Interactions

In the following section, we present six cases that describe university—Science Park interactions related to talent attraction. The cases are coherent with our model (Table 4):

Table 2 Interactions collected in the literature

		Interactions with Science Park tenants having a:	
		Lower maturity	Higher maturity
Formalism of interactions	Formal	Organise or participate in education and training programmes (Klofsten and Jones-Evans 2013; Vedovello 1997)	Recruitment of graduates (Hommen et al. 2006; Löfsten and Lindelöf 2002; Vedovello 1997; Walcott 2002)
		Provision of resources to help students become self-employed (Huffman and Quigley 2002)	Internship programmes (Hommen et al. 2006; Huffman and Quigley 2002; Walcott 2002)
		Commercialisation of knowledge (Cai and Liu 2015)	Scholarships in anticipation of employment after graduation (Huffman and Quigley 2002)
		Business plan competitions (Huffman and Quigley 2002)	Job fairs on the university campus (Hommen et al. 2006; Huffman and Quigley 2002)
		Breakfast meetings and seminars accessible through membership to entrepreneur club (Klofsten and Jones-Evans 2013)	Researchers and students' involvement in projects (Vedovello 1997)
		Use of university's facilities (Walcott 2002; Westhead and Storey 1995)	Engagement of university academic staff for consultancy (Vedovello 1997)
		Incubators (Huffman and Quigley 2002)	Involvement of universities in park ownership/management (Albahari et al. 2013)
		Regional innovation systems (Coenen 2007)	Headhunting (Zhu and Tann 2005)
	Informal	Support for academic entrepreneurship (Bienkowska et al. 2016; Díez-Vial and Montoro-Sánchez 2016; Etzkowitz and Klofsten 2005; Klofsten and Jones-Evans 2013; Klofsten and Lundmark 2016; Martínez-Cañas and Ruiz-Palomino 2010)	Marketing the business school to previously chosen companies and obtaining information regarding hiring trends (Huffman and Quigley 2002)

(continued)

Table 2 (continued)

		Interactions with Science Park tenants having a:	
		Lower maturity	Higher maturity
		Human resources flow, mobility resulting in the creation of new firms (Dahlstrand 1997)	Human resources flow, mobility resulting in the flow of knowledge and skills (Tan 2006; Zhu and Tann 2005)
		Students using Science Park's facilities (Cadorin et al. 2017)	Science Park brand/image (Cadorin et al. 2017)
		Personal contact (Cadorin et al. 2017)	Use of internet (newsletters and social media) (Cadorin et al. 2017)
		Physical proximity to the university. A location that confers status and prestige (Felsenstein 1994; Florida 1999; Quintas et al. 1992; Tan 2006; Vásquez-Urriago et al. 2016)	
		Informal information networks (Tan 2006)	
		Alumni network (Huffman and Quigley 2002)	Alumni network (Huffman and Quigley 2002; Walcott 2002)
			Fostering links between the university and park tenants (Löfsten and Lindelöf 2002; Martínez-Cañas and Ruiz-Palomino 2010; Phillimore 1999; Vedovello 1997)

Table 3 University—Science Park interactions to develop and attract talent

		Interactions with Science Park tenants having a:	
		Lower maturity	Higher maturity
Formalism of interactions	Formal	Support talent in the development of new ideas and creation of new firms	Support firms in spotting talent in the university, and create opportunities for temporary involvement
	Informal	Create meeting places so that talent can find inspiration and resources	Create an environment where firms can express their needs for skills

LARM

SPM and student organisations of Linköping University interact informally to promote recruitment fairs together annually, creating opportunities for companies, regardless of their maturity level, and students to get to know each other. In such interactions, Linköping University has a slight participation or even none. This practice is justified in the words of the SPM Community and Employer Branding Manager:

Table 4 Illustrative cases from Science Park Mjärdevi

		Interactions with Science Park tenants having a:	
		Lower maturity	Higher maturity
Formalism of interactions	Formal	Demola	
		LiU game awards	LARM
		LiU innovation	Sommarmatchen
	Informal	LEAD incubator	Östgötamorgon

> […] for matters regarding talent attraction, I have more interactions with student unions than with LiU as an organisation, because this is a more direct and faster collaboration.

SPM invites companies, but the contract and payment of the fee are carried out directly with the student union Lintek. Approximately 200 students and 35 companies participated in the 2017 edition.

LiU Innovation

LIU Innovation is owned by Linköping University with the mission to support academic entrepreneurship. Its primary aim is interacting informally with students and researchers to mature their business idea and prepare them with all necessary skills. In the end, the team should be self-sufficient and able to properly conduct their venture to grow into a valuable business in the next stage, that is for some ventures joining the incubator, LEAD. Although Linköping University owns LiU Innovation and is one owner of LEAD, they are housed in Science Park Mjärdevi facilities, immersed in its business environment and somewhat out of the academic context, representing a smooth integration of the academic and business environment and vice versa.

Sommarmatchen

Sommarmatchen is a 6-week programme promoted by LiU Innovation, where a group of university students have the opportunity to formally participate and get involved in projects of prospective or newly formed research-based companies of Linköping University researchers. Temporary hiring during summer holidays allows companies to test the students, who are required to take academic ideas to a different perspective, such as a market analysis.

The links generated by the programme are the basis for the future recruitment of students, allowing them to stay in the region after graduating. This opportunity

generation is one of the leading concerns of Linköping University, according to an innovation adviser at the LiU Innovation office, who states:

> […] make students stay and start their careers in this region is the challenge of the university, Mjärdevi and the Östergötland region.

LiU Game Awards

Linköping University annually develops a competition among entrepreneurial students called 'LiU Game Awards'. Science Park Mjärdevi formally participates as an event sponsor. In the competition, students present the games that they have developed, which are evaluated by experts from the gaming industry, and the best games are awarded. These events aim to support students with new ideas and business in their early stages.

Demola

Placing students and companies in contact is a means of building the students' entrepreneurial skills and facilitating attraction as they both have the opportunity to recognise the qualities of the other. Considering this, Linköping University offers an entrepreneurship course for interdisciplinary development in cooperation with the international development platform Demola. In this course, students can broaden their networks and also develop their professional skills. The projects are created based on real problems of the companies and students work in teams to offer a solution. The course promotes the integration of companies with students, who are able to demonstrate their qualities, which links to future recruitment. In addition, by working with other students and developing new solutions, there is also the creation of links between students, who may in the future develop a new venture together. Both situations contribute to the recruitment of young university talent.

Östgötamorgon

The purpose of attracting' talent is not limited to current students but extends to Linköping University alumni network. Former students are also desired. In order to attract former students back to the region, the County of Östergötland organises an event called 'Östgötamorgon' in collaboration with Linköping University, which is in charge of sending invitations to its alumni, Science Park Mjärdevi and twelve municipalities in the region of Eastern Sweden. The event consists of meeting around three times each semester in Stockholm for networking and attending lectures during

breakfast. The goal is to strengthen ties with former university students and bring them back to the region as they potentially have extensive business experience and can add value to both small and large park companies.

Conclusions and Implications

The reviewed literature as well as the illustrative cases suggest that universities have been playing their role 'in economic and social development' (Etzkowitz 2003, p. 110), assuming a mission 'in developing pedagogies and practices that stimulate entrepreneurial attributes and values, provide real insights into the entrepreneurial life-world' (Gibb and Hannon 2006, p. 90). By acting entrepreneurially, the university prepares and supports its students and researchers, as well as the workers of the Science Park, in all aspects involving entrepreneurship. This seems facilitated by the existence of a structure and diverse services provided in the associated Science Park—whether by the Science Park office itself or by the university. This engagement of universities in their social and economic environments, however, does not only benefit the emergence of new businesses, but also in-park consolidated companies, for instance. They might also gain the opportunity to interact with university students during their studies or even after graduation, allowing them to select the best professionals for them, in terms of qualifications and alignment with the company profile.

One of our main aims was to search the literature for theory regarding the interactions occurring between engaged universities and Science Parks to attract talent for on-park firms. While looking for an answer to our first research question, we noticed that some interactions are mentioned, but in most cases, university—Science Park relations and talent recruitment are treated separately in academic literature. Our literature review has highlighted the fact that these interactions can be characterised by two dimensions in particular: the degree of formality (Vedovello 1997); and the degree of maturity of the involved firm (Klofsten and Jones-Evans 2013). Our literature review has also raised questions regarding the stakeholders involved in the interactions: even though we have been focussing on interactions between the engaged university and the Science Park, both organisations gather multiple stakeholders: for instance, interactions can occur between the Science Park management office, or tenant firms, and between the university administration, or organisations belonging to the university, or even student organisations.

Furthermore, we have studied more in depth how the formal and informal interactions contribute to the attraction of talent, for firms with different levels of business maturity. Our classification of interactions has led us to distinguish four main types, thus answering our second research question: (i) creating meeting places, where firms can diffuse their need for specific skills and (ii) meeting talent (Huffman and Quigley 2002; Tan 2006), and (iii) where talent can find an attractive environment to start a new business (Cadorin et al. 2017; Díez-Vial and Montoro-Sánchez 2016); (iv) spotting talent (Hommen et al. 2006; Walcott 2002); and (iv) supporting talent in

their creation of new companies (Huffman and Quigley 2002; Westhead and Storey 1995). Beyond classifying the interactions collected from the literature, this theoretical model shows intermediary objectives that are used together by Science Parks and their nearby engaged universities to facilitate talent attraction.

Observing the interactions occurring between Linköping University and Science Park Mjärdevi for talent attraction enabled us to verify that these interactions illustrate what we have found in the literature. For example, firms with a higher level of maturity tend to create formal links with the university in order to renew their staff by recruiting graduates. Recruitment fairs and participation of university students in firm's projects seem to be efficient recruitment tools. On the other hand, new ventures or firms with a lower level of maturity take advantage of the formal links with the university to get a qualified support to develop their business. In this case, the university needs to be entrepreneurial and engaged in developing the entrepreneurship skills of its students by providing training programmes or helping them to develop their ideas by offering consulting services at innovation offices and incubators. The informal links occur mainly considering the geographical proximity of firms and universities as well as their participation in events. Young and senior talents can be reached in such events and recruited to companies either with high or low maturity levels.

A number of policy implications arise from this study for engaged universities, Science Parks and their tenant firms. Firstly, university managers might stimulate the entrepreneurial spirit of students and researchers, giving them the opportunity to network, develop their skills, and mature their ideas. Entrepreneurship courses that integrate students and researchers in firm projects, seminars and network events are examples of activities that can contribute to the qualification of the young entrepreneurs so that they are prepared to enter the incubator and later in the Science Park, retaining talent in the region.

Secondly, Science Park managers might be alert to the needs of their tenants and create opportunities for companies and talent to meet and get to know each other. The matching of interests will occur naturally when the environment is open to networking and interactions. Providing such environment should be one of the main objectives of the managers in order to attract university talent.

Finally, tenant firms need to understand that in order to attract university talent, they must increase their participation in academic activities, seeking to interact with students and researchers, so that they have the opportunity to get to know companies and their projects better. The participation of the company in academic courses besides contributing to the entrepreneurial training of the students also creates interpersonal and professional bonds that will influence a future recruitment cycle. In order to influence students positively when they are seeking employment, company managers should plan activities to advertise the brand and the company's areas of expertise, in addition to its needs for talent with certain skills. In addition, small actions, such as integrating students and researchers into their networks, creating links and encouraging the discovery of common interests among academics and entrepreneurs, can also contribute to attracting academic talent.

Future research could explore to what extent tenant firms can influence the content of the teaching offer of the engaged university. It could also investigate to what extent

the university influences the choices of its nearby firms to orientate their activities towards an area covered by the university, both in terms of research and education. Such studies could develop policy implications for universities to closer adapt their curriculum to the needs of the society, benefiting themselves, as well as the workforce, businesses, and also the economy as such.

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Engagement Through Communication: Communicating Scientific Knowledge to SMEs

Sarai Løkkegaard and Marianne Lykke

Abstract In this chapter, we work from the assumption that university engagement can be fostered by addressing the dissemination of scientific knowledge as a communication process, and we explore how university engagement can be encouraged through the communication of scientific knowledge to SMEs (small and medium-sized enterprises). First, a literature review allows for the identification of well-known barriers to the dissemination of scientific knowledge to SMEs. Second, an empirical study of the 'situation' of eight Danish SMEs provides insights into their situation (circumstances, barriers and potentials) in relation to scientific knowledge, which must be taken into account in attempts to communicate scientific knowledge to SMEs. Based on this analysis, we discuss solutions and outline some communicative principles that can contribute with a solution-oriented perspective on how communicating scientific knowledge to SMEs can foster university engagement.

Keywords Engagement · Small and medium-sized enterprises (SMEs) · Scientific knowledge · Communication · Knowledge dissemination · Qualitative study

Introduction

This chapter explores how university engagement can be fostered through the communication of scientific knowledge to SMEs (small and medium-sized enterprises). SMEs are defined as "enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding EUR 50 million" (European Commission 2015, p. 3). It is relevant to focus on SMEs because they are the backbone of many countries around the world. For example, nine out of every ten enterprises in the EU are SMEs, and in 2013, over 21 million SMEs provided 88.8 million jobs throughout the EU, which corresponds to two out of every three jobs (European Commission 2015). Accordingly, optimising the dissemination of scientific knowledge to SMEs is a relevant focus area regarding the creation of engaged universities because this

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optimisation could create value for not only SMEs and universities but also for society at large.

We work from the assumption that the dissemination of scientific knowledge is a communication process. Communication (lat. *communicare*) means to exchange information, to make something common or to share insights. To communicate is to convey meaning between two or more parties, and accordingly, the motivation behind communication is to achieve understanding (Heath and Bryant 1992). While there is no shortage of definitions of communication (see, for example, Dance 1970), the basic constituent elements of a communication process are simple (Oates 1964): a sender, a message (and the passing on of this message) and a receiver. These three basic constituent elements are also involved in a process of disseminating scientific knowledge: the university, scientific knowledge (and the dissemination thereof) and SMEs.

A variety of channels are used to disseminate scientific knowledge to SMEs. These include *generic pathways* (e.g., patenting, commercialisation and scientific publications) and *relational pathways* (e.g., graduate recruitment and faculty consulting) (Corral de Zubielqui et al. 2015). An understanding of relational pathways as being more suited to the communication of scientific knowledge appears to be prevalent (see, for example, Abbasnejad et al. 2011; Cronholm and Sandell 1981; Geuna and Muscio 2009; Lock 2010). However, Corral de Zubielqui et al. (2015) state that SMEs are most likely to acquire scientific knowledge using generic, tangible, transactional pathways rather than pathways with high relational involvement. Using generic pathways, they state, suggests the use of weak ties in the search for useful knowledge. Relational pathways require more developed and stronger ties, which engender more trust and therefore lead to more effective knowledge dissemination. However, while relational pathways may offer rich opportunities for knowledge dissemination, one downside of these relational pathways is that they require high levels of co-ordination, collaboration and sustained interaction. Generic pathways, on the other hand, rely on impersonal forms of dissemination and are thus less demanding for the involved parties. One limitation of generic pathways, however, is that they require knowledge to be explicit rather than tacit (Polanyi 1966) and encoded rather than embodied (Blackler 1995). For that reason, knowledge dissemination through generic pathways may be considered less rich. However, while generic pathways have their limitations, they appear to be SMEs' preferred channel via which to access scientific knowledge. For that reason, this chapter explores how the dissemination of explicit scientific knowledge (i.e., journal articles, research units or press clippings) through generic pathways can be optimised—and thus how the ties involved can be strengthened—as a means of fostering university engagement.

We will begin the chapter by conducting a literature review regarding barriers to the dissemination of scientific knowledge between universities and businesses/industry (including SMEs). This will provide insights into known issues, barriers and solutions. After that, we will conduct a qualitative study addressing the 'situation' (Clarke 2005) of SMEs in Denmark. This will enable us to identify problems and potentials related to SMEs' use of scientific knowledge, as identified by the SMEs themselves. The analysis will allow us to outline four principles for

the communication of scientific knowledge to SMEs. As we will show, these communicative principles contribute to an understanding of how communication can foster university engagement. The contribution of this chapter is thus threefold: (1) it explores the dissemination of scientific knowledge as a communication process, (2) it provides an in-depth understanding of SMEs' situation in relation to scientific knowledge and (3) it offers some concrete suggestions (communicative principles) regarding how scientific knowledge can and should be communicated to SMEs based on this understanding of their situation.

Literature Review: Barriers Related to the Dissemination of Scientific Knowledge to SMEs

In this section, we will review the barriers to the dissemination of scientific knowledge to SMEs. The barriers addressed here are not exhaustive. We focus on barriers related specifically to the size of the enterprise and to the dissemination (communication) process. However, such a review quickly becomes complicated because of a diverse terminology used within this field of study. Therefore, a few clarifications are in order before we begin. While we use the term 'dissemination', much of the literature referenced in this chapter uses different terms and approaches to the dissemination process, i.e., collaboration, transfer or exchange. While there are differences regarding what these terms mean, they all somehow refer to the process of *knowledge being passed on between parties*. Accordingly, our understanding is that these terms all cover aspects of a communication process. However, their communicational perspectives vary. While knowledge exchange, for example, is defined as a two-way flow of information (see, for example, Acworth 2008), knowledge transfer is a one-way flow of information, in which knowledge is simply transmitted from one party to another. Collaboration can be understood as a more demanding type of communication in which ongoing relational contact is required, as opposed to dissemination, which does not necessarily require interpersonal contact. When we use the term 'dissemination', however, this refers to a somewhat one-sided understanding of communication. We explore how universities can improve their engagement in communicational efforts based on an in-depth understanding of the target group (SMEs). Although the literature referenced in the following uses various terms and approaches to the dissemination process, we include it here because it provides perspectives on barriers to the dissemination process.

Barriers to Communication

A fundamental barrier to the dissemination of scientific knowledge to SMEs is that a cognitive and social distance exists between the university and the enterprise

(Bellefeuille and Rice 2002; Lakpetch and Lorsuwannarat 2012; Muscio and Pozzali 2013; Muscio and Vallanti 2014; Santoro and Bierly 2006). This distance can be observed at several levels. For example, universities and enterprises have different expectations, interests, and motives for engaging in knowledge dissemination (Foley 1996; Gattringer et al. 2014; Muscio and Vallanti 2014; Siegel et al. 2003). Because of this fundamental cognitive and social distance, several problems occur when scientific knowledge is disseminated to SMEs. For example, universities and SMEs may have different opinions about what constitutes sufficiently clear and timely communication. According to Bucchi and Trench (2014), some translation is required to establish a connection between science and society at large (not SMEs specifically) in terms of making the elements of the science domain approachable, understandable and appealing. This translation process suggests the need for revised communication efforts.

Poor or non-existent communication is a significant barrier to the dissemination of scientific knowledge. The fact that universities are bad at promoting their scientific knowledge and must do more to make businesses aware of it is mentioned frequently in the literature (Decter et al. 2007; Draghici et al. 2015; Philbin 2012; Ranga et al. 2008; Schofield 2013; Siegel et al. 2004). As a consequence, SMEs may not even know what scientific knowledge exists or how this knowledge can be acquired. Ranga et al. (2008) state that although small firms only rarely interact with universities and similar organisations, this is not the result of a lack of interest on behalf of the small firms but rather the consequence of poor communication regarding the opportunities offered. However, scientific research is commonly conducted and financed with a scholarly goal in mind and within a specific context. Time and money are not often allotted for translating research into other settings. This has focused attention on scientists' communication abilities. As argued in the Bodmer Report (1985, p. 6), 'scientists must learn to communicate with the public, be willing to do so, and indeed consider it their duty to do so.' Expecting scientists to be capable of communication is problematic (Burchardt 2007). While scientists are adept at performing their research, they are not necessarily adept at disseminating this research to laymen. Consequently, scientists are now offered courses in scientific communication, and universities often have communication units, journalists, or technology transfer offices (TTOs) to help transform science and research into news and patents.

Alves et al. (2007) concluded that universities usually lack proper mechanisms via which to disseminate scientific offers, i.e., scientific knowledge. They point to co-ownership interfaces as part of the solution. These can be cooperative platforms that improve the relationship between universities and businesses by mediating communication. It has been widely concluded that the lack of a functional interface or system for knowledge exchange between universities and businesses is a central part of the problem (Ankrah and Omar 2015; Decter et al. 2007; Kelli et al. 2013; Massingham 2015).

Opinions regarding which channels to use to disseminate scientific knowledge differ considerably. Some find the problem to be a lack of interpersonal relationships and communication (Alexander and Childe 2013; Fukugawa 2013; Gertner et al. 2011; Lee and Win 2004; Wang 2013). Others point to the use of contractual

and sporadic contacts rather than long-term contacts (Alves et al. 2007; Chen 1994; Nielsen and Cappelen 2014; Santoro and Bierly 2006; Wang and Lu 2007). A qualitative study by Boehm and Hogan (2013) found that the existence of open, honest, personal and especially frequent communication is a factor in success for all parties. Bruneel et al. (2010) and Liu and Sharifi (2008) found that to ensure successful communication, several channels must be used in order to make it easy for firms to contact universities.

Barriers Related to the Size and Resources of the Enterprise

In the literature addressing the dissemination of scientific knowledge between universities and businesses/industry (including SMEs), the size and resources of a given business are well-known factors. Due to the smaller scale at which SMEs operate, they generally have fewer employees and limited financial resources for in-house research and development. Such limited capacities and resources hinder the efficient dissemination of scientific knowledge (Ankrah and Omar 2015; Corral de Zubielqui et al. 2015; Decter et al. 2007; Fukugawa 2013; Lock 2010; Ranga et al. 2008; Yusuf 2008). Consequently, SMEs have a greater need to access external knowledge (Hausman 2005; Ranga et al. 2008; Woolgar et al. 1998). Freitas et al. (2013, p. 52) address this problem directly: "Small firms often possess few of the spare resources (financial resources, personnel, managerial skills) needed to initiate and organise a contract with a cognitively and socially distant organisation such as a university."

The attention paid to business size and resources is often related to a firm's *absorptive capacity*. Absorptive capacity is a well-known concept within this field of study. The term originates from research by Cohen and Levinthal (1989, 1990) and refers to a firm's ability to use external scientific knowledge. The smaller the firm, the smaller its absorptive capacity. Muscio (2007) and Comacchio et al. (2012) specifically mention that SMEs have less absorptive capacity than larger companies. Given this perspective, it can be concluded that SMEs require more help accessing and implementing scientific knowledge.

A relevant understanding of SMEs' situation is expressed by Ranga et al. (2008), who cite Woolgar et al. (1998) in defining the *SME-centric universe*. In this approach, SMEs are at the centre of their own world. They are not isolated, and they relate most intensively with their suppliers and customers. Universities fall well outside of SMEs' focus because SMEs have very specific and specialised concerns, to which the notion of research needs is largely remote. Because of this, communication between universities and SMEs often fails to happen. Similarly, Corral de Zubielqui et al. (2015) found that SMEs tend to form expressive ties with organisations and people within their supply or value chains. Such organisations are primarily customers and suppliers. SMEs, consequently, overlook universities when appropriating information and new knowledge.

It is commonly accepted that because they have more in-house resources, larger enterprises can more easily and more efficiently use the knowledge of external

sources, such as universities (Abbasnejad et al. 2011; Ankrah and Omar 2015; Freitas et al. 2013; Lee and Win 2004; Ramos-Vielba et al. 2010). Alves et al. (2007) emphasise that universities tend to have privileged relationships with large firms rather than SMEs because universities are more likely to cooperate with firms that invest in research and development and have human resources dedicated to that task. Decter et al. (2007, p. 145) argue that 'ironically, companies that may be most able and likely to license university research are those who already have a reasonable level of research capability.' Supporting this, after studying 1,226 SMEs, Corral de Zubielqui et al. (2015) found that only a modest proportion of SMEs collaborated with universities. In conclusion, SMEs are not likely to access the above-mentioned knowledge, even though they are eager to acquire it. While most of the literature mentioned here focuses on collaborations and relational pathways rather than dissemination or generic pathways, the lesson to be learned related to the focus of this chapter is that while SMEs can benefit from external knowledge, such as scientific knowledge, they often have difficulties absorbing it. This can be interpreted as a way to potentially improve the communication of scientific knowledge to SMEs.

Qualitative Study: The Situation of SMEs

In this section, we present the results of an empirical study on the 'situation' of eight Danish SMEs (Løkkegaard 2018; Løkkegaard and Lykke 2016). Our goal is to understand SMEs' use of scientific knowledge and discuss how the dissemination of scientific knowledge to SMEs can be optimised in order to foster university engagement. More specifically, we focus on analysing why, how, and where SMEs look for knowledge and what barriers and potentials they attach to this process. We will continually refer to the literature to support and challenge our findings.

Research Design

We chose a qualitative and exploratory approach for our research and were inspired by situational analysis (Clarke 2005). Studying the situation of the target group means studying the people and context involved and thus understanding their reality and points of view. Situational analysis offers an empirically and epistemologically sound approach to the study of social life through qualitative research. In situational analysis, the action-centred concept of basic social processes, which is the conceptual infrastructure of grounded theory, is replaced with a situation-centred framework of social worlds/arenas/negotiation. In situational analysis, the "situation per se becomes the ultimate unit of analysis, and understanding elements and their relations is the primary goal" (Clarke 2005, p. xxii).

As noted by Corral de Zubielqui et al. (2015, p. 438), "micro firms may behave differently from small firms which may behave differently from medium-sized firms."

To capture these differences, we chose a purposive sample (Patton 1990) of SMEs based on a principle of maximum variety (Sandelowski 1995) regarding demographics and enterprise type. We limited the enterprises to knowledge-intensive firms (Alvesson 1993; Blackler 1995), of which four types of services can be identified: (1) high-tech knowledge-intensive services, (2) knowledge-intensive market services, (3) Knowledge-intensive financial services and (4) other knowledge-intensive services (Eurostat 2016). Regarding demographics, we chose SMEs with diverse characteristics in terms of size, age, field and location. In choosing eight SMEs, our intent was to include two SMEs with different demographic characteristics from each knowledge-intensive service category. Table 1 shows the SMEs and their characteristics.

As Table 1 shows, we did not succeed in including two SMEs from each knowledge-intensive service category because several SMEs declined to participate due to a lack of time. Furthermore, the variation regarding location is especially far from optimal.

Our study of SMEs' situation involved three data-collection methods: (1) introductory interviews with eight CEOs (or the like) to obtain an understanding of the firms' missions, goals and overall working methods; (2) eight walking observations and interviews, which Kusenbach (2003) calls 'go-alongs', during which we conversed with CEOs and employees and observed their arrangements, ways of working, and the tools available; and (3) 29 semi-structured interviews with employees at the eight SMEs. The positions of these employees are outlined in Table 2. The purpose of the twenty-nine interviews with employees was to obtain their views on their everyday work assignments and processes and to learn about their relationships with universities and scientific knowledge. More specifically, we asked how and where they search for new knowledge in relation to their work, what their immediate understanding of universities and scientific knowledge was and what obstacles and potentials they identified in relation to scientific knowledge. The interviews ranged in length from 9 to 61 min, and all interviews were audio-recorded and transcribed. Together, these data provide an in-depth understanding of the situation of SMEs and allow us to characterise their general practices.

To analyse the data, we conducted a thematic analysis, which is a qualitative research method used in searching for aggregated themes within a dataset (Gibson and Brown 2009). A thematic analysis is an exploratory and inductive way of opening up a dataset and splitting the material into themes and codes, which are then strongly linked to the data themselves. Accordingly, it reflects an open-coding process in which data are examined, compared and categorised over several iterations (Bryman 2012; Kvale and Brinkmann 2015). We categorised unedited quotes obtained from the 37 interviews, and after several iterations, each quote was made into a theme that consisted of a number of codes. We will present these data in two ways. Primarily, we will use quotes from the interviews to exemplify some of the themes and codes. Secondarily, the number of quotes (n) associated with each code has been tallied. Because of the open-ended questions, not all respondents answered all questions, and it was also possible for them to provide more than one answer per question. Because of this, the number of quotes may vary.

Table 1 Overview of SME characteristics

Field	Number of employees	Enterprise age (at the time)	Geographical location	Type of knowledge-intensive service
Marketing and sustainability	2	1 year	Aalborg	(2) Knowledge-intensive market services
Architecture and design office	11	19 years	Aalborg	(2) Knowledge-intensive market services
Social media	15	5 years	Aalborg	(2) Knowledge-intensive market services
Advertising and counselling	25	3 years	Aalborg	(2) Knowledge-intensive market services
Concerts and cultural activities	150	1 year	Aalborg	(4) Other knowledge-intensive services
Engineering and technology development	165	21 years	Nørresundby	(1) High-tech knowledge-intensive services
Energy production and energy trade	220	16 years	Aalborg	(1) High-tech knowledge-intensive services
Banking and financing	250	100+ years	Sæby	(3) Knowledge-intensive financial services

Findings from the Practice Study

Our findings show that SMEs were predominantly problem-oriented in their search for knowledge. Fewer employees and scarcer financial resources caused SMEs to look for new knowledge primarily when facing a specific and pressing job-related problem. Only secondarily did they look to effect a general update of their knowledge or find inspiration or ideas for job assignments. When the respondents provided reasons for their need to solve a specific and pressing problem, the following codes were identified: to 'Update or upgrade skills' (n = 11), to live up to a 'Constant need

Table 2 Positions of interviewed employees

Trade	Interviews
Marketing and sustainability	(1) Owner and sales manager, (2) communicator
Architecture and design office	(1) Partner and constructing architect, (2) technical assistant, (3) constructing architect, (4) accountant, (5) architect
Social media	(1) Owner/partner, (2) community manager, (3) graphic designer, (4) PHP web developer, (5) social media developer and instructor
Advertising and counselling	(1) CEO/partner (2) frontend developer, (3) creative director, (4) project manager, (5) communication director
Concerts and cultural activities	(1) CEO, (2) program manager, (3) manager of sales and marketing, (4) event coordinator, (5) ticket and information coordinator
Engineering and technology development	(1) CTO; design services; (2) vice president, design services; (3) senior project manager; (4) engineer, (5) project manager; (6) CEO, development and operations
Energy production and energy trade	(1) Head of communications, (2) senior developer and team leader, (3) head of risk management and quantitative analytics, (4) trader, (5) quantitative analyst and portfolio manager
Banking and financing	(1) Manager of private customers, (2) manager of business customers, (3) back office employee, (4) guidance counsellor, (5) private customer counsellor

for development' (n = 10), to 'Find new solutions' (n = 7), to 'Be first movers/at the forefront' (n = 4), to 'Meet externally imposed demands' (n = 2) and to 'Save time and resources' (n = 2). All these codes are related because they address a need for SMEs to constantly evolve and continually justify their existence.

> We make our living on selling our knowledge, so we have to constantly develop it. Otherwise, we cannot continue to sell it.
>
> It is a world that is constantly moving. The way it is today is not the way it was yesterday, and it will not look that way tomorrow either. So, it is a process of continuously allocating an amount of time for knowledge development to gain new knowledge and find out how to actually use it in practice.
>
> But as a rule, it is important. We cannot even operate in the market if we are not at the forefront, because things are going so fast.

These quotes bear witness to the fact that SMEs are not just under a constant time and resource pressure, which is a well-known barrier within this field, but also under constant developmental pressure, which makes new knowledge extremely valuable to SMEs. However, several circumstances can pose barriers to the assimilation of new knowledge.

Barriers Related to Knowledge in General

When asking the respondents about what barriers to finding new knowledge they could identify, 'Time/busyness' was the most frequently mentioned barrier (n = 24):

> If I had time, I would study semiotics, but of course, I do not, because I work very, very much. Actually, I am not ever really off.
>
> I guess it is also the time. We just work on and on. It is not like we have a lot of time to sit and reflect on things. It is cut to the case all the time.
>
> I rarely have time for it at work. Then, it is called free time. Interested free time.

Another frequently-mentioned barrier was that knowledge is 'Difficult to find/convert into something concrete' (n = 11). This barrier points to scientific knowledge being too general to be useful for enterprises (Gilsing et al. 2011) and too difficult to translate into practice (Alves et al. 2007; Gattringer et al. 2014). One respondent articulated this point as follows:

> Knowledge, to me, is useless if I do not know how to transform it into something solution-oriented. If I were to sit down and read a book about some piece of advanced technology or whatever, that knowledge would be worth nothing to me if I did not know that I would somehow be able to convert it or use it. Then, it is useless to me. I have often read something that has turned out to be a waste of time because I never found out how to use it. So, I could spend a lot of time and a lot of wasted time on gaining knowledge, but it would be wasted knowledge because I would not use it. I would not convert it.

A related barrier was that SMEs 'Do not know what they need to know' (n = 2). While this was a less-mentioned barrier, it is very illustrative of the situation of SMEs:

> Sometimes, it can be difficult to gain access to that knowledge because if I do not know what I need to know, then it is difficult to find it, but I guess that is a traditional problem for many, I think: if you knew it, why then look for it? Then, it might be that sometimes, I have to create some knowledge others may have created before. I simply do not know that they did.

This quote indicates that SMEs cannot be expected to search for something when they do not know what it is they are searching for. The fact that these SMEs lack time and resources enhances this problem. These SMEs require that the solution appear quickly and be directly implementable in their work processes. Other frequently mentioned barriers were that 'Too much material is available' (n = 7), which indicates that SMEs have a hard time finding relevant knowledge, and 'Business as usual/we know best ourselves' (n = 9), which indicates that SMEs tend to follow the procedures they are accustomed to, as indicated below:

> I search for what I know and what I know to be good. Otherwise, I use my network and call someone and say 'I need this, do you know something good?' I cannot find that online, I think.
>
> I think that is one of our challenges, that we very much have a blind faith in the notion that we know best ourselves.

These quotes show that the SMEs were explicitly aware of their routine-based use of knowledge, i.e., that they "search for what they know to be good". Thus, SMEs may

not experience a need for new knowledge. This relates to what is often identified as a lack of "pull" from business (Decter et al. 2007; Siontorou and Batzias 2010; Szejko 2002; Wang and Liu 2007), or a lack of motivation to acquire external knowledge, which can result in passivity. On a similar note, the existing literature indicates that firms often experience a lack of convergence of interest with universities and that scientific knowledge is not in sync with the needs of businesses (Alves et al. 2007; Barbosa and Romero 2012; Bearden et al. 1995; Bellefeuille and Rice 2002). The fact that firms have a hard time identifying their own needs in relation to scientific knowledge was also mentioned (Alves et al. 2007; Freitas et al. 2013). While our analysis confirmed several of these findings, it also documents perspectives on SMEs' experiences and shows that the reasons for SMEs' use of scientific knowledge are complicated.

Barriers Related Specifically to Scientific Knowledge

Regarding scientific knowledge in particular, the barrier most commonly mentioned was 'Ignorance' (n = 20). This included SMEs being unaware of what universities could potentially contribute. The SMEs did not know what subjects' universities engaged in or whether that knowledge could be relevant to them:

> I would have to know what they have to offer at universities. It is too unclear. It could be really great, but it is just confusing because the university is many things.
>
> But purely technically, how we can use one another? I have difficulties connecting that because they do not know my point of view and I do not know their knowledge about it.

At the same time, SMEs took the immediate attitude that scientific knowledge is 'Not relevant/have no need for it' (n = 12):

> I have not had a need for it, and I have a legislation I have to follow, and I guess research is a stage before legislation, so I have not had the need to talk to any scientists yet.
>
> I have not found anything out there recently that has been of interest to my area, and therefore, it is just not the road I take.
>
> What is really important to us is knowledge about market and strategy and knowledge about creativity. I do not know. I do not think that the university has a role to play there.

Furthermore, they perceived a significant 'Lack of communication/exposure' (n = 13). These results echo what was mentioned in the literature review. One related barrier was that SMEs found it 'Difficult to find/search for scientific knowledge' (n = 13). The fact that they often found it unclear what subjects universities address and what can be done with this knowledge even if it were known enhances this barrier.

One barrier related to the *form* of the knowledge was that scientific knowledge is considered 'Too theoretical/specialised, not concrete/practicable' (n = 19):

> Often, what they work on at universities or at the university here is actually at a different, abstract level, a more academic level than what we need. It is much more a practical level we really need, and you may find a solution that is not be very academic but functions okay anyway in a product you develop.

> We are not a Novo Nordic that donates five years to conduct research within a specific subject. Our use of the university must be much more application-oriented, and it must be something that meets a specific need.

Similar results have been found in other studies indicating that scientific knowledge is too difficult to translate into practice (Alves et al. 2007; Gattringer et al. 2014). The barrier of scientific knowledge being 'Overly heavy material/not results-oriented' (n = 9) is also related to this point. Changing this situation would require a great deal of translation on the part of individual scientists and communications specialists. Still, this circumstance cannot be ignored if university engagement is to be fostered through communication with SMEs. Scientific knowledge must be presented differently, which will require its reorganisation. However, this is not easy. The black box model (Ndonzuau et al. 2002, p. 282) illustrates that transforming scientific results into economic value is unknown territory and involves numerous obstacles and other sources of resistance. For enterprises, especially SMEs, it is risky to pursue this strategy. In conclusion, certain fundamental characteristics of scientific knowledge complicate its communication to SMEs.

Another considerable barrier was 'Overly long-term/overly long production times' (n = 10). SMEs generally work on a short-term basis, while universities often have long-term goals. Because of constant time and development pressure, SMEs cannot wait for scientific knowledge to be produced, published and commercialised. Because of this, it often remains beyond reach. Siegel et al. (2004, p. 121) addressed this point, stating that firms expressed great anxiety about 'time to market,' which underscores the fact that time horizons are an important topic for enterprises engaged in knowledge dissemination.

Our findings indicate that SMEs are prone to think that scientific knowledge is too advanced for them, as was also mentioned in the existing literature (Alves et al. 2007; Bearden et al. 1995; Muscio and Pozzali 2013). The respondents' descriptions of their immediate perspectives on universities supported this: while opinions of universities as a 'Good/interesting/usable' resource dominated the results (n = 12), negative attitudes toward universities, such as their being 'Not relevant' (n = 4)', 'Too theoretical/not practicable' (n = 6) or 'A closed world' (n = 4), were also mentioned frequently. This shows that aspiring to improve university engagement through communication is justified but that classical presumptions must still be overcome.

Potentials of Scientific Knowledge

Our study contributes with a solution-oriented perspective on the potentials to scientific knowledge as identified by SMEs themselves, which can be used to improve the dissemination process. When asked about the potentials of using scientific knowledge, the most frequently given answer was 'Access new/useful/specialised knowledge' (n = 24).

> Well, I believe that they (the university, red.) are always 100 percent updated. I have the idea that they are. That is my immediate assessment, without having anything to back it up. I would think that you have the required theoretical knowledge.
>
> The universities also have a good approach to the constructional. They contribute a great deal in terms of research and design.
>
> And because we believe that the people sitting in the universities are best at it.

Also mentioned frequently were 'Talent development/recruitment' (n = 9) and 'Product development/problem solving' (n = 8). Some of the less mentioned codes in this theme are also interesting, i.e., to 'Be first movers/at the forefront' (n = 2), that scientific knowledge is 'Neutral/unbiased knowledge' (n = 2) and that it can be used to ensure 'Backing/credibility' (n = 2). These codes give certain ideas about what SMEs can use scientific knowledge for:

> But if there is something to say for it, this is, as I see it, a neutral attitude towards a specific issue or subject, where there is no commercial interest. I see that as incredibly positive.
>
> The customers do not give a shit about quality and price. They are after completely different things, and we have been out telling the customers that this is knowledge, that we have it from these two professors and that it is about price not even being that interesting.
>
> To refer to that division for energy planning again, they have spent a lot of resources on researching the future of power plant heat: smart, intelligent energy systems. Some of the results they have found are, for us, a perfect match to the business model we have and actually some of what we already do. This gives us some authority when we are marketing our services, that there is scientific backing.

It is worth noticing that all the codes identified in this theme refer to attributes that can help SMEs optimise their business conduct. As analysed above, scientific knowledge can, in fact, be valuable to SMEs, and accordingly, these codes can be used to concretise scientific knowledge and communicate arguments to convince SMEs that scientific knowledge is valuable and worthwhile.

Channels Via Which to Find New Knowledge

Exploring how and where SMEs look for new knowledge can reveal ideas about the most effective channels via which to communicate scientific knowledge. 'Colleagues' (n = 33) were the most frequently mentioned channel via which to acquire new knowledge. This implies that SMEs prefer to access knowledge through personalised relational channels, which is a quick and cost-effective way of learning something new. Also, the knowledge gained in this way is immediately available and directly practicable. However, asking a colleague can also nurture a habitual way of thinking and working, indicating a lack of motivation or the need to look for new external knowledge. However, the respondents mentioned 'Online searching' (n = 31) nearly as often as 'Colleagues', which implies that there is, in fact, a desire to look beyond the enterprise for ways of solving tasks. The behaviour of engaging in online searching also points to the need for quickly accessible and inexpensive knowledge. The mentions of 'Rival companies' (n = 15) and 'Previous projects' (n = 9)

both indicate a need for knowledge to be experience-based. The use of 'Market- and business-oriented online forums' (n = 11) and 'Social media' (n = 9) indicate an orientation toward ad hoc knowledge that provides ideas and inspiration specific to the market and business.

Discussion

Our qualitative study of the situation of SMEs contributes with new perspectives on how SMEs' experience and use scientific knowledge and what barriers and potentials they themselves identify in that regard. Several of the insights derived from our analysis echo insights obtained from the literature review. In this way, our study strengthens the common knowledge of the field and also contributes with new and nuanced insights into the perspectives of SMEs and their requirements regarding external knowledge acquisition. The discussion of the findings will show what the dissemination of scientific knowledge to SMEs must take into account and how this can help foster university engagement. A simple model of or universal solution to communicating scientific knowledge to SMEs does not exist. However, some communicative principles can be outlined.

First, our findings have indicated a need to promote scientific knowledge. Our findings show that SMEs have difficulties finding and even searching for scientific knowledge. We have stressed the importance of universities promoting scientific knowledge and thus showing SMEs that it exists and where to find it. From SMEs' perspective, researchers do not always clearly convey what problems they are attempting to solve. The fact that universities are bad at promoting their scientific knowledge and must do more to make businesses aware of it (know that it exists, understand it and search for it) was also frequently mentioned in the literature.

The lack of communicative effort in terms of the presentation and promotion of scientific knowledge is a considerable challenge. Understanding the situation of SMEs means accepting that they will not be the proactive party in the communication process. SMEs need universities to show them what subjects these universities address, how to convert this scientific knowledge into something practicable and how this knowledge can contribute to business operations. Promotion can help diminish SMEs' ignorance of scientific knowledge. Accordingly, to foster engagement through communication, universities must strive to be proactive parties and demonstrate to SMEs what universities do, where scientific knowledge can be found and how it can be of value to SMEs.

Second, our findings show that there is a need to reorganise scientific knowledge. We found evidence that SMEs prefer experience-based and problem-oriented information rather than theoretical and specialised information, and we have shown that SMEs often deem scientific knowledge too theoretical/specialised and not concrete/practicable. In order for SMEs to be able to implement scientific knowledge to resolve their own situations and issues, they require scientific knowledge to be practically oriented, rather than theoretical, and general, rather than too specific.

Furthermore, they need scientific knowledge to be application-oriented and usable in order to meet specific needs. Accordingly, to foster university engagement, universities must consider ways of transforming their scientific knowledge into products that meet SMEs' criteria.

Third, our findings indicate that SMEs require scientific knowledge to be concretised. The university must show SMEs what subjects scientific knowledge addresses and what types of knowledge products exist. Furthermore, how this knowledge can be used to solve specific, practical work-related problems must also be illustrated. Concretising scientific knowledge means offering examples of how it can be translated into practical use and profitability. This means focusing on results rather than methods. Universities must provide such exemplifications and concretisations in order to foster engagement.

Fourth, scientific knowledge must be provided to SMEs. It is important that it be easy for SMEs to find scientific knowledge. Our results suggest that it could be beneficial to provide scientific knowledge where SMEs already look for new knowledge, i.e., websites, market-specific communities, business networks and physical arrangements. In conclusion, the communicative principles for disseminating scientific knowledge to SMEs are as follows:

(1) Promoting
(2) Reorganising
(3) Concretising
(4) Providing

In addition to these communicative principles, another contribution of our study is that it pointed out the potentials that SMEs ascribe to scientific knowledge. These potentials can be used as arguments to convince SMEs to use scientific knowledge. To 'be at the forefront', 'save time and resources', 'meet externally imposed demands', 'find inspiration', 'upgrade skills' and 'access new/useful/specialised knowledge' are all attributes that can help optimise the running of a business when only scarce resources are available. Communicating these potentials can make scientific knowledge appear more attractive to SMEs and motivate them to upgrade their use of it. In this way, university engagement can be fostered by proactively disseminating scientific knowledge to SMEs, thus showing these SMEs that they do not always know best themselves and that scientific knowledge can be both valuable and relevant to them.

Conclusion

To ensure engagement through communication, universities must accept that SMEs will not be the proactive parties in the dissemination process. SMEs need the university to take on this role. Accordingly, universities must ensure that their scientific knowledge is (1) *promoted*, thus making it visible and drawing SMEs' attention to it;

(2) *reorganised* according to SMEs' needs, i.e., made problem-oriented and practicable; (3) *concretised*, thus showing SMEs what subjects are addressed and how they can be used and (4) *provided* on platforms already used by SMEs, thus optimising SMEs' searches for the information. Collectively, using these communicative principles can foster university engagement because it can help reduce SMEs' ignorance and motivate them to use scientific knowledge.

Based on our findings, we suggest the creation of a platform that disseminates scientific knowledge to SMEs following the above-mentioned communicative principles and theory (Lykke et al. 2017, 2018). Such a platform should make access easy, exemplify use and relevance, allow a personalised and experience-based dialogue about scientific knowledge and communicate the potentials mentioned above. Such a platform can be considered an *intermediary* with which to help overcome institutional, cultural and social barriers (Acworth 2008; Ankrah et al. 2013; Decter et al. 2007; Lakpetch and Lorsuwannarat 2012; Yusuf 2008). This platform could become a "collaborative arena" (Kelli et al. 2013), facilitating dialogical communication and inviting SMEs to participate in the dissemination of scientific knowledge and help foster university engagement. In this way, aspects of relational pathways can be included in generic pathways, which could allow the dissemination of not only explicit and encoded knowledge but also tacit and embodied knowledge, potentially enriching the dissemination process.

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An Entrepreneurial University Taxonomy Proposal

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Abstract In the last decades the European higher education landscape has changed from only teaching to economic and social development of the regions (Bronstein and Reihlen in Ind Higher Educ 28(4):245–262, 2014; Maassen in From governance to identity. Springer, Berlin, pp 95–112, 2009; Pinheiro and Stensaker in Public Organ Rev 14(4):497–516, 2013; Vukasovi et al. in Effects of higher education reforms: change dynamics. Sense Publishers, Netherlands, 2012), turning the Entrepreneurial University into a potential solution to these changes (Clark in Creating entrepreneurial universities: organizational pathways of transformation. Pergamon, Kidlington (Oxford), 1998). Due to this fact, this paper shows an Entrepreneurial Universities taxonomy proposal exploring the nature of the Entrepreneurial University's results. Based on a cluster analysis, three distinct groups are identified, which are in different phases within the transformation into an Entrepreneurial University: (i) the first group of universities (Cluster 2) is in the first phase of the path, since they are not obtaining high Entrepreneurial University's results yet; (ii) the second group (Cluster 3) is in the second phase of the path, obtaining good results in hard entrepreneurial university results; and finally, (iii) the third group (Cluster 1) is composed by the most Entrepreneurial Universities. In addition, universities are not unmovable within a group, they can improve and move from one stage to the upper one or not continue that path and move down again to a lower stage. In fact, this paper shows which the main levers are in order to move from one stage to another.

Keywords Entrepreneurial university · Taxonomy · Academic entrepreneurship activities · Cluster analysis · Entrepreneurial university results · Academic entrepreneurship · Higher education · Internal entrepreneurship support factors · External entrepreneurship support factors

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Introduction

The European higher education landscape, over the past two decades, has been facing a period of changes in order to face social global challenges which extend well beyond the economy, innovation and entrepreneurship (Bronstein and Reihlen 2014; Maassen 2009; Pinheiro and Stensaker 2013; Vukasovi et al. 2012). To overcome these challenges, universities need to meet the needs of its environment and contribute to regional and national socioeconomic development (Peterka 2011); transforming into an Entrepreneurial University (Bronstein and Reihlen 2014; Clark 1998; Kirby 2006; Sporn 2001).

The appearance of the Entrepreneurial University is the result of internal development of the university and external influences on the university (Peterka 2011), due to differences in organisational culture and leadership, the process of working on entrepreneurial capacity differs from one university to the other (Peterka 2011). Therefore, not all Entrepreneurial Universities are equal, nor are they in the same stage within the path towards the Entrepreneurial University.

There is convincing evidence for seeking a valid and empirically justified means for classifying Entrepreneurial University stages (Moroz et al. 2011). Literature shows that some universities obtain better results than others at commercialising research, promoting entrepreneurial interactions with firms and/or setting up new ventures (Di Gregorio and Shane 2003; Etzkowitz 2002; Segal 1986).

In the same line, university's transformation into an Entrepreneurial University has been described as three consecutive phases: in the first phase, the university becomes more aware of the potential for commercialisation, the second phase is characterised by identifying opportunities for commercialisation, and the third phase by developing commercialisation opportunities (Tijssen 2006).

Nonetheless, there is little research on classifying the Entrepreneurial University (Moroz et al. 2011); showing a need to develop an empirically justified Entrepreneurial University taxonomy. In fact, universities are dynamic entities; they can improve and move from one stage to the upper one or not continue that path and move down again to a lower stage. A taxonomy would help universities to identify the main levers in order to move from one stage to the other. Hence, the main objective of this paper is to create a taxonomy of Entrepreneurial Universities based on "soft entrepreneurial university results" (onwards Soft EUR) and "hard entrepreneurial university results" (onwards Hard EUR), based on the external environmental and the internal organisational entrepreneurship supporting factors (Markuerkiaga et al. 2014).

The paper is organised as follows: in Section "Entrepreneurial University Framework" based on a review of the literature on the factors fostering the Entrepreneurial University an integrative conceptual framework is built, differentiating between external and internal entrepreneurship support factors. In Section "Methodology" the research design is introduced. Section "Results" presents the empirical analysis

and through Section "Discussion" the results are discussed. At last, Section "Conclusions, Limitations and Future Research" shows the main conclusions, limitations and future research.

Entrepreneurial University Framework

For the last two decades the topic of the entrepreneurial university has been discussed subject of discussion (Etzkowitz et al. 2000; Tuunainen 2005). Spila et al. (2011) define the entrepreneurial university is defined as having a tendency towards managerial models, and focusing its academic objectives on the transfer of knowledge to the business sector and organisations in general (Spila et al. 2011). This type of university shows a distinguished focus on the third mission, thus aiming to ensure that the university is engaging actively with the business sector and other organisations in its environment in order to enhance the social and economic value of the knowledge generated by university research (Etzkowitz 2003).

Despite the fact that there is no prevailing definition of the entrepreneurial university (Guerrero and Urbano 2010), a number of general characteristics common in this kind of university encompasses have been identified (Gibb 2012). These characteristics can also be described as factors that contribute to the success of the entrepreneurial university (Guerrero et al. 2011; Rothaermel et al. 2007). Figure 1 shows the different factors that are measured and analysed.

These different factors that are measured and analysed in this study are now being explained in more detail:

Institutional context: An essential factor in becoming an entrepreneurial university seems to be the local supportive mechanisms (Rasmussen et al. 2012). The dissemination of knowledge can be facilitated by governments through their laws and regulations that enable universities to transfer intellectual property and knowledge quickly to the wider community (Wood 2011). Financial incentives for entrepreneurship education (Guenther and Wagner 2008), and for the creation of university spin-offs (Fini et al. 2009) can also be provided by governments. Therefore they play a crucial role in creating financing mechanisms for developing programmes, activities and initiatives in the context of entrepreneurship education and spin-off creation (Volkmann et al. 2009). Within the institutional context, an analysis of the extent to which government and public administrations become involved in and facilitate entrepreneurship is conducted, examining the approving legislation that promotes the dissemination and transfer of knowledge and creating financing mechanisms for entrepreneurship education, the creation of university spin-offs and the development of programmes, activities and initiatives related to entrepreneurship.

Industrial context: An important determinant in business and innovation opportunities can be the composition of the industry and service of a particular territory. Close interaction between the university and businesses and organisations in the area are likely to facilitate the creation of a social environment that offers support and encouragement for sharing knowledge and ideas (Fini et al. 2009). The extent

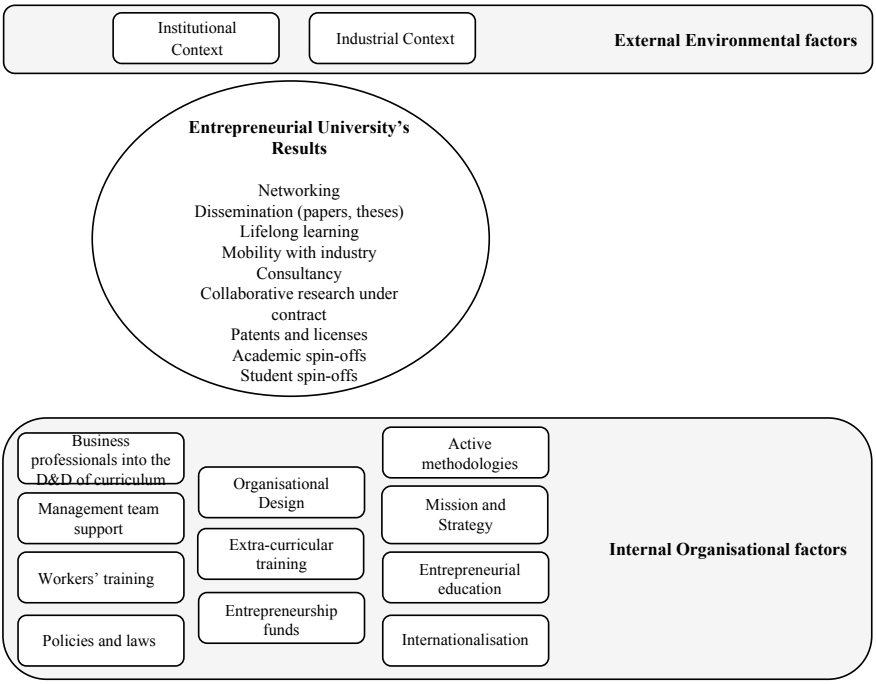

Fig. 1 Entrepreneurial university framework

to which nearby organisations and companies that operate in the same or a similar business sector interacted with the university by sharing the same field of research, knowledge and ideas through formal and informal networks is described in this factor.

Funds for entrepreneurship: A fundamental factor within an entrepreneurial university are financial resources, demonstrating the university's autonomy (Guerrero and Urbano 2010). As shown in Hu (2009), both public and private funding sources are important to support the development of an entrepreneurial university. When looking at this factor, a distinction between the funds for research and teaching in entrepreneurship and the funds for creating entrepreneurship projects and setting up companies and organisations.

Training in entrepreneurship for faculty staff: Even though there is an growing interest in entrepreneurship education, a lack of critical mass of lecturers in entrepreneurship is still very present and indicates that the current number of entrepreneurship lecturers needs to be increased (Volkmann et al. 2009). According to Moroz et al. (2010), the coordination and work on entrepreneurship education should be conducted by academics from fields such as business management, rather than individuals with specific training in this area, or academics who have researched or practised in this field. The extent to which the university offers entrepreneurship training to its staff, emphasising knowledge transfer and spin-offs creation so that the staff can promote entrepreneurship among their students is analysed in this factor.

Including professionals from businesses and organisations into the development and delivery of the curriculum: The presence of experts from the business world is vital in the development and delivery of the curriculum facilitates a continuous university-business collaboration process. An effective tool is the use of guest lecturers and representatives of private and public organisations within bachelor, postgraduate and doctoral programmes (Davey et al. 2011). Organisations are in a position to contribute to the university curriculum, providing advice on the current needs and practices of businesses and organisations which helps students to develop appropriate skills (De Luca et al. (2014).

Mission and strategy: The importance of strategic decision-making in entrepreneurship at the organisational level has been emphasised in some research (Zahra 1993). Clark (1998) stated that having a clearly defined strategy is one of the key elements of an entrepreneurial university. Various authors come to the conclusion that any university mission statement and strategies must include the word 'Company/Organisation' or 'Entrepreneurship' (Etzkowitz 2004; Gibb 2012; Kirby 2006). The publication of the concepts of 'company/organisation' and 'entrepreneurship', this would generate acceptance of these concepts as part of the 'meaning' of the university, leading to each member of staff sharing a common vision for the creation of an entrepreneurial university (Peterka 2011). If we take the strategic entrepreneurial decision-making at the organisational level into account, this factor analyses the use of the words 'Company/Organisation' or 'Entrepreneurship' in any of its documents (mission, vision values, strategic plan).

University Policies: Academic entrepreneurship literature assesses the influence of university policies, procedures and practices in Academic Entrepreneurship Activities (O'Shea et al. 2005). Rothaermel et al. (2007) states that key factors in the success of university spin-offs are university policies on intellectual property, networking activities and resource provision. Di Gregorio and Shane (2003) agreed that more academic spin-offs are generated if universities adopt certain policies (such as incentives). This factor evaluates the existence and possible influence of university policies, procedures and practices on Academic Entrepreneurship Activities.

Support from the management team: The behaviours and actions within the university reflect the traits of the management team members, since they influence the strategy of the university through decision-making processes (Gibb 2012; Miller and Katz 2004; Visintin and Pittino 2010). According to Todorovic et al. (2005) the nature and strength of leadership in supporting entrepreneurial culture in the university are essential. Therefore, management team support to the entrepreneurial culture is necessary for an entrepreneurial university (Gibb 2012). This factor analyses the leadership, understanding and support of the management team regarding the entrepreneurial culture in the university, as shown in decision making, behaviours and actions that influence the university's strategy.

Organisational structure: Universities organisational structure should be designed as to promote and facilitate entrepreneurial behaviour (Gibb and Hannon 2005). In this line, there are same key factors associated with the organisational design that boost the entrepreneurial behaviour within the university, like: flexibility in the

integration of strategies, decentralised decision making and the degree to which individuals have the power to innovate, among others (Gibb 2012).

Formal education in entrepreneurship: Individual specific competences (behaviours, knowledge, skills and attitudes) should be developed within Entrepreneurship education, which might be on different levels throughout one's professional career and in the socioeconomic development, in the long-term (Bratianu and Stanciu 2010). Researchers show that the entrepreneurial competence could be acquired or learned (Kuratko 2005; van der Heide and van der Sijde 2008), hence it should be developed into all educational levels (Gibb 2006). Furthermore, for developing an entrepreneurial culture within the university it is essential to foster entrepreneurial competencies, skills and knowledge and for that entrepreneurship education is the key (European Commission 2012).

Extra-curricular training for academic entrepreneurship: Academic entrepreneurship is a continuous process that integrated a series of events (Friedman and Silberman 2003). Indeed, some authors described academic entrepreneurship as a multi-step process that identifies the actors, activities and key success factors associated with each stage of the process (Salamzadeh et al. 2011; Wood 2011). Due to this fact, an Entrepreneurial University should work on the different stages of the entrepreneurial process. As it is difficult to develop curricular activities on each of the stages, the extra-curricular training process for academic entrepreneurship refers to the training activities carried out outside the curriculum, such as awareness-raising, workshops for opportunity identification, courses for innovative project implementation, business plan development and spin-off launching, among others.

Active learning methodologies: Students from any education system should be prepared to work in a rapidly changing, dynamic, entrepreneurial and global environment (Volkmann et al. 2009); consequently, both creative and critical thinking skills, attributes and behaviours need to be improved (Guerrero and Urbano 2010). This situation provokes a paradigm shift for the academic world that should worked on new teaching-learning methodologies (Moroz et al. 2010). Therefore, in order to facilitate students the confidence to take risks and learn from successes and failures an open environment should be created by entrepreneurship educators (Volkmann et al. 2009), and active learning methodologies are main actors in this task. Among other, case studies, gamification, problem-based learning and participation in real projects are all active learning methodologies that can promote the entrepreneurial culture.

Internationalisation: Internationalisation and the Entrepreneurial University are closely related (Larionova 2012), such as that the Entrepreneurial University considers internationalisation as a key tool (Gibb 2012). Indeed, it is necessary to realise the value of international mobility of students, academics and business partners in the development and improvement of the Entrepreneurial University (Bramwell et al. 2012; Gibb 2012). In addition, remarkable that the internationalisation process also contributes to universities revenues, reputation, research opportunities, new partners and to a better cultural understanding (Gibb 2012). Therefore, international research

projects, joint degrees with universities abroad and mobility activities of students, academics and business partners are key activities of the Entrepreneurial University.

Methodology

Unit of Analysis

Relating to Entrepreneurial Universities literature and the usual units of analysis, Brennan and McGowan (2006) identified the following five levels of analysis:

- Individual: an academic recognised by the university as an entrepreneur.
- Community of practice: an informal social network.
- The academic school: the most basic unit of academic staff for the purpose of university administration.
- University: a grouping of academic schools coordinated through a central faculty structure.
- The entrepreneurship system: the individual and corporate actors who interact in a recognisable context to form the infrastructure for entrepreneurship.

Due to this classification and in order to achieve the main objective of the research, the unit of analyses is the university and the TTO Director the person to interact. The research is based on European universities.

Research Instrument

A questionnaire was constructed to collect data directly from universities undertaking the Entrepreneurial University path.

So as to encourage the TTO Directors to read and answer the questionnaire, the questionnaire's form was taken into account. A set of questions about the variables to be measured was developed, grouped into related blocks, given that the easiest way for the respondent for concept association. Besides, this questionnaire consisted of closed questions, dichotomous (true/false) and polytomous (a five-point Likert scale, with five being the most important and one the less important rating).

The next step was the pre-testing, getting the initial response and a subsequent interview with 6 experts from different positions and profiles, such as deans, TTO Directors, academic coordinators and entrepreneurship teachers, in order to identify areas where the questionnaire could have needed corrections (Fatoki and Asah 2011). In consequence, various suggestions were incorporated to make the final questionnaire for the study.

Sampling Design, Selection and Size

The sampling is composed by European universities that are promoting entrepreneurship within their organisations. Hence, due to the novelty of the subject, they are taking part in international conferences in order to disseminate their learning and best practices. Therefore, the universities and their respective respondents are selected due to their assistance in international conferences related to Entrepreneurial Universities and Entrepreneurial Education (such as FINPIN Conference, UIIN Conference, BCERC Conference, ECSB Entrepreneurship Education Conference and Global Entrepreneurship Monitor—GEM). In total, 361 European universities were contacted.

Data Collection Procedure

A self-administered e-mail questionnaire was applied to collect data for the survey from TTO Directors of the targeted universities. The online questionnaires collecting process lasted five months, with a monthly reminder during the first three months. Out of the 361 surveys mailed sixty-nine were returned (19.11%).

Descriptive Statistics

After data collection, the data analysing and interpreting stage started (Robson 1993). A quantitative research methodology is established for the correct development of the research.

Preceding the measurement scales assessment, validity and reliability of the instrument are explored by incorporating an exploratory factors analysis (Cronbach's alpha) (Parsian 2009). The analysis shows that the validity and reliability of the instrument is accepted. Besides, Skewness and Kurtosis are tested for normal data distribution and all variables are reasonably normally distributed. Then, descriptive statistics are conducted with the assistance of SPSS Version 20.0.

Regarding the variables that composed the research, every variable of the study is constructed based on a 5-point Likert scale. Table 1 shows the external and internal entrepreneurship support factors and the Entrepreneurial Universities results.

Cluster Analysis

In order to explore the patterns of European Entrepreneurial Universities, based on both soft and hard entrepreneurial university results, cluster analysis is used; therefore, information dissemination, networking, industry mobility, consulting, contract research, patent and license, and spin-off firm formation were the clustering variables.

Table 1 Descriptive statistics of all sample universities

	N	Minimum	Maximum	Mean	Std. deviation
INST_CONTEXT	69	1.50	4.80	3.1072	0.73491
INDUS_CONTEXT	69	1.40	4.80	3.0797	0.78151
STRATEGY	69	1.30	5.00	3.3826	0.88649
MANAG_SUPPORT	69	1.00	5.00	3.1883	0.79326
ORGANI_DESIGN	69	1.00	4.75	3.0430	0.75977
POLICIES	69	1.00	5.00	3.4616	0.96867
INDUS_CURRI	69	1.40	4.80	2.9968	0.75443
E_CURRI_ACTIVITIES	69	1.00	5.00	3.3387	0.92678
INTERNATIONALISATION	69	1.25	5.00	3.2843	0.83722
E_FUNDS	69	1.00	5.00	2.4254	0.89540
E_EDUCATION	69	1.00	5.00	3.0149	0.90754
E_STAFF	69	1.00	5.00	2.4248	1.00179
METHODS	69	1.00	5.00	3.0361	0.82034
INFO_DISSEMINATION	69	1.00	4.33	2.8761	0.62047
NETWORKING	69	1.33	4.33	3.2532	0.62159
I_TRAINING	69	1.00	5.00	3.0435	0.86492
IND_MOBILITY	69	1.00	4.33	2.5343	0.62410
CONSULTING	69	1.00	5.00	3.2319	0.80704
PR_RESEARCH	69	1.67	5.00	3.0530	0.72748
PATENT_LICENSE	69	1.00	4.00	2.5707	0.59232
ASO	69	1.40	4.20	2.5478	0.56532
SSO	69	1.25	4.25	2.7283	0.61198

As a result, the universities are clustered into three different groups: Cluster 1 composed by fourteen universities (high values in Soft EUR and on the mean in Hard EUR), Cluster 2 composed by ten universities (low values in all Entrepreneurial University's results) and Cluster 3 composed by forty-five universities (on the mean in all Entrepreneurial University's results) (see Fig. 2).

Subsequently, to confirm the difference between the three clusters regarding Entrepreneurial University's results an ANOVA analysis was developed. In this manner, through a comparison of means (see Table 2) the rejection of the null hypothesis of equal means is shown.

Once the differences between groups' means are demonstrated, each clusters' means are analysed. Cluster 2 obtains the less significant values on all Entrepreneurial University's results, except for Collaborative Research, variable that is in the same level of Cluster 3. Universities in Cluster 1 obtain the highest values on Soft EUR and are in the same level of Cluster 3 regarding Hard EUR. Finally, Cluster 3 is on the mean on all Entrepreneurial University's results.

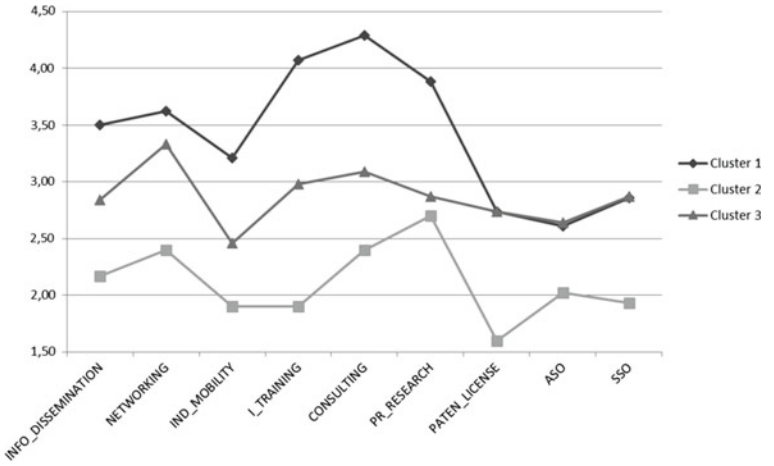

Fig. 2 Entrepreneurial University's results of the three clusters

Table 2 ANOVA analysis of Entrepreneurial University's results for the three clusters

		Sum of squares	df	Mean square	F	Sig.
INFO_DISSEMINATION	Between groups	10.525	2	5.262	22.187	0.000
	Within groups	15.654	66	0.237		
	Total	26.178	68			
NETWORKING	Between groups	9.421	2	4.710	18.447	0.000
	Within groups	16.853	66	0.255		
	Total	26.273	68			
I_TRAINING	Between groups	28.063	2	14.032	40.607	0.000
	Within groups	22.806	66	0.346		
	Total	50.870	68			
IND_MOBILITY	Between groups	10.691	2	5.345	22.335	0.000
	Within groups	15.795	66	0.239		
	Total	26.486	68			
CONSULTING	Between groups	23.388	2	11.694	36.926	0.000
	Within groups	20.902	66	0.317		
	Total	44.290	68			
PR_RESEARCH	Between groups	12.263	2	6.131	17.057	0.000
	Within groups	23.725	66	0.359		
	Total	35.987	68			

(continued)

Table 2 (continued)

		Sum of squares	df	Mean square	F	Sig.
PATENT_LICENSE	Between groups	11.066	2	5.533	28.547	0.000
	Within groups	12.792	66	0.194		
	Total	23.857	68			
ASO	Between Groups	3.268	2	1.634	5.841	0.005
	Within groups	18.464	66	0.280		
	Total	21.732	68			
SSO	Between groups	7.547	2	3.773	13.897	0.000
	Within groups	17.921	66	0.272		
	Total	25.467	68			

Table 3 ANOVA analysis of external entrepreneurship support factors for the three clusters

		Sum of squares	df	Mean square	F	Sig.
INDUS_CONTEXT	Between groups	9.388	2	4.694	11.332	0.000
	Within groups	27.338	66	0.414		
	Total	36.726	68			
INST_CONTEXT	Between groups	7.565	2	3.783	7.350	0.001
	Within groups	33.966	66	0.515		
	Total	41.532	68			

In order to identify the main mechanisms that leading universities had for Entrepreneurial University's results promotion, based on these three clusters, it was interesting to analyse their differences regarding external and internal entrepreneurship support factors. In order to accomplish this goal, an ANOVA was performed for both groups (see Tables 3 and 4); which shown all *p*-values under the threshold 0.005, falling to reject the null hypothesis.

After demonstrating the differences between groups' means, a means analysis of external and internal entrepreneurship support factors for each cluster was done (see Fig. 3). Indeed, Cluster 2 obtained the less significant values on all external and internal entrepreneurship support factors which agreed with the results on Entrepreneurial University's results, considering that this group of universities had the lower values on Entrepreneurial University's results. Concerning Cluster 1, the best universities as to Soft EUR, obtained the highest results on all external entrepreneurship support factors and the highest results on almost all internal entrepreneurship support factors, except for Extra-curricular training and Workers' Training. Finally, Cluster 3

Table 4 ANOVA analysis of internal entrepreneurship support factors for the three clusters

		Sum of squares	df	Mean square	F	Sig.
STRATEGY	Between groups	10.723	2	5.361	8.284	0.001
	Within groups	42.717	66	0.647		
	Total	53.439	68			
MANAG_SUPPORT	Between groups	10.497	2	5.249	10.727	0.000
	Within groups	32.292	66	0.489		
	Total	42.790	68			
ORGANI_DESIGN	Between groups	7.530	2	3.765	7.834	0.001
	Within groups	31.722	66	0.481		
	Total	39.253	68			
POLICIES	Between groups	23.753	2	11.876	19.570	0.000
	Within groups	40.053	66	0.607		
	Total	63.806	68			
INDUS_CURRI	Between groups	9.998	2	4.999	11.493	0.000
	Within groups	28.706	66	0.435		
	Total	38.704	68			
INTERNATIONAL.	Between groups	13.128	2	6.564	12.545	0.000
	Within groups	34.535	66	0.523		
	Total	47.663	68			
E_FUNDS	Between groups	5.213	2	2.607	3.489	0.036
	Within groups	49.305	66	0.747		
	Total	54.518	68			
E_EDUCATION	Between groups	7.058	2	3.529	4.758	0.012
	Within groups	48.950	66	0.742		

(continued)

Table 4 (continued)

		Sum of squares	df	Mean square	F	Sig.
	Total	56.007	68			
METHODS	Between groups	5.848	2	2.924	4.835	0.011
	Within groups	39.913	66	0.605		
	Total	45.761	68			
E_CURRI_ACTIVITIES	Between groups	15.155	2	7.578	11.563	0.000
	Within groups	43.251	66	0.655		
	Total	58.407	68			
E_STAFF	Between groups	12.013	2	6.007	7.050	0.002
	Within groups	56.230	66	0.852		
	Total	68.243	68			

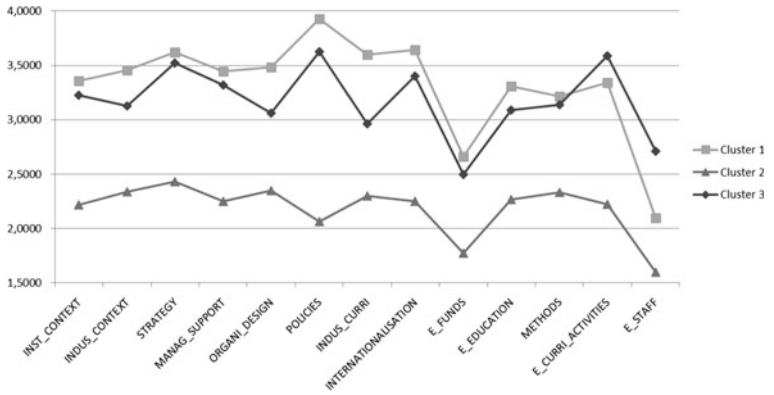

Fig. 3 Entrepreneurship support mechanisms level of the three clusters

showed better results on Extra-curricular training and Workers' Training than Cluster 1 although their results on Soft EUR were worst.

Results

The analysis shows three different groups of universities depending on Entrepreneurial University's results: Cluster 1 composed by fourteen universities, Cluster 2 composed by ten universities and Cluster 3 composed by forty-five universities. Thereafter, an ANOVA analysis was developed in order to confirm the difference between the three clusters, and the present section gathers further details regarding each cluster.

Cluster 1

The fourteen Universities in Cluster 1 are the ones which stand out for their exceptional results on Lifelong Learning, Consultancy and Collaborative Research. These three results are directly related to knowledge transfer, therefore it suggest a higher university business collaboration. This fact could be as a result of the high support they have from industry (i.e. high values on Industrial Context). Besides, regarding internal organisational factors, first cluster universities obtain high values as to their organisational design, because they promote the decentralisation of decision making and empowered their employees to innovate (through a bottom-up flow) through a contemporary organisational design. This fact could also reinforce the promotion of Lifelong Learning, Consultancy and Collaborative Research, seeing that the decentralisation of decision making push academic and researcher into knowledge transfer activities. Although universities from this cluster also obtained good results in Dissemination, Networking and Mobility with Industry, they are similar to Cluster 3. Regarding Patents and Licenses, Academic spin-offs and Student spin-offs (or Hard EUR), these universities are in the same level as Cluster 3. Moving on to the entrepreneurship support mechanisms, these universities obtained high values on almost all entrepreneurship support mechanisms except on Extra-curricular training and Workers' Training. This fact reiterates previous results, ratifying that the support of Extra-curricular training and Workers' Training is unnecessary for improving on Soft Entrepreneurial University's results if there is a supportive industrial context (Industrial Context).

Cluster 2

The ten universities that obtained the worst values on all Entrepreneurial University's results (except for Collaborative Research, result that was in the same level of Cluster 3), are the ones that composed Cluster 2. Besides, these universities have neither a supportive external environment nor a supportive internal organisation; since all the values obtained within these factors are really low. These facts could be because these universities are still at the beginning of the Entrepreneurial Universities' path.

Cluster 3

The forty-five universities that composed Cluster 3 obtain average scores on almost all Entrepreneurial University's results, except on Patents and Licenses, Academic spin-offs and Student spin-offs; which are on the same level as Cluster 1. Therefore, universities from this cluster are good on Hard EUR development. In addition, it should be highlighted that this group of universities obtained the lowest values on Collaborative Research; fact that could be related to the high level of Hard EUR, since fostering direct mechanisms of knowledge transfer could reduce Collaborative Research. Moreover, the low Industrial Context that this group of universities have could be another reason for the low values on Collaborative Research. In the same line, the low presence of Professionals from businesses into the development and delivery of the curriculum is another characteristic of these universities; which could be also due to the low Industrial Context. With respect to the internal entrepreneurship support factors, Extra-curricular training and Workers' training stand out because of their high values; which could be directly related with the good values on Hard EUR.

Discussion

The cluster analysis and the subsequent statistical analysis show that universities are in different stages within the path towards the Entrepreneurial University. There is a first stage (Cluster 2) where universities do not have a supportive external environment and internally there are straggler on internal entrepreneurship support factors. Therefore, they are not obtaining high Entrepreneurial University's results yet. In the second stage (Cluster 3), universities start promoting entrepreneurship (through Extra-curricular training and Workers' training) within its collective and although they do not have a really supportive Industrial Context, they are obtaining good results in Hard EUR. And finally, the third stage (Cluster 1) is composed of the most Entrepreneurial Universities, which thanks to a supportive Industrial Context obtain really good values on Soft EUR; maintaining the same level as the second stage on Hard EUR. Besides, this cluster promotes less Extra-curricular training and Workers' training and obtains the same results on Hard EUR as Cluster 2, reinforcing the importance that a supportive industrial context has.

The cluster analysis showed that not all universities are in the same level regarding Entrepreneurial University's results. The analysis determine that universities are in different stages within the Entrepreneurial University path; in fact, they could be classified into three stages. First stage universities do not belong to a supportive external environment and internally, concerning internal entrepreneurship support factors, are still backward. Hence, this group of universities are not obtaining high Entrepreneurial University's results. Second stage universities are achieving good results on Hard EUR through two main activities: providing support within the whole entrepreneurship process and training its staff on entrepreneurship. Furthermore,

it has to be highlighted that these universities do not have a really supportive industrial context. Finally, universities from the third stage, owing to a supportive industrial context obtain really good results on Soft EUR; being at the same level as the second stage on Hard EUR. Moreover, universities from these group develop less internal entrepreneurship support factors, in particular the support within the whole entrepreneurship process and the training in entrepreneurship for its staff. Nevertheless, having a supportive industrial context is the main factor for staying in this stage.

Universities are not unmoving within a specific stage; they can improve and move from one stage to the upper one or not continue that path and move down again to a lower stage. In fact, an Entrepreneurial University has to work on specific factors depending on its objective. For example, if university's goal is to get better results on Hard EUR it has to promote the support within the whole entrepreneurship process and the internationalisation activity, and do not care about industries' presence on curriculum development and delivery. Therefore, with respect to the promotion of these two internal entrepreneurship support factors, universities should implement different activities.

Concerning university's support within the whole entrepreneurship process, academic entrepreneurship is not a single event, it is a multi-stage process model that identifies the key actors, activities, potential stakeholders and key success drivers associated with each stage of the innovation commercialisation process (Salamzadeh et al. 2011; Wood 2011). Therefore, the university should provide supportive activities within each phase of the entrepreneurship process; such as: talks with entrepreneurs in order to make aware of the entrepreneurship importance, innovation and creativity workshops in order to generate new possible business ideas, business model and business plan courses in order to become this business ideas into business project and finally, courses on new business venture launching.

On the contrary, if university's objective is to increase Soft EUR, industries' presence on curriculum development and delivery and developing policies and laws regarding entrepreneurial issues are the main factors to be worked on. Besides, training staff in entrepreneurship is not a factor to make any effort on.

The industry presence in curriculum development and delivery is the process of developing human resources relevant to the modern society and creating a learning environment. Hence, universities should include the following mechanisms: university business collaboration in the development of a fixed programme of courses, modules, planned experiences as well as guest lectures by delegates from private and public organisations within undergraduate, graduate, PhD programmes or through further professional education (Davey et al. 2011).

With respect to policies on both university-business cooperation and entrepreneurship, universities should develop some policies in order to establish a working framework. On the one hand, regarding university-business cooperation policies, universities should establish students' internships, knowledge transfer activities and the promotion of R&D, among other activities. And on the other hand, regarding entrepreneurship universities should establish the distribution of royalty rates between inventors and the university, the university's choice to take an equity stake in the spin-off firm and the use of internal venture capital funds.

Conclusions, Limitations and Future Research

This research showed that not all universities are in the same stage regarding Entrepreneurial University's results. The analysis reveal that universities are in different stages within the Entrepreneurial University path and they could be classified into three stages.

In addition, universities are not unmoving within a specific stage; they can improve and move from one stage to the upper one or not continue that path and move down again to a lower stage; and the performance-based taxonomy of Entrepreneurial Universities showed within this paper would help universities to identify the main levers in order to move from one stage to the other.

However, the research also presents some limitations. Firstly, the sample size used, which do not allow a more rigorous statistical analysis. Indeed, sixty-nine European universities answered the whole questionnaire out of the 361 surveys mailed. In like manner, the results' generalisability is unreal; since, although normality was achieved for all variables, the sample was not significant enough to extrapolate the results to the whole population. This makes that the findings of the previous section were applicable only to the sample tested. Secondly, another limitation dealt with the measures used in the research; since data was gathered throughout scales getting TTO Directors' self-perceptions on her/his university, and therefore these variables have a degree of subjectivity.

Regarding the future lines of the research, an analysis of more European universities, increasing the size and the homogeneity of the sample would the next step. Furthermore, in order to achieve a global vision of the Entrepreneurial University, it could be interesting to survey different people within the university. Indeed, two different groups could be analysed: on the one hand, the management team, the TTO Director, etc. and on the other hand, the researchers, professors, etc. This large number of questionnaires could allow developing more complex models that include latent (unobserved) variables, formative variables, chains of effects (mediation), and multiple group comparisons (e.g. multilevel analysis) of these more complex relationships.

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Part V
The Individual Perspective

The Role of Experience of Academics in University Engagement: Looking at University-Industry Linkages

Nisha Korff, Carolin Plewa and Thomas Baaken

Abstract University-industry linkages (UILs) can generate significant tangible and intangible benefits by combining a university's specialized knowledge and human resources with industry expertise. Individuals contribute skills, knowledge, competencies and experience to such linkages and are the key drivers for determining their success. While having prior experience in UILs has been discussed as important to achieve substantial UIL, literature is yet to understand why this is the case, considering in particular the behavioral changes university representatives and academic actors make as they gain such experience. This change in strategies and mindset is an entrepreneurial one. In terms of the book entrepreneurial universities are also seen as engaged Universities. Based on an interview series the impact individual experience has on project and relationship success, as well as related changes in three levels, strategic, personal and operational, are discussed, leading to theoretical and managerial implications.

Keywords University-industry linkages · Entrepreneurial universities · Role of prior experience of academics · Individual behavioral change · University-industry partnerships

Introduction

Recent challenging economic times have again shown how important innovation is for the recovery from economic downturns and for future organizational and national prosperity (Davey et al. 2018; Dodgson 2018; Archibugi 2017; Cohen et al. 2002;

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Salter and Martin 2001). In this environment, university-industry linkages (UILs) have gained in relevance and number, as universities offer a source of pioneering thinking and specialized knowledge that complement industry expertise (Arvanitis et al. 2008). By working with universities, companies may gain knowledge and technologies required for their continuing success (Santoro and Betts 2002; Lee 2000). Universities also benefit from working with industry, not only by means of additional financial resources but also through gaining industry insight, realizing broader social benefits of their research and by opening up new opportunities for their students (Baaken et al. 2016; Mindruta 2013; Abreu and Grinevich 2013; Bozeman et al. 2013; Perkmann et al. 2013; Hewitt-Dundas 2012; Nilsson et al. 2010; Lam 2011; Lee 2000).

University-industry interaction in research and development includes all the joint research activities, contract research, consulting, informal networks, joint publications, joint supervision of theses, and different student projects carried on together (Davey et al. 2018). The research and their results are important for industry for producing new products or services, improving processes and through all of that, achieving to outreach new targets.

Experience is seen as working experience in relevant fields of UIL (no matter if this experience has been archived by the individual in companies or in academia). Not a relevant UIL experience is considered e.g. in just some administrational issues with no direct involvement in the content of UIL (Plewa et al. 2013).

Literature in the field of UIL is quite advanced. As such, much of the existing literature on UILs provides extensive information about structural and organizational factors hindering and benefiting the success of such linkages (Davey et al. 2018; Bower 2018; Nilsson et al. 2010; Clarysse et al. 2011; van Rijnsoever et al. 2008; Ponomariov 2008; Welsh et al. 2008; Bozeman and Gaughan 2007). Focus on the individuals engaged in the relationships is in so far discussed as the characteristics—such the motivation, age, gender, tenure, experience, knowledge area—of the actors are analyzed in respect to the surrounding environment they are operating in (Abreu et al. 2016; van Rijnsoever and Hessels 2011; Clarysse et al. 2011; Bjerregaard 2010; Bruneel et al. 2010; D'Este and Patel 2007). An emphasis on the interrelations between the actors or the individuals as such is rarely discussed in existing literature.

Success in UILs, however, is only possible when engaging the right people and facilitating interaction between them. Only certain individuals, or champions, can overcome well documented barriers to UILs, such as differing institutional structures, culture and norms (Davey et al. 2018; Estrada et al. 2016; Ho et al. 2016; Bjerregaard 2010; Verheugen and Potocnik 2005) and drive cross-sectoral collaboration success. University-industry champions serve as the central driving link between the university and industry partner, proactively driving and pursuing opportunities for mutual benefit (Betts and Santoro 2014; Santoro and Betts 2002).

Adding to the discussion on university-industry champions in literature, which has focused on their characteristics and motivations, this research sets out to understand whether an individual's experience with UILs makes a difference to the success of their collaborations and, if yes, how this is achieved. In line with the call for research to uncover "socially dynamic interactions between collaborating UI partners during

collaboration, and how collaboration strategies mix and are modified in circumstantial ways in such processes" (Bjeeregaard 2009, p. 173), this research develops a better understanding and framework around the strategic, personal mindset and operational adjustments these individuals have made over time by learning from successful collaborators on both university and industry sides. This insight provides valuable input not only for individuals engaging in UILs but also for policy makers in their respective institutions, leading to specific recommendations for industry managers on how to get the most out of university collaborations.

The paper is structured as follows: after having outlined the methodology and empirical field work, it will focus on different strategies, different mindsets, and different operationalization of strategies in the discussion as those are identified as the most influencing frameworks.

Background

In understanding the topic of UILs and the interplay between different factors inhibiting and facilitating those relationships, a continuously reoccurring factor in the literature is the aspect of individuals having prior experience, either in UILs in general (Bruneel et al. 2010; D'Este and Patel 2007) or having worked in the opposite environment (Filippetti and Savona 2017; da Cunha Lemos and Cario 2017; Guiliani et al. 2010; Ponomariov and Boardman 2009; van Rijnsover et al. 2008; Lubango and Pouris 2007; Lin and Bozeman 2006). Research specifically focusing on experience in UILs remains sparse, with extant research showing, for example, that with increasing experience academics engage in a broader range and greater variety of interaction with industry (D'Este and Patel 2007; Villani et al. 2017; Abreu et al. 2016). Furthermore, the more experience a researcher has gained in facilitating UILs, the more likely it is that longer-term partnerships lead to discussion and superior value creation beyond specific projects and that the academic engages in positive word of mouth (Plewa et al. 2013). Yet, previous joint research activities with the counterpart do not help reduce the perceived barriers related to administration and intellectual property agreements in UILs (Bruneel et al. 2010).

Prior work experience in the opposite working environment, i.e. academics having been employed in business, has often been confirmed as relevant for both industry representatives and academics, explained by a shift of academics towards a more entrepreneurial behavior (Kalar and Antoncic 2016; Abreu et al. 2016; Clarysse et al. 2011), an advancement in the universities' innovation related activities (Bstieler et al. 2015; Lubango and Pouris 2007) as well as accelerated change of conducting interdisciplinary research (van Rijnsoever et al. 2008). Academics as well as industry representatives show a greater network activity (van Rijnsoever et al. 2008) and a heightened probability as well as intensity of joint research activities (Ponomariov and Boardman 2009). Research has further confirmed such experience as an essential factor to determine the success of collaborative project work (Galán-Muros and Plewa 2016; Hagedoorn and Schakenraad 1994).

The relevance of experience in this context can be explained by its impact on the behavior of an individual, exemplified by experiential learning theory. Specifically, the experiential learning cycle explains that individuals learn by reflecting on a concrete experience, which leads to the formation of abstract generalizations. The new ideas or understanding, in turn, can be tested by engaging in new behaviors when faced with a relevant situation, which again creates new experiences the individual can reflect upon (Kolb 1984). This cycle leads to an adjustment of behaviors as the individual learns over time. Adding to this insight is the fact that for enhancing and smoothing future UILs, individuals with experience, especially in UILs, acquire tacit as well as practical knowledge in respect to communication and collaboration procedures (Bjerregaard 2009; Johnston and Huggins 2016; Villani et al. 2017; Rajalo and Vadi 2017).

Bercovitz and Feldman (2006) support this statement by proposing that behavior may be affected by previous experience gained through professional relationships and thereby learning and observing opportunities. Hence, as individuals gain experience, they become more competent in fulfilling a particular task, leading to better performance (Reagans et al. 2005). Adding to the thought of individuals' experience levels and its impact on behavioral change is the study conducted by Lam (2010) who created categories for academic researchers on a bipolar continuum—namely traditional and entrepreneurial orientation of the academic researcher. The essence gained from the study is that experienced researchers are more likely to influence and thereby alter the industry partners' expectations to set the boundaries of the relationship (Lam 2010). Furthermore, researcher strategies are altered to overcome problems, to take control of the relationship and to ensure the collaborative work is conducted in the interest of the academic (Lam 2010).

Through prior experience in UILs, activities and processes that have proven to function well and lead to positive project and relationship outcomes eventually become routines and practices performed by the participant (Bruneel et al. 2010). These routines are not only applicable to an individual, but also to research teams leading to better collaborative work and more economic benefits (Dutrénit et al. 2010). Thus, the experience is employed as a learning instrument for enhancing collaborative project work. Partners who collaborate on a frequent basis with each other are more likely to establish routines to find mutual research targets (Gomes et al. 2005), disseminate research results (Hall et al. 2003) and determine a time frame for delivering results (van Dierdonck et al. 1990). A specific emerging routine is the increased usage of standard protocols (Hertzfeld et al. 2006) to moderate collaborative research projects. In this respect, the study by Bjerregaard (2009) identifies collaboration strategies utilized by industry and academic partners for enhancing the formation and optimization of processes as well as UIL outcomes. Three strategic changes were identified relating to the (a) motivation for engaging in UILs, selection of the partner and definition of goal/aim of UILs, (b) process optimization and (c) exploitation of collaboration results (Bjerregaard 2009).

It is interesting to note that the majority of previous works imply and conclude individual behavioral changes with advancing experience levels in UILs. However, the changes are only focused on future practices and activities (publications, network

activities, support of students) in UILs but do not necessarily consider the changes done in respect to the interpersonal aspect, meaning the behavioral changes occurring when individuals interact with each other. This paper is intending to contribute knowledge to narrow the research gap as indicated in the introduction by focusing on the individual.

Method

To investigate and understand the topic in detail an empirical research approach was chosen in addition to the analysis of existing literature. The inductive research approach is commonly employed when there is not a lot of literature on a certain topic (Saunders et al. 2007), which is applicable in this case. When using the inductive approach, data are first gathered and as a result a theory is formulated (Saunders et al. 2007; Bryman and Bell 2007). The purpose of the inductive approach is to "understand better the nature of the problem" thus the approach answers the questions "why" (Saunders et al. 2007) and to uncover occurrences and interconnectivity of emerging phenomena (Malhotra and Birks 2007). Further, it is suggested to make use of comprehensive analysis of a small sample to better understand the contexts, and to allow for a semi-structured proceeding during the research (Saunders et al. 2007). Qualitative research is the most common way to collect data for the inductive research approach (Bryman and Bell 2007). To better grasp the underlying reasons for individual change in behavior in-depth interviews were thus utilized, allowing for an in-depth analysis of an individual's perception and reflection.

Sample

The interview series aimed to capture diverse views on what changes experience in UILs has made to an individuals' behavior to UILs. To ensure a broad range of perspectives, 15 academic researchers and 15 industry partners across two countries (this papers is showing the situation using the example of Germany and Australia), operating in a wide variety of industry sectors and research areas, were interviewed. When profiling the academic researchers, interviewees originated from the engineering, science/medicine, social sciences, agriculture, marketing and information systems area (see Table 1). The sample for industry partners comprised individuals stemming from engineering, science/pharmaceuticals, government agency, aged-care, fast moving consumer goods, IT and management service.

Despite different historical development of UILs and university funding systems in Australia and Germany, research has shown relational success factors to remain similar for the two countries (Plewa et al. 2013) and therefore present the study with limited systematic bias (Patton 2002). All respondents classified themselves as having either medium or high level of experience in facilitating UILs. The participants were

Table 1 Sample profile

Australian interviewees	German/Dutch interviewees
8 academic researchers 3 medium experience with UIL 5 high experience with UIL *Engineering, science/medicine, social sciences, agriculture*	**7 academic researchers** 4 medium experience with UIL 3 high experience with UIL *Engineering, marketing, information systems.*
6 industry partners 4 medium experience with UIL 2 high experience with UIL *Engineering, science/pharmaceuticals, government agency, aged-care provider*	**8 industry partners** 3 medium experience with UIL 5 high experience with UIL *Fast-moving consumer goods, IT, management services*

asked to reflect on their experience in UILs and how this experience has changed their behavior.

Data Collection and Analysis

To investigate the relevance of experience and its impact on individuals' behavior in UILs an interview series was undertaken. In most cases the interviews were conducted on a face-to-face basis and in rare cases via telephone; all were tape recorded. The interviews were of semi-structured nature and are most suited for qualitative research studies as the researcher is able to identify and understand the underlying reasons of the problem (Saunders et al. 2007). Semi-structured interviews present the researcher with the benefit of being able to alter and change the direction of the interview, depending on the response of the interviewee and thereby allowing talking about a certain topic in more detail (Saunders et al. 2007). Thus, the tactics of the research strategy can be described as having an unstructured interview situation, utilizing a non-standardized questionnaire with open and closed questions. Questions related to an individual's experience, including the frequency with which an individual is engaged in partnerships with industry partners, the level of understanding of industry requirements, and the extent to which well-developed contacts with people from industry background exist. Participants were also asked to reflect on their increasing experience levels and any notable changes in behavior, including approaches to realize behavioral intensions, this has brought about.

Following the transcription of all interviews, the digital coding software NVivo 10 was employed to analyze the data. The interviews were coded according to each newly mentioned topic related to a change caused by increased experience levels in UILs. An inductive and explorative approach of analyzing data allowed the researchers to accumulate reoccurring topics into heterogeneous categories. In addition, triangulation with existing literature enabled further classification and categorization of interview statements. Each interview was cross-coded by both researchers and

discussed where disagreements occurred. A generalization of research results cannot be concluded due to the small sample size.

Discussion of Results

A consensus emerged regarding the importance of experience, with interviewees agreeing that they made a number of behavioral changes as they gained experience in UILs over time. While both the academic and the industry participants discussed strategic and personal changes as discussed in detail below, only academic researchers reflected on specific changes in the operationalization of their strategies. This may be due to the fact that processes for conducting collaborative projects are more established in industry and defined on a company-wide level whereas the management of projects in universities is more dependent on the individual involved in the project and therefore may differ significantly. Moreover, the fact that academics often take on the role as service providers in these partnerships may explain the importance they place on seeking and improving the tools that optimize the service delivery and partnership with industry partners.

The framework in Fig. 1 shows what individuals with experience in UIL believe they do and see differently now, as they reflect on altering strategy, personal mindset and operationalization of strategies.

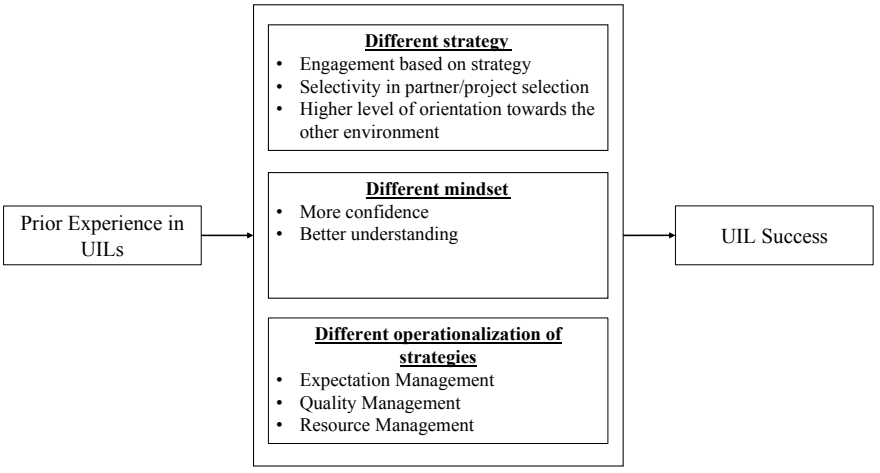

Fig. 1 Framework—prior experience in UILs as a driver of change

Different Strategy

UILs imply a meeting of individuals from different sectors and environments and thus entail challenges that may not be encountered when working in purely academic or purely private sector partnerships. Despite an increasing number of such linkages, however, and the emergence of extra-curricular seminars and workshops, neither industry training programs nor university degrees commonly train individuals in how to successfully engage with universities and industry partners, respectively. Hence, hands-on experience has been for many the only opportunity to develop strategic thinking and approaches in this context.

That means, in most cases, the first UIL projects an individual engages in occur by chance or are planned with a particular narrow purpose in mind, such as the funding of a particular study or the improvement of a particular product. Inexperienced individuals commonly have little knowledge about the range of possible benefits that can be generated or the criteria that might be relevant for choosing the best partners, and thus are unlikely to engage in a considered, long-term approach. On a strategic level this research identified three primary changes, namely engagement based on strategy, a greater selectivity in terms of partners and projects, as well as a higher level of orientation -towards the other environment.

Primary and significant change that arises from experience is the deliberate development of a UIL strategy. Individuals mentioned the development of a long-term UIL strategy, which can be incorporated in a broader company/university strategy in respect to Human Resource Management (for companies) and/or general research areas (for universities), as explained in the following quotes that might serve as examples:

> Originally it was based, it was based around opportunity, now we're moving towards engagement based on strategy where we identify you know, where the opportunities are over the next 20 years in clean energy space where there, where we believe there's enough interest and capability in industry to invest (University)

> So, 4 years ago I developed a strategic concept, in which the topic of collaboration with universities was not conducted opportunistically, so a benefit by doing something together on a loose basis, but to engage in close relationships with some universities, deliberately searching for projects, conducting projects and not just in the sense of advertisement via university trade fairs. We work closely together with the career service. The goal is to get to know students and thereby potential employees, already in the project work with the aim (Industry)

Such strategic behavior is no doubt beneficial for the party implementing it, as it provides clear guidance to the individual and his/her team on the direction and future of their work. But importantly, when developing a UIL with a partner that acts based on a well-developed, long-term strategy, one can be assured that the partner is more likely to commit to the linkage and thus spend time and effort into making it work.

In line with a more strategic behavior lies a higher level of selectivity of partners and projects. While initially individuals may have engaged with the partner who is available at the time, with experience comes a pool of knowledge relating to the characteristics that determine a valuable partner and project and that are required to

increase the chance of UIL success. This knowledge is put to use when considering new partners and projects, as illustrated below:

> In the beginning it was rather opportunity seeking. This changed into a qualitative selection of partner (University)
>
> I've become far more aware of it and I can, I'm more demanding about what I expect from researchers and I actively avoid certain people and groups (Industry)

Choosing the right collaboration partner is thought to be a substantial element to successful project work and is thus critical for both industry and university management to embrace. This finding adds to the results identified by Bjerregaard (2009), who states that depending on the project outcome individuals engage in different partner selection procedures, whereby individuals keen on optimizing short-term collaborative project outcomes refer to already existing contacts and those conducting research in areas in which personnel and research activities are limited, rather seek to expand their network and engage in long-term cooperation.

When further reflecting on the change experience in UILs has made, both university and industry participants reported a higher level of orientation towards the other environment. For example, this implies a greater appreciation of the contribution or specific needs partners bring to a linkage.

> We do research but we're geared to an industry frame of mind (University)
>
> We now recognise the importance of research and of the university involvement I think prior we would have seen it as a much smaller component to what we do whereas now we see it as a huge component. We wouldn't, we don't develop any service without some good evidence and some sort of service research that's gone on behind it (Industry)

For both industry managers and university researchers, there is great benefit in having a partner who actively seeks to embrace the strengths and interests offered by the partner and its environment. The external orientation that comes with experience should thus be fostered in one's own organization but also actively sought out when trying to identify new potential partners. This finding adds to the work of van Dierdonck et al. (1990), who found academic researchers with previous collaboration experience to change their attitude towards industry partners.

Different Mindset

With experience also comes a different mindset that exemplifies growing confidence and a better personal understanding of the other environment. Individuals with greater experience in UILs recognize that they have a higher level of confidence when dealing with the other environment, encouraging them to take on more responsibility or extend their work into other knowledge areas, as the following examples quotes indicate:

> I am more confident; and more picky, more, it's more like, I am also more confident to say I don't think that's really researchable topic for, that you should get industry money. (University)

> I think it's, there's been attention to a bit of the power balance that possibly it was more that we felt that the universities were a bit scary because they came with all this research skill and they were going to come to us and sort of it was all going to be too much […] The other thing too is we're taking the lead in a lot of the projects and I don't think we realised how much influence we could actually have (Industry)

Confidence comes with a better personal understanding of the environment and of UIL success factors. Not only do individuals better grasp the partners' working environment, they also better understand its relevance for the success of a project. Experience changes an individuals' understanding of the counterparts' environment, which is not only limited to understanding the work attitude and language utilized but also the importance of the individual and his/her skills.

> It is important to understand how the academic works and this comes through experience (Industry)

> If you want to survive in this business you have to adapt yourself to the changing environment. And I think that you learn from every contact with every company, and that means that you take it to the next meeting, or you. Well, if you start as a freshman in this domain you don't speak the language, so you have to learn the language the hard way (University)

Having confidence of one's own capabilities aids in determining project goals and thereby better managing expectations of the project and the partnership. This finding contrasts Lam (2010) who proposes that especially scientists who are experienced in collaborating with industry try to influence and in some ways manipulate the partners' expectations to set the boundaries for the relationship.

Different Operationalization of Strategies

Findings regarding the operationalization of strategies can be grouped into three categories—those relating to expectation management, quality management and resource management. As stated earlier, academics reflect in the tools they developed and/or used in their day-to-day management of UILs. Yet it was obvious that with many of these approaches routines have developed. Hence, once a particular behavioral approach was tested and found to be valuable, researchers soon adopted it as part of a routine, which allowed them to follow their strategic direction with purpose, calmness and a heightened confidence level described above. This indicates benefits of introducing novices to UILs in a safe and positive environment which may occur by teaming up individuals interested in working with the other environment with more experienced colleagues, supplemented by structured training sessions. A certain routine that develops as experience grows certainly supports any change in mindset and behavior. The specific routines extend the work of Gomes et al. (2005), Hall et al. (2003) and van Dierdonck et al. (1990) who identified routines related to finding mutual research targets, disseminate research results and determine a time frame for delivering results.

Experience highlighted the importance of expectation management in the initial stages of UILs, leading to defining clear focus on expectations to be achieved during

the project very early on. An approach relating to the management of expectation is the running of taster projects, in which the academic side aims to test the working behavior of new partners and prove their ability to deliver results.

> How I deal with the client whilst doing the project is definitely different in terms that I make sure that we set up. Before I sign a contract or engage in the research process, as we are putting together the proposal, I use either like a Gantt chart and come up with agreed upon set of timelines, and make sure that in the project I spell out exactly what I will do, and I guess I am more careful about kind of guarding my own, like protecting myself […] And so now I make sure that I'll underline that I understand their expectations, and we get it on paper (University)

> [We do taster projects] especially with people that we don't, we haven't dealt with before. And we tell them we can do a certain thing within a certain time, and we do it within that time, but we do it very well (University)

To ensure the quality of collaborative projects and results for the industry partner, academics adapted to industry reporting standards by adjusting the format, extent, time and language. This adds to the finding of Hertzfeld et al. (2006) who identified protocols as an emerging routine in collaborative projects. For example, one individual described a specific reporting framework that was tailored to industry needs. Another reflected on changes in the type and extent of record keeping as well as a stricter focus on reporting timeframes:

> I guess industry works towards certain standards on any process. I mean not that we don't have standards, but I guess you're working at a level that industry wants, which is obviously different from what you do in an academic environment. So it's a bit more exacting, the record keeping has to be proper, the reporting has to be on time (University)

Another way of managing quality perceptions is the focus on under-promising and over-delivering within each project:

> If you say you're going to do something, which you know will take eight months, you make it, eight or ten months, you say you'll do it in a year. If you say we deliver five things within the year, you might deliver six things. So you're always kind of over achieving (University)

Academics with experience in UIL also described themselves as more conscious of utilizing appropriate resources, in particular related to personnel. Not only is the deployment of qualified staff key to operationalizing strategies, so is the financial investment in such personnel.

> In the early days, we were so lean on resources, we were probably at a 95-percent quality level, which isn't good enough. And so we've invested more in good staff, good training. We've had to put the salaries up quite a lot to make sure we reward the really good people very well. And so we provide a quality standard that is now not an issue. So that's been an important thing (University)

A deeper understanding of how academic behavior changes in respect to the operationalization of strategies provides industry managers with the insight that academic researchers are eager to adapt their behavior to embrace predefined standards utilized in industry. Therefore, industry managers can aid academic partners by introducing common approaches used in the industry environment, contemplating the overall

success of the project and partnership. By assisting and supporting each other, individuals are working as a team with a common focus. Given the fact that UILs are commonly performed by a group of people, individual experience is not only relevant for the person itself but also for advancing the entire project group. Project teams, having previously worked together, were identified to work more effective and efficiently as each team member is aware of the other team members' skills and competencies and can therefore better assign tasks to the most appropriate person using their experience (Reagans et al. 2005).

Conclusion, Implications and Future Research Directions

As implied by literature the findings of the paper confirm that experience matters. It matters as the individual brings that experience to the linkage and develops a unique set of strategies, personal mindset and operationalization of strategies that can be utilized to improve relationship effectiveness and broader value creation in UILs. The identified attitudinal and behavioral changes are not necessarily restricted to a specific phase of the partnership. They rather relate to the overall management of UILs at all stages of engagement and can thus inform a number of managerial implications. First, individuals seeking suitable UIL partners may integrate a potential partner's UIL experience level as a decision criterion in the partner selection process. Furthermore, when working with current partners, one should develop strategies that help capture the strategies and approaches for operationalizing strategies utilized by experienced individuals and assess the value of executing these within different partnerships. Individuals may also wish to periodically reflect on the impact their ongoing experience with individual relationships has on their attitudes and behaviors, and capture insights to enable learning individually and as part of a group and institution.

Despite the fact that individuals are the key drivers for UILs, the respective institutions cannot be neglected. As such, the task for the institution lies in enhancing the value of individuals' experience beyond that person's linkages for the benefit of the broader institution. This requires the development of suitable structures and policies that allow institutions to cultivate and institutionalize changes individuals make based on their personal experience. One aspect to be considered by institutions is the engagement of experienced individuals in new linkage endeavors to utilize the individuals' strategies, mindsets and approaches for operationalizing strategies for the benefit of these linkages. In addition, allowing novices to work alongside experienced individuals and thereby permitting them to learn by observing and imitating behaviors without compromising potential benefits for the parties involved is of great value.

Another factor to consider is the design of an incentive system that recognizes the value of UIL experience and the value this creates and thus encourages individuals to engage in such linkages over time. Lastly, the development of a structure through which strategies and approaches for operationalizing strategies as described above are

captured and communicated in internal training programs open to both experienced and novice staff is beneficial. The number of different tools identified by this research identified suggests that a broader exchange even between experienced staff would be of value. First and foremost, institutions should also ensure that they allow and encourage individuals to gain experience, as what one has not experienced, one will never understand in listening or reading (Baaken et al. 2015).

While the study provides valuable insights, several limitations should be considered. First, the limited scope of the findings reported here should be acknowledged. The diversity of the sample comprising thirty individuals across two countries created a solid foundation for this research yet should be broadened in the future to seek insights from individuals in other countries and contexts. Second, while the diversity of participants, for example in their research fields and working environments, allowed for a comprehensive analysis of viewpoints on the impact of experience, it does not enable industry-specific insight. Hence, future research may focus on, and compare, particular research fields. Third, the interviewers asked individuals to outline their experience and related changes in their behavior and mindset based on an overall reflection of their work. Adding to such broad-picture approach, an investigation of changes occurring within a particular relationship over time would add valuable additional insight.

Future research investigating changes relating to experience should preferably take a longitudinal approach and follow individuals as they gain experience in UILs or follow partners throughout the evolution of a particular relationship as they learn and adapt their behavior over time. Furthermore, a dyadic approach would be beneficial, as it would not only allow the identification different perspectives on changes that emerge but also the partner's response to such change.

Appendix: Interview Guide

I. **General**
Information about the interviewee

1. What kind of linkages with industry/university are you involved in?
2. How many projects/relationships are you involved in?
3. When did those partnerships commence?
4. Have you been employed in industry/at university previously?
5. What role do you have in the projects/relationships?

II. **Experience**
Discuss first and ongoing involvement with industry/commercialization
University:

1. Why did you get engaged?
2. How was first contact made?
3. What happened? How do you manage/handle collaborative projects?

4. With increasing experience, did you change? If yes, how?
5. What did you change in your behavior?
6. How did your approach change?

Industry:

1. How did you first get involved with universities?
2. How was first contact made?
3. What happened? How do you manage/handle collaborative projects?
4. With increasing experience, did you change? If yes, how?
5. What did you change in your behavior?
6. How did your approach change?

III. **Individual relationships**
Relationship (various relationships; focus on individual relationship when answering questions)

1. Briefly describe what kind of relationship you are engaged in
2. How long has it been running (e.g. several projects or one project, length of time)?
3. How many people are involved on both sides?
4. How much is involved (how important for you)?

IV. **Clarifying and probing questions**
Interviewers were asked to seek clarifications and ask for specific examples in relation to the individual university-industry relationships mentioned throughout the interview.

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Entrepreneurial Educators as Academic Intrapreneurs

Sue Rossano-Rivero

Abstract This research investigates the entrepreneurial behaviour of academics. Nowadays, universities are expected to be organisations with open boundaries, allowing for the cooperation and interdependency among different actors in the society. Against this background, this research focuses on the engagement of academics on entrepreneurial activities with external actors, such as business, so as to introduce novelties in teaching to create value for the university. While these academics might not be interested in leaving the university and taking on the role of a business owner, they are willing to champion ideas and introduce novelties to the university in order to create new value. These academics represent "intrapreneurial actors" within the university. In this contribution, the concept of academic intrapreneurship is introduced first, then the focus shifts to explaining how new value is created through academic intrapreneurship within the context of education, highlighting the importance of networking for academics; finally, it turns the attention to the question of how it can be encouraged in academic settings.

Keywords Academic entrepreneurship · Intrapreneurship · University-business cooperation · Networking · Higher education

Introduction

The emergence of digital technologies that enabled and popularised massive open online courses (MOOCs) (Perna et al. 2014), and the fact that a considerable share of research and development activities is currently conducted in other organisations and (user) communities, (Drejer and Jorgensen 2005) have positioned the universities in a competitive landscape. Hence, frequent and profound questions are being raised concerning the purposes and accomplishments of contemporary higher education and learning (Bensing and Van Oortwijn 2006; Jentleson and Ratner 2011).

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In the view of prominent scholars (e.g. Clark 2001, 2004; Etzkowitz 1998; Gibb and Hannon 2006) universities needed an "entrepreneurial response" to confront this competitive landscape and remain sustainable within this changing context. The entrepreneurial response from universities supposes an innovative approach along their core activities of (1) research and (2) teaching and learning. In this way, the universities would reconfigure themselves to best pursue opportunities beyond currently available means, but would keep the underlying values that characterise universities, combining the "old" and the "new" in a revised form of organisation (Clark 2001, p. 10). On the one hand universities and departments must adapt to changing external conditions and engage in market-oriented activities. But on the other hand universities must secure the position of basic research and the values and morals attached to this core function of university, which Clark (2001) calls "the academic heartland".

Entrepreneurship is an important engine for any organisation to push internally-centred growth into completely new opportunities unrelated to current mainstream activities, as well as to create new sources of wealth and value creation (O'Connor and Rice 2013). The interest in harnessing entrepreneurial behaviour within universities does not come as a surprise, given the growing external expectations on universities to better contribute to society and to play a more prominent role in shaping the knowledge society promoting economic growth (D'Este et al. 2012).

In a knowledge-based society, universities are to be regarded as the most relevant organisations (Etzkowitz 2008). Many concepts such as "University-Business Cooperation (UBC)" and the "Entrepreneurial University" build on the assumption that industry-university-government all working in harmony have the potential to advance innovation and ultimately the economic and social wellbeing of people (Etzkowitz 2008).

As a result, in recent years, universities have become increasingly involved in generating additional economic returns through bridging the gap between industry and the universities. Perkmann et al. (2013) uses the term "academic engagement" as an umbrella term for all forms of cooperation between academics and non-academic actors (p. 424). Such collaborations include, networking with practitioners (Bonaccorsi and Piccaluga 1994; D'Este and Patel 2007; Meyer-Krahmer and Schmoch 1998; Perkmann and Walsh 2007), mobility for students and staff, life-long learning efforts (Davey et al. 2011; Davey 2015) and the introduction of novelties in teaching with the participation of external actors to the university (Hasanefendic et al. 2016; Laredo 2007). In fact, previous studies find that these collaborations have stronger prevalence among academics than the formation of spin-offs and commercialisation of research via patents and licences (Perkmann et al. 2013).

For this reason, academics are nowadays considered to have a more prominent role in the creation of new social and economic value (Bozeman et al. 2013; Perkmann et al. 2013), not only through the commercialisation of their research via patents, licences and start-ups, but also through their engagement in collaborations with other actors in order to create value for the students, the university and society as a whole. These collaborative activities of academics with business and external actors in education have proved to generate many benefits (Forsyth et al. 2009; Plewa et al. 2015) such as the enhancement of students' entrepreneurial skills (Baaken et al. 2015;

Kiel 2014). Hence, while often overlooked, the novelty and value-creating character of these activities justify, and in fact call for such activities to be regarded as instances of academic entrepreneurship (Goddard 2007; Spaapen and Drooge 2011).

Nevertheless, research on academic entrepreneurship has, to date, been carried out mainly from an economic perspective with special emphasis on the translation of outcomes from research activities into commercial applications through the development of patents, licences and spin-offs (Czarnitzki et al. 2016; Shane 2004; Shane et al. 2015). There has been far less discussion of academic entrepreneurship in the context of educational activities and how these can lead to the creation of social value for the university itself.

In this context, academic intrapreneurship is understood as the engagement of academics in entrepreneurial activities with external actors so as to introduce novelties in teaching. While these academics might not be interested in leaving the university and taking on the role of a business owner, they are willing to champion ideas and introduce novelties to the university in order to create new value. These academics represent "intrapreneurial actors" within the university. In this contribution, the concept of academic intrapreneurship is introduced first, then the focus shifts to explaining how new value is created through academic intrapreneurship within the context of education, highlighting the importance of networking for academics; finally it turns the attention to the question of how it can be encouraged in academic settings.

Academic Intrapreneurship

The concept of "*Intrapreneurship*" has been coined by Pinchot (1985), whose publication attracted a lot of interest among scholars and practitioners. Intrapreneurship consists of the prefix intra meaning inside or within and a shortened form of entrepreneurship. Consequently, "*…entrepreneurship within an organization …*" can be used as a general definition. Nowadays Intrapreneurship is an important topic for most managers in organisations of any size and nature. Intrapreneurship has become more and more recognized as a vital element in organizational development, having relevance not only for the organisation itself but also for the individual. Many researchers have discovered the importance of intrapreneurship and its role in organizational renewal, innovation, and the creation of new businesses activities (Menzel 2013; Antoncic and Hisrich 2001; Pinchot 1985).

While the relevance of intrapreneurship is well recognised in industrial settings and private organisations (Kuratko et al. 2015), the conception of the university as an entrepreneurial organisation has found increasing resonance among the international higher education community (e.g. Berger 2008; Kesting 2012). In the last decade, entrepreneurial modes of thinking and acting—understood as the mind-sets and processes with which activities are created and developed (European Commission 2010, p. 10)—have attracted increasing interest among knowledge managers and higher education policymakers.

Even though the idea of harnessing entrepreneurial behaviour among academics has been appearing in scientific literature for more than three decades (Rothaermel et al. 2007), there is still no general accepted definition, nor is there unanimity about how the concept should be understood. As a consequence, "entrepreneurialism" in academia has been a cause of controversy, with varying levels of acceptance and differing views on what actually constitutes an "entrepreneurial activity" (Audretsch et al. 2002).

Indeed, authors have used the term of "academic entrepreneurship" to represent a wider array of knowledge transfer activities, that does not only include the engagement in spin-off formation by academics (Göktepe-Hulten and Mahagaonkar 2010). This broader definition has gained acceptance among the academic community as it has been recognised that academic entrepreneurship occurs in many modalities and mechanisms other than the literature has covered for (Benneworth and Jongbloed 2010; Olmos-Peñuela et al. 2014). For instance, Benneworth and Jongbloed (2010) and Perkmann et al. (2013) assert that academic entrepreneurship may entail a much broader spectrum of formal and informal activities, in which universities and academics interact and collaborate with a variety of public and private actors in order to develop and implement scientific knowledge in and for practice. For example, Hasanefendic et al. (2016) have found that academics engage with external network contacts for the development and delivery of novel and entrepreneurial teaching formats.

Despite the lack of definition, there is broad consensus, both in the academic and practice fields, about the relevance and the need to bring entrepreneurship into the setting of the university (Davey 2015; Rothaermel et al. 2007). Already, Schumpeter (1934), who stated that "new enterprises are mostly founded by a new man and the old businesses sink into insignificance", identified the need to establish the logic of entrepreneurship within established organisations. Thereby, he associated entrepreneurship with innovation. Stemming from the Latin word innovatio, "innovation" means newness or difference, and to innovate means to make changes, introduce new things (Hornby et al. 2002), or bring new methods and ideas or make a change (Soanes and Stevenson 2004).

Academic intrapreneurship in this research is defined with respect to the behavioural perspective on entrepreneurship, where it is defined as a process of opportunity pursuit, thus "Entrepreneurship" is defined as "*the process of recognising and pursuing opportunities for the purpose of creating new means-ends relationships* (Eckhardt and Shane 2003, p. 336; Shane and Venkataraman 2000) *regardless of the location of the resources currently controlled* (Stevenson and Jarillo 1990, p. 23)". This definition stresses that the essence of entrepreneurship is the willingness to pursue opportunity, regardless of the location resources available, since the entrepreneur will always find "a way" to make it happen.

In the context of the university, this definition suggests that academic intrapreneurs enact themselves in order to acquire the necessary resources to realise opportunities. Particularly, in the university setting, academics are constrained in terms of resources. A classroom, a schedule and their own time are common resources for academics to execute their teaching tasks, however, academics need to enact themselves in order

to make it happen, especially if they want to engage in innovation within the teaching mission of the university.

Academic intrapreneurship is then founded in the logic of pursuing entrepreneurial opportunities for new value creation within the context of the university. Hence, academic intrapreneurship is defined with respect to the definition of entrepreneurship that is given previously. This definition explicitly includes other outcomes of intrapreneurship, such as new ways of working or teaching. This leads to the following definition of academic intrapreneurship: "*The process by which an academic recognises and pursues opportunities for the purpose of creating new value for the university regardless of the location of the resources currently controlled*".

In order to successfully introduce novelties in teaching, academics need not only good ideas, but also key resources, including legitimacy and contacts. Therefore, the pursuit of opportunities by academic intrapreneurs is performed within and through relationships with stakeholders in the social and institutional context.

Therefore, for a broader understanding of the entrepreneurial behaviour of academics and their value-creating activities in interaction with others, two research issues need to be considered: (1) the role of the environment affecting the entrepreneurial behaviour of academics, as this provides them access to (or in some cases withholds) ideas, resources, moral support and legitimacy throughout the entrepreneurial process and (2) the role of the individual driving the entrepreneurial process.

To address the aforementioned issues, this research approaches to the overall research question from a sociological perspective, considering that entrepreneurship is not merely an economic process, but rather that it draws from the social, spatial and institutional contexts that shape entrepreneurial behaviours, processes and outcomes (Jack and Anderson 2002; Welter 2011). This research addresses the following question: *how do the social interactions of academics affect their entrepreneurial behaviour within the context of UBC-based education, and (if any) with what effects on the education mission of the university?*

Academic Intrapreneurship Within the Context of Education as a Form of Organisational Renewal

Introducing novelties in teaching through intrapreneurship addresses and extends one of the most important facets of intrapreneurship—organisational self-renewal (Covin and Miles 1999; Zahra 2007) to the context of the university. Covin and Miles (1999) have noted that "*renewal*" refers to changing and improving the relationship with the external environment.

In this context, when academics engage in UBC for the introductions of novelties in teaching, it is not only the resources they receive that can explain the successful exploitation of opportunities, but also the fact that they are engaging with the external environment to obtain information they need to align their research (also embodied

in products and services) or their teaching activities with the requirements of the external environment (private or public organisation, or future employers).

The study from Davey et al. (2016) reinforces this premise. They found that "Drivers for UBC" positively and significantly affect the development of academic entrepreneurship. In the same vein, Rossano and Wakkee (2018) and Rossano-Rivero (2018 forthcoming) found that the networking competency of the academics, as well as their networking behaviour play a significant role in the extent of development of their entrepreneurial behaviour within the context of education. While networking with academic peers within the university is important for academics (Rossano and Wakkee 2018), their interactions with the external environment become the source of ideas and new value creation in the form of organisational renewal.

By examining the phenomenon of entrepreneurship within the university setting through the "*intrapreneurial*" lenses, the pro-active engagement of academics with the "*external environment*" becomes a key behavioural characteristic of academics acting as entrepreneurs within their organisation (university). These findings highlight the important role of the external environment for intrapreneurial endeavours. Entrepreneurs by nature seek to exploit external opportunities embedded in their environment. As Schumpeter (1934) noted, it is the essence of entrepreneurship to capitalize on environmental change. Thus, in the uncertain environment that university executes nowadays, academic entrepreneurs must capitalise on their social environment, engaging in social networks with external actors that can provide them with advice, resources, experience and information to exploit opportunities within the university environment, such as the commercial exploitation of the results of their research or the introduction of novelties in teaching (Mustar et al. 2006; Vohora et al. 2004).

Implications for Academic Intrapreneurship Within the Context of Education

How can entrepreneurship be influenced within the university setting? This is a question that has triggered the curiosity of scholars in the field (e.g. D'Este et al. 2012; Davey 2015). The body of literature focusing on the individual asserts that personal characteristics and motivations determine entrepreneurial behaviour among academics (D'Este et al. 2012; D'Este and Patel 2007; Lam 2011). However, the isolated consideration of the individual ignores relevant organisational factors, such as organisational culture, availability of knowledge and resources, as well as cooperation with others.

In contrast, the stream of literature at the university level, asserts that the entrepreneurial behaviour of academics is shaped by and subject to the institutional arrangements and structures of the university, such as technology transfer offices (TTOs), science parks and incubators, as well as supportive internal rules and procedures (Clarysse et al. 2011; Siegel et al. 2003).

The new sociological contribution defines entrepreneurship as a collective phenomenon, which recognises the actions and contributions of dynamic actors but simultaneously acknowledges the substantive impact of the larger social network and institutional community in which these actors are embedded, constraining or facilitating their behaviour.

Nowadays, definitions of entrepreneurialism within the university highlight the importance of collaboration and networking between the spheres of academia, industry, government and society as a whole to promote economic and social development, as well as innovation. Bienkowska et al. (2016) conceptualise the university as being a "permeable institution". This permeability of the university is grounded in the Triple Helix systems (Etzkowitz 2008), emphasising boundary permeability among institutions as an important source of organisational creativity, which allows for the exchange of ideas within and among institutional spheres (Ranga and Etzkowitz 2013). In this sense, the permeable university encourages interactions of students, academic faculty and external organisations that can evolve into networks of knowledge circulation to create new value for all actors involved (Van der Sijde 2012). This new value could be reflected in the introduction of novelties in teaching.

Academics, in their role of educators, bring into the teaching environment real experiences from business and combine their pedagogical expertise to trigger the development of entrepreneurial behaviour among students (Täks et al. 2014). From their side, external actors, such as businesses, acquire access to new knowledge (Teixeira and Mota 2012) and new methods and tools to solve the real problems faced in their business environment, from the work done by the students and lecturers in the university. These novel combinations of resources and information, especially through new ways of exchanging and combining resources have been considered as sources of new value creation (Tsai and Ghoshal 1998, p. 468).

The social interactions of the academic create a networked context of cooperation, in this case a UBC context. Academics' behavioural aspects at the individual level, such as their actual networking behaviour, will determine the successful configuration of their networks and their social capital for the attainment of entrepreneurial goals within the context of the university.

The entrepreneurial behaviour of academics creates new learning environments for students through a learning network created by UBC-based teaching. A UBC-based form of teaching becomes a network of learning, where different members of that network engage in a knowledge circulation process. From a social constructivist view on human cognition (Jonassen 2009), learning also depends on social interactions, not only between instructors and classmates, but also among the actors in the learner's socio-economic context, providing a source of expertise and experience from the world of work (Pugalis and Liddle 2014).

Entrepreneurialism within the university cannot only be centred on the creation of economic value, but also of social value, where academics and business people can exchange knowledge in diverse forms (Lamichhane and Sharma 2010; Teixeira and Mota 2012), such as through education-based collaborations (e.g. Caniëls and van den Bosch 2011). These knowledge-exchange collaborations create new means-ends relationships, adding value to the education mission of the university and to the

business, by engaging in a knowledge circulation process. Education-based collaboration with business enhances students' employability and entrepreneurial skills (e.g. Forsyth et al. 2009; Baaken et al. 2015; Kiel 2014; Rossano et al. 2016; Plewa et al. 2015). To this end, the cooperation between academics and business generates social value reflected in new types of knowledge and new or different ways of working, such as new ways of teaching.

Theoretical and Practical Implications

Networking as a practice of the individual academic entrepreneur seems to be a significant indicator of the extent of development of teaching practices that are implemented with business; a teaching practice that is recognised as a novelty in teaching (Hasanefendic et al. 2016). Not only does the academic's networking behaviour to undertake UBC activities and present key insights into UBC and academic entrepreneurship literature, but it also contributes to the understanding of social capital formation and accumulation between academics and business and therefore to the social capital and entrepreneurial networking theories.

The significant role played by the networking behaviour of the academic in entrepreneurial activity, as discussed in Rossano and Wakkee (2018) and Rossano-Rivero (2018 forthcoming), portrays academics as, as reflective agents who endogenously decide on, and are practitioners of networking practices that shape their collaborations and, ultimately, their social capital. Hence, academic entrepreneurs are not only the subjects of specific structural network configurations. Furthermore, they can also be considered strategic actors that intentionally pursue valuable new connections to organise their social capital in the first place.

The extension of factors to be considered in academic entrepreneurship within the context of UBC refers to the individual practices of academics that form and shape their networks with business people. In this case, the individual practices refer to the networking practices of academics. Therefore, the proposition of D'Este et al. (2012) and Davey (2015) to consider other factors affecting entrepreneurship at universities needs to be extended by the networking behaviour of academics in this respect.

Developing theory on the actual practice of entrepreneurship within universities is useful in order to harness and foster entrepreneurial behaviour among academics on a continuous basis, as opposed to randomly-occurring academic entrepreneurial activities, which are highly dependent on the personal initiative and personal contacts of the academics. Harnessing and fostering entrepreneurial behaviour within organisations and through interorganisational collaboration are also relevant aspects of intrapreneurship and corporate entrepreneurship in all kinds of organisations. The findings therefore advance this literature strand as well.

In addition to the theoretical implications highlighted above, this contribution holds practical implications. As such, universities willing to foster and harness entrepreneurial behaviour among academics demand novel perspectives on the management of the university. As previously discussed, academic intrapreneurship should

be understood as a value-creating process that can be manifested in the introduction of novelties in teaching to create value for the students, the university and all actors involved.

Nevertheless, academics vary in their networking practices, even under similar institutional environments and similar conditions (Rossano and Wakkee 2018), indeed, some academics might not have an external network of contacts with whom they can undertake UBC-based teaching practices. Therefore, for these academics, networking within the university is crucial, since it will be their affordance to reach colleagues who might occupy bridging positions and hence provide them access to some external actors. In this respect, managers of universities should encourage interactions among the academic community and foster the collaboration among academic peers within the university. This approach in turn calls for a collective approach towards fostering academic entrepreneurship within the university.

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A Conceptual Framework of Leadership and Governance in Sustaining Entrepreneurial Universities Illustrated with Case Material from a Retrospective Review of a University's Strategic Transformation: *The* Enterprise University

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Abstract A conceptual framework of leadership and governance is described here, the aim of which is to help universities undertake strategic transformation in becoming more entrepreneurial, that is, more agile, resilient and innovative. The framework is illustrated with case material from a retrospective analysis of changes in a UK university that was differentiating its mission to become *the* enterprise university. Making explicit the implicit ways of change management and partnership working involved in strategic transformation, the framework draws out those leadership and governance processes operating in practice. In this way, those practices and processes promoting healthy idea flow are identified as well as those acting as barriers to innovation. It is posited that the framework could support universities and other knowledge organizations to more fully advance their purpose by enhancing value creation released through social networks driving innovation. The leadership and governance model dominant in most university and industry management systems is a hierarchical, formal authority structure. While relevant to organizational resourcing, accountability and scaling, bounded hierarchy is not well-positioned to support the healthy flow of ideas necessary for successful entrepreneurial activities. Given that universities and many industries are 'idea factories', new models of leadership and governance that serve to more fully leverage the creativity embedded in the organization can accelerate delivery against the shared goals emerging from collaboration. New ways of working that better reflect the actuality of innovation and the idea ecosystem are identified, given that ideas emerge from community systems comprised of diverse individuals connecting with others in groups with ideas flowing along social networks. Peer-to-peer exchanges are inherently more agile, and engagement is characterized by idea exploration, harvesting and co-creation with idea flow across institutional barriers. New models of leadership and governance that underpin the dynamic articulation of the formal hierarchy with the unbounded community of social networks can support entrepreneurial activities and are key to securing

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sustainable university-industry partnerships. The model described here draws upon learning explored in executive education and talent development programs exploring institutional sustainability leadership, including approaches to driving innovation and social enterprise (undertaken in the USA, Europe and UK). New ways of working are proffered that re-frame university-industry partnerships as dynamic social networks, where ideas are exchanged and developed, supported by leadership and governance processes that promote, rather than hinder, healthy idea flow. Trustful relationships are developed over time across boundaries, both disciplinary and organizational, and support experimentation and innovation in line with the expressed shared purpose. In an entrepreneurial university, leaders at every level need to be conscious of the organizational senior management hierarchy operating as one system and the community of social networks acting as another system, and seek to understand how best to harness the creative tensions between the two systems. Rather than an organizational chart defining membership, creative and decision-making processes and systems are designed to better reflect actual interactions and idea flow throughout the organization and with its partners. Developing new models of leadership and governance that map against the stages of idea flow can serve to drive up successful entrepreneurial (and intrapreneurial) activities. In this way, entrepreneurial universities can increase idea flow within the university-industry network(s) in line with their strategic intent. In making the implicit explicit it is possible to transform the behaviour of the people involved and, through them, the culture that supports entrepreneurial partnerships. The conceptual framework described here is necessarily reductionist in nature, however, mapping idea flow from successful projects and applying such knowledge to future project flows along with the associated governance processes could add atomic-level detail relevant to the organizations and projects concerned to drive healthy idea flow over the long-term. The conceptual framework is illustrated by reference to the strategic transformation of a UK university becoming more entrepreneurial as it delivered change in line with differentiating its academic mission to become *the* enterprise university.

Keywords Leadership · Governance · Entrepreneurship · Enterprise · University-industry partnerships · Social networks · Idea flow · Trust

Introduction

Entrepreneurial universities (Smith 1999; Guerrero et al. 2006) have emerged in response to economic and social forces acting upon higher education. As academic institutions move to differentiate themselves in light of disruptive forces such as technology, connectivity and globalisation, they have drawn upon their core mission to connect more powerfully with business and industry (Vorley and Nelles 2008; Wright et al. 2008; Purcell 2014). In this way, ideas can flow more freely into society and societal needs themselves can better influence the academy. In so doing, some

universities have become place-makers, anchored locally and connected globally, operating as agents of change (Purcell et al. 2016).

The pan-institutional transformation required to develop an engaged and entrepreneurial university, challenge traditional academic leadership models. The pace and scale of change required relies upon a clarity of direction and full activation of all staff and wider stakeholder groups. As such, a top-down directional leadership model is insufficient to deliver the quantum of change needed. However, leadership that activates people around a shared purpose and secures full advantage from peer-to-peer social networks offers much to explore in driving more entrepreneurial organizations. It is here that the present account locates itself in exploring a new conceptual framing of institutional leadership and governance.

In order to gain greater autonomy and become more entrepreneurial, universities have moved to transform themselves through diversification (Clark 1998). Erkkilä and Piironen (2014) argued that competition in higher education has led to increasing institutional autonomy, a necessary pre-requisite for diversification and the development of a differentiated unique mission (Freimuth 2008). Clark (1998) went on to articulate five traits of 'the entrepreneurial university' which were extended by Gibb et al. (2013) to include a conceptual link with the pressure on universities to focus on innovation, risk-taking and dealing with uncertainty. Gibb incorporated the traits identified by Clark and others (i.e. Etzkowitz 2008) into a broader conceptual framework that presented key components of "*an organization moving to cope entrepreneurially with high levels of uncertainty and complexity*" (Gibb et al. 2013). It is here that our conceptual model of iterative de-risking plays into securing scalable change that is transformative and sustained over the long-term.

Florida (1999) stated that the "*university functions less as a direct engine of economic development but that its role is quite subtle and nuanced taking on a function which is even more important: that of enabling infrastructure for technological and economic development*." More recently, the concept of 'anchor institutions' has gained momentum being described as "*civic, cultural and intellectual institutions which contribute to the cultural, social and economic vitality of cities*" (Maurrasse cited in The Work Foundation 2010). Anchor institutions are, in the author's opinion by definition, entrepreneurial given their role in leveraging against the key assets of place to create value. As such they can bring a range of direct and indirect economic, environmental, human and reputational benefits to a city-region, as well as bringing potential challenges. The Work Foundation (2010) conceptualised these impacts according to the types of capital the institutions represented: financial (budgets, purchasing); human (employment); physical (land holdings, development projects); intellectual (skills, leadership); market (identity, brand, reach); social (networks); and cultural (centers of learning and dissemination) capital. The significance of the role universities play in the economic development and regeneration of their local area is increasing (Sölvell 2015; The Work Foundation 2010) given the forces of urbanisation and the move to a knowledge-based economy.

Alongside the developing concept of universities as anchor institutions, there is more interest now in considering entrepreneurship and enterprise within higher education. However, a move by a university towards a more entrepreneurial ethos

presents a major challenge for university leaders (Gibb et al. 2013). Many tensions may result, for example, between institutional goals, cultural preferences, and individual and organizational drivers (Bridgman 2007). These tensions can impact on the availability and application of resources and effort. Perhaps the greatest challenge for leadership is to foster an innovative approach *throughout* the organization, and thereby potentially confront the academic independence of individual departments. The ability to recognise enterprising leaders as change agents is essential, as is the ability to communicate clearly concepts of innovation to all disciplines, and support this with resources (Gibb et al. 2013). As such, the characteristics of an 'entrepreneurial leader' are not dissimilar to the concept of 'transformational leadership', with a need for intellectual and visionary leadership to remove negative perceptions of entrepreneurship, and to drive through the necessary change of culture, mission and strategy. This is relevant to the conceptual model described here. In seeking to secure sustainable transformational change, a more agile and connected leadership and more adaptive governance processes that accommodate the social networks and agreements need to be in place. Clark (1998) went on to identify several defining features of entrepreneurial higher education governance and culture, which was further developed by Middlehurst (2004) who used a framework to explore how far institutions had travelled towards entrepreneurialism. These definitional concepts are reflected within this discourse on transformational agreements and the wider iteration of the Senior Management Hierarchy (SMH) with the Community of Social Networks (CSN) framed around purpose-driven organizational networks that together constitute the conceptual framework described here.

This account adds to that published by Crow (2008) who, as its President, explored Arizona State University (ASU) as a case study of the 'New American Research University' based on an organizing principle of academic enterprise—that is, an organization that is agile, competitive, adaptable and responsive to the changing needs of stakeholders and the wider society. Like the author as President Vice-Chancellor in this account, Crow (2008) highlighted the need for change to the institutional mindset and associated structures, both highlighted in the conceptual framework described here. It is worth noting that the literature on entrepreneurial universities includes very few criticisms of the 'academic revolution' that led to higher education's 'third mission' for social and economic development (Etzkowitz 1998; Fusilier and Munro 2013; Sam and van der Sijde 2014). Exceptions to this include Nedeva's (2008) concern that it would distract universities from conducting basic research and Philpott et al. (2011) who reported that academics who felt a strong top-down push towards the 'third mission' might actually reduce entrepreneurial activity across a university. Despite such criticisms, the 'third mission' has been widely accepted and adopted to varying degrees by universities with entrepreneurship incorporated into, and not just additional to, teaching and research in maintaining academic identity (Sam and van der Sijde 2014). However, the author continues to take exception to the description of a 'third mission', and positions entrepreneurship and enterprise as the lens through which the core academic mission, that is teaching/learning and research/innovation, of the university should be viewed.

To realize more fully the innovation potential of university-industry partnerships, new capabilities need to be built into their leadership and governance systems and processes to enable idea flow across and within the partners involved (Cullen-Lester et al. 2017). A university and its industry partners operate as an ideopolis, with ideas emerging from individuals, teams and through interactions with one another, stakeholder groups and students. This type of community reflects social networks that are agile and adaptive, characterized by idea creation, co-creation and flow across institutional barriers. However, the governance processes typically in place are bounded and hierarchical and can present a barrier to co-creation such that creativity and innovation are hindered (Le Roux and Pretorius 2016). Indeed, it has been suggested "*that the corporation is at odds with the future*" (McCracken 2013) such that agility is central to successful enterprises. New models of leadership and governance that support a more dynamic articulation of the senior management hierarchy with the unbounded community of social networks across the life cycle of an idea from inception to outcome should better support entrepreneurial activities.

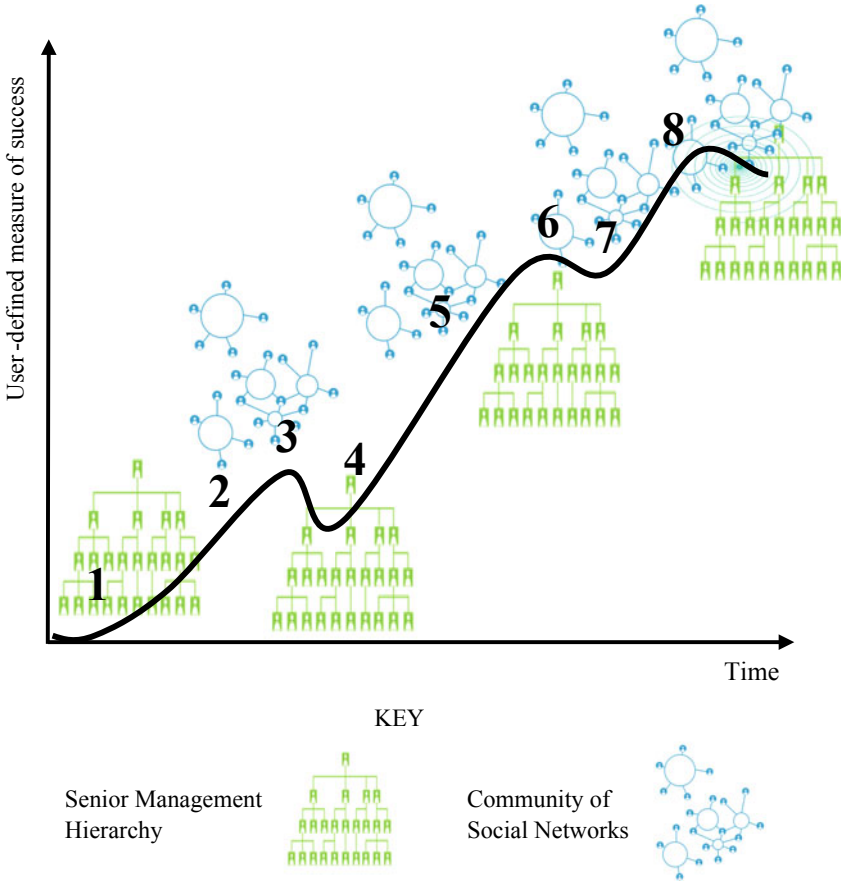
The conceptual framework presented here seeks to make explicit the iterative decision-making processes that are often an implicit part of organizational life. The power of the senior management hierarchy is in defining and communicating the strategic direction of the entrepreneurial university and giving 'permission' to members of the university-industry community to engage in co-creation and innovation with each other and create and sustain the conditions essential to releasing creativity in the organization (Cullen-Lester et al. 2017). The senior hierarchy signals to the university and industry communities at large the strategic intent of driving up engagement among its partners, giving authority for ideas to be released (safely) into the decision-making processes. The leadership and governance systems thereafter need to go beyond this mandate however and serve to harness the ideopolis in delivering against the mission's higher purpose by careful selection, resourcing and stewardship of ideas. Such processes create the infrastructure for ideas to flow through the life cycle of being generated, iterated, selected (or abandoned) and communicated. The senior management can then direct a level of resource, in a timely manner, to further develop ideas that 'fit' with the strategic intent of the organization and support a level of piloting and experimentation important to de-risking the innovation. However, it is more often the case that ideas get 'stuck' and do not move forward to create value and deliver impact (Le Roux and Pretorius 2016). This is where the conceptual framework presented here locates itself, seeking to identify leadership and governance practices and processes that better support innovation and partnership working in support of entrepreneurial universities. Working open source, Sharp (2016) trained leaders to explore how ideas flowed through their organizations, drawing on examples from universities, businesses and industries across the world. Taking this practice forward into academic research and situating it in the literature, the framework described here is a reductionist view adapted for modelling purposes and applied retrospectively to a pan-university transformational process to identify key steps in effecting complex change.

Main Results and Findings

The study draws on learning secured by working with leaders across a range of different organizations, including universities, business and industry undertaking Harvard University's executive education programs, bespoke courses delivered in Europe and programs delivered in partnership in the UK through the Environmental Association of Universities and Colleges (EAUC; see http://www.eauc.org.uk). Leaders were at senior- and middle-management levels and worked indivdually and in groups on the concept of accelerating change toward creating more resilient and sustainable organizations. This model is being applied here to entrepreneurial universities working with business and industry. The insights secured are placed within the literature with an emphasis on leadership and governance as a conceptual framework, highlighting social physics and the emerging field of leadership science. The study is illustrated by reference to a Case Study of a UK university that embarked on a strategic transformation to become *the* enterprise university (Plymouth University, UK).

The framework characterises two organizational operating systems that interact one with another. The first is the bounded, fixed authority structure of hierarchical senior management typically involved in command-control activities and representing the more traditional formal power structure. The second is an unbounded, agile and emergent community formed of social networks that develop around shared purpose and represent creative hubs engaged in innovation. We have referred to these two systems respectively, as the Senior Management Hierarchy (SMH) and the Community of Social Networks (CSN) (Purcell et al. 2017) and adopted a visual lexicography to describe the interactions of one system with the other (see Fig. 1). Figure 1 shows a schematic of a user-defined perception of successful idea flow (Y-axis) against time (X-axis), from idea inception to project approval (or indeed a decision not to proceed), to delivery, scaling and evaluation; the moves that result in measurable output are given in Table 1). Figure 1 shows how an idea progresses through an organization over time, and Table 1 shows the different stages from launch (step 1) to roll-out (step 8). The intervening steps (2–7) reflect the idea flowing from the SMH out into a community or group comprised of people connected via social networks. The idea iterates through these groups, which may be existing stand-alone committees or advisory boards, or which may have been formed as project or task-and-finish groups. As the idea moves in and out of the SMH and the CSN it matures, and the organization learns more about it, such-that risks are revealed, and staff are engaged in the change process and transformation itself.

Taking the two systems illustrated in Fig. 1 and reviewing idea flow maps created by several hundred people, key patterns were identified in the activities of each system as recurring inflections in the idea flow 'graph'. While not an exhaustive account, the list below gives a brief description of some of the ways of working that hinder idea flow.



Example of Key Activities

1 – Launch of strategy
2 – Idea creation
3 – Idea creation and champions
4 – Resources sought
5 – Engagement and piloting
6 – Review and refinement
7 – Resources and integration
8 – Roll-out and ongoing review

Fig. 1 Schematic of a user-defined perception of successful idea flow against time developed from forensic idea flow mapping showing the life cycle of an idea over time (X-axis) with user-defined qualitative measure of success (Y-axis). Key activities are mapped as inflection points (1–8) and shows an idealised idea flow between the two operating systems from the Senior Management Hierarchy through to the Community of Social Networks from idea inception to full project roll-out and ongoing review

Table 1 Activities of the two main operating systems: the bounded formal authority structure of the Senior Management Hierarchy and the unbounded, more agile, Community of Social Networks showing the location of key change management activities

	Senior Management Hierarchy	Community of Social Networks
Sensing, insight, research, external drivers	X	X
Vision—What?	X	
Ideation—How?		X
Coalition—via dialogue		X
Resources—allocated/not	X	
Piloting and analysis		X
Reporting to CEO/Board		X
Alignment with strategy	X	
Engagement and buy-in		X
Approval and roll out	X	

(1) A SMH disconnected and unaware of feedback from its users (clients/customers/staff/students) such that this critical information circulates in the CSN and is not captured by the SMH for action. Hierarchy isolated or disengaged in this way fails to 'sense' into the future and use feedback to influence the idea lifecycle—which may be a product or service; failure to engage in the sensing/feedback loop could ultimately lead to failure of the product/service or even the organization itself.
(2) A CSN operating without appropriate strategic guide rails from the SMH such that creativity is insufficiently framed by strategy and organizational/partnership energies are dissipated and not focused on delivering against shared aims and the mission of the organization.
(3) A system that fails to pilot and de-risk innovation in a staged fashion such that roll-out and securing buy-in via engagement with community members impedes or stalls uptake of the innovation throughout the social networks.
(4) Failure of the SMH to hardwire the innovation into the organization such that the strength of the CSN is insufficient to sustain the change within the community.
(5) Lack of appreciation of the distinctiveness of the two systems and as such a failure to communicate the staging of healthy idea flow and leverage this knowledge.

In exploring where a lack of organizational appreciation of the distinctiveness of the two systems was relevant, a key stage in the lifecycle of an idea was identified where members from the CSN move to seek formal approval from the SMH. Miscommunication in such exchanges can leave team members feeling demoralised while the senior team can view the staff members as weak or ill-prepared. For example, the senior team may be of a mind that they are being invited to offer critique and challenge in terms of how the innovation will fit with existing operations rather than

being asked for formal sign-off of the project while the advocate(s) from the CSN are looking to get to a 'yes' in terms of formal approval to proceed. In this scenario, the team member(s) can lose social/political capital while the organization itself can lose a potentially valuable idea now and indeed a pipeline of future ideas.

The analysis of many hundreds of idea flow maps identified some useful generic idea flow archetypes or patterns as described earlier. However, the analysis showed that forensic idea flow mapping by the organizations concerned revealed institutional patterns that related to the governance structures and processes at play as well as to the individuals involved and their roles and leadership styles. This atomic-level analysis by an organization itself in undertaking forensic idea flow mapping was highly valued. Guiding senior leadership to reflect upon their own in-house processes and the personnel concerned served to advance understanding of idea flow as a concept and ideas as institutional assets. This provided an evidence-based case for revisions and/or full-scale changes to the decision-making architecture and/or the people involved. In some instances, the organizations concerned went on to review their governance processes to better support idea flow. For example, in managing up, team member(s) approached senior level encounters with the questions the SMH is set up to answer, such as fit with strategy, resources available and risks inherent etc. With respect to advancing healthy idea flow, it was noted that the shorter the distances between those making the decisions and those impacted by the decisions seemed to correlate with healthy idea flow through to successful project execution and outcomes. This was also the case where an organization deliberately exposed ideas for change to the communities potentially most impacted by the change—piloting and testing ideas carefully with clear feedback and feed-forward loops.

The approach described here in undertaking forensic idea flow mapping reveals how work gets done within organizations and seeks to make this implicit way of working explicit in leadership and governance processes. From the SMH driving strategy, through to the CSN engaged in delivery and feeding back, the model of governance in place reveals key inflection points where actions can advance, or indeed impede, entrepreneurial activities. The hypothesis is that the information gleaned from such mapping exercises could be used by universities to shift from their default SMH processes to forward design more CSN-aware governance processes. In this way, barriers to idea flow could be attenuated or even eliminated and enablers and accelerators of idea flow could be supported further to advance healthy idea flow as measured by tangible innovations. Overall, the two operating systems identified, namely the SMH and the CSN, need to be in close communication always to make sustained progress. People who can move in and out of the two systems are identified as 'ambidextrous' leaders; for example, a member from the SMH may establish a group to explore new ideas making themselves a member of the group.

Using the conceptual framework being developed here, a retrospective analysis of a whole institutional change was undertaken as it relates to an entrepreneurial university in the UK that had embarked on a transformational journey to become *the* enterprise university. The case study presented here relates to one key innovation, that of developing a university-industry collaborative partnership to create a regional innovation ecosystem.

Case Study: An Entrepreneurial University Developing a Regional Innovation Ecosystem Based on University-Industry Engagement

Plymouth University (PU) in the UK set out its academic mission in 2008 to be *the* enterprise university.

> Our enterprising approach will further develop our reputation as a world-leading university and our enterprise culture will deliver sustained innovation and international impact. We will use the knowledge we create to change lives. We will achieve this through world class research, excellence in teaching and learning, and through partnerships and collaborations. We will maintain our commitment to driving social inclusion, economic prosperity, and environmental quality in our local community and beyond.

This differentiated mission emerged from strategic discussions among the university's SMH through its Chief Executive Group (CEG), a goup led by the President Vice-Chancellor and including her senior direct reports drawn from academic and professional areas. These discussions were framed by a deep understanding of the economic and political dimensions of the global higher education sector, a clear sense of the present and aspirational competitor set of the university and clarity about the regional higher education landscape. The strategic direction was then elaborated by a diverse group of people as a CSN drawn from across the university as a project group around the shared purpose to think "without borders" in terms of realizing the new mission. In so doing, the CEG served to prime and activate a more agile and adaptive community working along social networks (the CSN), framed initially as a Change Academy team; the team was supported by the Leadership Foundation's Change Academy project, an initiative of the Higher Education Academy funded by the Higher Education Funding Council for England.

In drawing the Change Academy team together, the President Vice-Chancellor was determined that she would not be in membership herself so that there were no perceived power barriers to idea flow. She also ensured through careful selection of members that the group would be diverse in terms of gender, age, staff with long experience of the university and those newer to the university; the group included executive, faculty and professional staff of the institution. The President Vice-Chancellor also reserved a seat in the group for a cynic voice, a person known to be able to challenge the team but without formal power by role, but who enjoyed significant followership power through influence (Kellerman 2008). Throughout 2008/9 the Change Academy team worked on socialising the concept of embedding enterprise throughout the university's CSN in academic and professional support services. The enterprising approach, as a concept, but primarily the need to embed organizational change to develop the maximum potential of the university, was strongly supported by the SMH in terms of direction and resource allocation. It was recognised widely among the senior management team that the new President Vice-Chancellor was pivotal in leading the institution to think with a new and ambitious mind-set whereby previous limitations on what could be achieved were lifted (Fusilier and Munro 2013). This particularly took root with regards to how aligned the university would

become with its City and its wider region as well as its national and international footprint. The conceptual framework of leadership and governance described here characterised two organizational operating systems, the interactions of which needed to be orchestrated to effect transformational change (Purcell et al. 2017). The first operating system, the SMH was represented here as the CEG with the second system, the CSN, was represented initially as the Change Academy and later extended to embrace an Enterprise Enabler network and finally to include all faculty, staff and students of the university together with its key stakeholders.

It is of course the position that there were social networks already in place within and across the university and that the Change Academy CSN cut across these more established communities. Given the radical new direction of the university, it was the considered view of the CEG (representing the SMH) that a new grouping needed to be formed that would become a co-ordinating network to draw other networks towards the new institutional mission and in this way drive a social movement of change across the university. Later in the change cycle, these established networks started to reform and reshape themselves in line with the new strategic direction of the university and many of the Enterprise Enablers emerged from these communities to become a new community of local change agents. As described earlier, the concept of enterprising activities being part of a 'third mission' was a difficult barrier to overcome among faculty in moving to adopt the new strategic mission. Nedeva's (2008) opinion that it is a distraction from undertaking research was voiced by many academics. However, the SMH through the CEG drew on the findings of Vorley and Nelles (2008) and their work on reconceptualising the academy. This was developed further by the author in positioning entrepreneurship and enterprise as the lens through which the core mission of the university was viewed, that is teaching/learning and research/innovation. In this way the 'third mission' became *the* mission of the university and this was a key step in overcoming barriers and tensions in adopting a more entrepreneurial university agenda.

As a regionally based anchor university, the academic mission of PU reflected its entrepreneurial activities in support of developing a stronger regional economy in order to sustain the conditions for talent acquisition and retention of staff as well as student recruitment and the creation of graduate-level jobs in a regional knowledge economy (Arbo and Benneworth 2007). PU recognised that due to its geographical location, at the far south-west corner of England, the role of an anchor institution was even more important than perhaps other areas especially given the abolition of the South West Regional Development Agency in 2012 and the depressed economic and social status of the area (the Regional Development Agencies had a wide range of responsibilities related to developing the economic prosperity of particular regions of England, they were abolished in April 2012; http://www.nationalarchives.gov.uk/webarchive/regional-development-agencies.htm). In order to support and deliver the PU's enterprise mission, the university's central Department of Research and Innovation was dedicated to driving the application and exploitation of research and knowledge transfer opportunities to the wider economy and community (Wright et al. 2008).

A key construct was developed and led by the university—the Growth Acceleration and Investment Network (GAIN), an innovation ecosystem established in 2010 (see https://www.plymouth.ac.uk/business-partners/gain). GAIN served to unify a £100M network of regional incubation, innovation and science park assets to accelerate growth and investment in high quality businesses and ideas to create wealth and jobs in the South West of England and bring together support services from across the region. The SMH of the university identified the opportunity to accelerate delivery of its enterprise mission by enhancing university-industry interactions. GAIN itself was effectively a CSN with partners drawn from the local City Council, regional Science Park, and regional incubation and innovation centers (Formation Zones in Devon and Cornwall; Cornwall's Unlocking Potential enterprise program; Cornwall's innovation centers and Beacon South West). Using GAIN as an innovation arm, PU successfully tendered for the contract to manage Cornwall's Innovation Centers, operated by the university on behalf of Cornwall Council with centers in Pool, Tremough and a Health and Well-being Center on the Cornwall NHS Hospitals Trust site in Truro, offering knowledge based businesses a space to thrive and grow. Pre-start-ups or people with a small business were also supported through the pre-incubation Formation Zone based in each of the centers. Through the university, the centers provided extensive development and training support. In showing the demand for their services, the Pool Center reached a 50% occupancy rate in less than six months—two and a half years ahead of schedule and at the last audit in 2014/15 236 businesses had been supported with 316 jobs created and over £13M added to the Cornish economy. The three Cornwall Innovation centers were ranked as amongst the best in the world by UK Business Incubation (UKBI) achieving INSPIRE accreditation, and are home to 139 businesses overall, employing around 480 people. The university also had two Formation Zones on its main city-center campus that offered supportive and collaborative environments for innovative start-ups in creative industries, hi-tech, marine, environmental, advanced engineering, and health and wellbeing sectors. Since its establishment in 2008, 178 businesses have been supported and some 70 jobs created and/or safeguarded. To provide the full business support cycle, from start up to grow-on, businesses could also access support at the Tamar Science Park—re-named the Plymouth Science Park; the Science Park was set up as a joint venture between PU and the City Council in 2013/4 and was drawn into the GAIN ecosystem.

One of the key investment decisions taken by the SMH of the university was to promote and support an area of research excellence, in PU's case it was marine and maritime research, which was also a key sector in the region and as such an opportunity to develop a knowledge-driven economy. In 2012, PU invested in developing a £19M Marine Building which housed the most advanced wave tank and testing facilities in Europe with the wave tank hired out to businesses from across the world as well as providing world class facilities for faculty and student staff. The Coastal, Ocean and Sediment Transport (COAST) laboratory provided physical model testing with combined waves, currents and wind and the building also housed the Marine Innovation Centre (MARIC). MARIC was established with funding from the European Regional Development Fund to support the South West of England's marine and

maritime businesses to become globally competitive. The knowledge exchange team worked to accelerate growth by connecting organizations, world-class knowledge, technologies, people and infrastructure and engaged with hundreds of businesses, helping to create a new pathway to grow-on business space.

Through the CSN, developed under GAIN, PU was at the forefront of accessing Regional Growth Funds (RGF), a national government fund designed to deliver sustainable jobs and economic growth; PU led in five of the six rounds of the RGF. Through GAIN, the university launched the first £1M PU and Western Morning News (WMN) RGF in 2011 and awarded 20 grants to businesses in Cornwall, Devon and Somerset. This was the first RGF program to be launched nationally and PU the first university to deliver such a program. This was followed by successful bids to the third and fourth rounds of RGF and the subsequent launch of the £4M PU-WMN Growth Fund in 2012 and 2013, and the £3M GAIN Growth Fund; the latter attracted expressions of interest valuing £15M within eight weeks of its launch. The GAIN Growth Fund was delivered as a key part of the Plymouth and South West Peninsula City Growth Deal led by the university in partnership with the City Council and national government to deliver economic growth in the region in exchange for devolved powers and funding. PU was key to securing the City Deal, which aligned around the university's research strengths with a focus on boosting the area's marine sector through job creation and an expansion of remediated dockyard-based workspace. Together, these three rounds of RGF funding have allocated £8M to 94 businesses and secured over £1M of private sector co-investment and was forecast to create over 1000 jobs through this funding. The impacts of RGF went far beyond these numbers: the program encouraged businesses to stay in the region; created jobs for graduates; and talent was drawn into the region through the creation of highly skilled and paid employment. In 2015 two further rounds of RGF grant programs were launched: the North Devon+ £5M Unlocking Business Investment program, and the £10M South West Growth Fund. It is estimated that a further 1440 jobs were created by the RGF grant programs and over £37M of private sector co-investment secured. This funding helped diversify the regional economy and address the city-region's historical dependence on the naval Dockyard, Armed Services and the public sector for employment. The Higher Education Business and Community Information Survey highlighted that PU had attracted five times the sector average for Regeneration and Development Program income. The speed at which the university responded to calls for funding and managed to deliver the programs reflected its enterprise mission and embeddedness in the city-region, allowing concepts to be fully realised at pace.

Reflecting on PU's pan-institutional transformation using the conceptual framework described here, an unbounded assembly of established business and industry social networks emerged as a community assembled under GAIN to act as a regional community of practice. Healthy idea flow was evident from the activities undertaken under GAIN and the outcomes thereof. The governance processes in place served to respect the local communities of practice while leveraging the scalability of the ecosystem by having an overarching GAIN Advisory Group linked to the SMH of its constituent members. GAIN was ranked as amongst the best in the world by UK Business Incubation (UKBI) achieving INSPIRE accreditation.

Conclusions and Recommendations

Taking a somewhat reductionist approach, two distinct leadership and governance operating systems were characterized—namely a Senior Management Hierarchy (SMH) and a Community of Social Networks (CSN) in order to map how new ideas move through an organization, in this case a university seeking to become more engaged and entrepreneurial. While the two systems have distinctive strengths, they are interdependent, and neither is intrinsically good or bad. The forensic approach to mapping how an idea moves through an organization reveals patterns that reflect the actuality of the governance processes at play. Against user-defined measures of success, events in the process of transmission of the idea are identified and a view taken as to whether they hindered or advanced healthy idea flow (Le Roux and Pretorius 2016). By using this conceptual framework, leaders in executive education settings were able to make explicit the implicit ways of working and could then move to adapt processes to enhance innovation in their host organization. The goal is to increase the volume of ideas that flow towards the shared purpose, for example university-industry partnership working, given that healthy idea flow is the single biggest performance factor that can be shaped by leadership (Pentland 2015).

The analysis presented here is the first to combine learning from senior-level and middle-level leaders from university, business and industry settings across the world in executive educational settings in the USA, Europe and the UK in mapping the journey of new ideas through their organizations over time. Drawing on this learning, a conceptual leadership and governance framework is articulated relevant to the ways in which entrepreneurial universities interact with industry partners. The framework identifies key activities related to the life cycle of an idea over time, and the critical points of inflection with leadership and governance processes. It is recommended that universities use forensic idea flow mapping to identify their own patterns of decision-making so that they can revise, as appropriate, their processes and systems to develop new ways of working that are more adaptive and future-facing and better support successful idea generation, capture, flow and scaling with industry partners.

The two operating systems in play, namely those in the bounded SMH and those in the more adaptive CSN need to work together and find a balance for effective governance (Cullen-Lester et al. 2017). The community networks are animated by shared purpose and social agreements among participants who are engaged—they are agile and creative, innovation in action—in an ‘ideopolis’. While the SMH, having secured a best fit ‘solution’ is able to power ahead and effect change by assigning dedicated resources and support to scale-up— it represents the formal authority structure, while the CSN is a more unbounded, informal or volunteer engagement.

The construct of social physics (Pentland 2015) is relevant here given that this quantitative social science seeks to describe the flow of ideas between people, exploring where new ideas come from, how they get put into action and how social structures are created that are co-operative, productive and creative. While ideal conditions for governance are increasingly rare (Dietz et al. 2003), the leadership challenge is to

devise institutional arrangements that help establish and sustain the healthy idea flow required for innovation. Shorter distances between those making the decisions and those impacted by the decisions seems to drive successful idea flow. This is in accordance with observations in the social physics literature that when decision making falls to those best suited to make the decision rather than those with the highest rank—the resulting organization is far more robust and resilient in the face of disruption (Pentland 2015). Given that the common fate of a new idea/decision is that it gets 'killed' en route to formal approval by governance processes designed to de-risk innovation, or the idea is never expressed given issues of trust and/or fear (Zak 2017), universities and industry partners can now systematically examine their shared governance processes drawing on the framework described here.

The opportunity is for leaders is to be more explicit around the design of their governance processes in shared ventures, to hardwire the SMH with the CSN. Tailoring these processes carefully could help to support innovation in a more effective, streamlined manner rather than stifling idea flow, as is commonly seen today in large institutions such as university settings. Re-engineering governance processes requires that university and industry leadership become more conscious of each operating system and understands how best to harness the dynamic tension between the two in delivering sustained innovation. There is also a critical need to consider what the right balance is for university governance processes, given the strategy being pursued to support partnership working and innovation (Purcell et al. 2016). In fact, as university-industry partnerships are examined more closely it may be that what emerges is the re-engineering of an holacracy—a functions-based organization to complement the hierarchy whereby the traditional management hierarchy is supplemented with a new peer-to-peer operating system that increases transparency, accountability, and organizational agility—the so-called CSN described here.

Developing a conceptual framework that maps the stages of idea flow, each in turn, to an appropriate governance process can drive up successful entrepreneurial (and intrapreneurial) activities. In this way, entrepreneurial universities (Smith 1999; Guerrero et al. 2006) can increase the volume of ideas that flow between them and industry partners and towards overall shared strategic purpose. A respect for both operating systems is essential, the key being to integrate both and thereby transform the culture, conditions, structures and relationship capital that support effective and entrepreneurial partnership working. Co-creation with university and industry partners working together adds a level of stakeholder complexity that needs to be accommodated in agile governance processes that support effective decision-making. On occasion, a shared university-industry governance space may be necessary as illustrated with the Case Study describing GAIN. In further developing the conceptual framework, it will be important to undertake more detailed idea flow mapping specifically with university-industry partners in order to surface patterns that correlate with healthy flow in this specific context. It would also be useful to follow up over time those organizations that revised their processes considering the information revealed from in-house forensic idea flow maps; anecdotal evidence reveals material improvement across a range of outcomes.

Given the disruptive forces acting on universities across a range of fronts from technology to the socio-political agenda, together with interdependencies and the accelerating pace of change, the need to adapt relies upon collaborative—innovation being a 'team of teams' activity (Chahine 2016). What the conceptual leadership and governance framework described here offers is the ability to systematically map and then plan change with leaders who are adaptive and able to work in both SMH and CSN settings—termed here, ambidextrous leaders. The orchestrated dialogue of engagements between the two operating systems builds shared understanding and trust, creating ownership and developing a coalition of support, enabling people to bridge from the old to new ways of working. It is clear from working with senior leaders from across the world that there are cultural differences in the levels of formality and hierarchy that can be accommodated. However, new leadership and governance models are emerging globally as work itself is disrupted. The SMH-CSN framework offers new tools and perspectives for exploring uncertainty, and reinforces the power of piloting and learning by doing. Leaders are positioned as chief decision-makers, able to decide deliberately, with decisions framed as collective long-term processes rather than one-off events in organizational transformation. The framework reflects a culture of healthy debate and healthy decision-making in a learning organization, sustaining organizational health and vitality. Leadership and governance process are both dynamic and stabile, with decision-makers holding certainty and uncertainty in one self-state. The SMH is passionately invitational and the CSN co-cognitive, a shared leadership model, with people empowered to make decisions outside the command-control structure. This framework more closely aligns itself with entrepreneurial people and organizations where a university sits in the middle of a web of relationships.

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