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Doctoral Thesis

TRANSFERENCIA DE TECNOLOGÍA Y CONOCIMIENTO UNIVERSIDAD—EMPRESA. ANÁLISIS DE LAS SPIN-OFFS ACADÉMICAS DESDE UNA PERSPECTIVA INTERNACIONAL

UNIVERSITY-INDUSTRY KNOWLEDGE AND TECHNOLOGY TRANSFER. ANALYSIS OF UNIVERSITY SPIN-OFFS FROM AN INTERNATIONAL PERSPECTIVE

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To Román and Ana

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Contents

Chapter 1. Introduction

Work experience: TTO research contracts

This thesis dissertation has its origins in the Knowledge and Technology Transfer activities between the University of Malaga and the Industry. My collaboration with the *Department of Economics and Business Administration* started in 2011 when I was hired by the Technology Transfer Office (TTOs) to assist the E-business research group in various investigative projects. I worked with them for two years dealing with statistical analysis of empirical data and writing scientific reports, among other assignments. Most of those projects were related with Knowledge and Technology Transfer and University Spin-off Companies (USOs) as a mechanism of academic entrepreneurship. This provided me the first contact with this research area.

Official Master Degree and PhD Program

The period previously mentioned, was crucial for my decision of enrolling myself in the Official Master Degree of International Cooperation and Developing Policies with access to a PhD programme at the University of Malaga (academic course 2011-2012). This Master was also useful to connect with other research areas and enhance my investigation skills. Two important events occurred as part of it. First, I got a scholarship from the International Relationship Office of the University of Malaga to perform practical training in *Point d´Appui NGO* in the region of Oruro in Bolivia. Second, this scholarship gave me the opportunity to work with the Technical University of Oruro and the Federation of Private Entrepreneurs. As a result, I was able to carry out an empirical investigative study about which factors have an impact on the Knowledge and Technology Transfer in Oruro and how they influence their regional development. The exposition of this empirical work was the final step for the Master Degree, obtaining the qualification of distinction with honour. Two years later, it was published under the title: *University- Business Collaboration and Regional development. The case of Oruro, Bolivia* (Padilla-Meléndez & Fuster-Martín, 2014).

Once enrolled in the PhD programme (academic course 2013-2014), I had several meetings with the thesis director and other qualified experts in the business organization area of the University to think about different research lines for the

project. Once the thesis project was defined, it was submitted to two different academic conferences: *Ingenio PhD Days 2013: New perspectives on Science, Technology and Innovation* (Valencia, May 2013), and *XXIII National Congress of ACEDE* (Malaga, September 2013) in the special forum for PhD projects. The feedback obtained at them was decisive for the final decision of carrying out this study.

International Research Stay

The international research stay is one of the requirements of the Doctoral Committee of the University of Malaga for the award of an 'International PhD'. From September 1st to December 30th 2013, I had the honour of being invited by the University of Leeds (in the UK) and work closely with Prof Nigel Lockett, expert in the subject of this doctoral thesis. Since the start, our objective was to progress in the scientific knowledge of this matter using appropriate theoretical and empirical methodologies and consolidating international ties with researchers. I devoted my staying at Leeds University to four specific activities, as I explain below.

First, we discussed about international bibliography on the subject having in mind a comparative study between the differences that might exist between USOs and their impact on regional innovation ecosystems of both countries in terms of innovation.

Second, we obtained a sample for the international comparative study through a series of interviews previously arranged with USOs entrepreneurs and key knowledge intermediaries from different regions of the United Kingdom (Cardiff, Leeds, London, Oxford, Sheffield, and Southampton).

Third, we scheduled some meetings with the purpose of working together on a publishable research paper related to the topic discussed.

Finally, we established a research line between the University of Leeds and the University of Malaga in the development of appropriate methodologies for the study of innovation in international USOs, Knowledge and Technology Transfer, and academic entrepreneurship. Part of this doctoral thesis is due to this collaboration.

The State of the Art

Since the enactment of the *Bayh-dole Act* in the USA in 1980, there has been a substantial rise in commercialisation of science created by universities in the USA (Grimaldi et al., 2011) in Europe (Maia & Claro, 2013; McAdam et al., 2016) and Asia (Zhang et al., 2013). These marketable actions are known as academic entrepreneurship and comprise the Knowledge and Technology Transfer activities between universities and industries. They constitute the third mission of universities apart from teaching and researching (Clark, 1998; Etzkowitz, 1998). They are defined as the interchange of new knowledge, products, and processes from one organization to another for the economic benefit of both parts (Decter et al., 2007). They include generation of new ideas, creation of USOs, intellectual property, and technology licences.

In the last twenty years, due to the recent world financial crisis and an increasingly competitive global marketplace, legislators have been adopting policies to stimulate innovation and entrepreneurship in the hope of producing economic growth (Autio et al., 2014). Universities have been the target of these policies (Morgan, 2007; Nicolaou & Birley, 2003), given their ability to stimulate the production and diffusion of new knowledge and act as catalysts of innovation across their regions (Nicolaou & Birley, 2003; Wright, 2014). As a consequence, universities are increasingly adopting a stronger entrepreneurship and innovation profile and reputation in order to provide a wider social and economic benefit to their territories (Siegel & Wright, 2015). It has given birth to the *entrepreneurial university* (Guerrero et al., 2014, 2016). This new model is characterized by providing a supportive *ecosystem* to the university community and its surroundings, in order to produce, diffuse, absorb, and use new knowledge that could become entrepreneurial initiatives (Carree et al., 2014; Guerrero et al., 2014). These entrepreneurial initiatives are mostly University Spin-off companies (USOs) which involves the creation of for-profit firms based on university research (Philpott et al., 2011). We have perceived that little research is known concerning this *entrepreneurial innovation ecosystem* created by universities. The most recent literature stream on the issue points at it as a promising and emerging research area (Autio et al., 2014; Graham, 2014; Hayter, 2016a; Siegel & Wright, 2015).

Aims of the Thesis Dissertation

The purpose of this work is to extend our knowledge on *innovation ecosystems* in academic entrepreneurship literature in three directions. First, to review the existing literature about this phenomenon to get familiar with the state of the art. Second, to evaluate the effect of USOs as the main mechanism used for Knowledge and Technology Transfer between universities and industries. Finally, to give light about the dynamism of *entrepreneurial innovation ecosystems.*

In particular, the general aim of this thesis dissertation is divided into five objectives, explained below. Firstly, related to the first mentioned direction, to identify the key research themes to date and the challenges for future investigation. Secondly, related to the second direction, two specific objectives are set up. First, to analyse if the investment and creation of innovative ventures around universities leads to the emergence of new *business ecosystems*. Second, to study the importance of the context where the entrepreneurial university is embedded in promoting academic entrepreneurship activities to achieve the development of an ecosystem. Finally, regarding the third direction, other two specific objectives are established. First, to examine the role of the agents involved in the dynamics of the *entrepreneurial university ecosystems*, with special attention paid to the intermediaries. Second, to carry out an internationally cross comparison to achieve a better understanding of the role of the context in the dynamic of the *entrepreneurial university ecosystem.*

In addition, a basic assumption behind this study is that not all *entrepreneurial innovation ecosystems* are the same. Therefore, the findings supported by this study can be tested in other regions or nations in order to extend the generalization of its results.

Theoretical approach

When studying a complex and emerging research area, a combination of theoretical perspectives offers a more comprehensive viewpoint and stronger explanations than a singer view (Van de Ven & Poole, 1995). In this sense, to analyse the *innovation ecosystems* in the academic entrepreneurship, we combine three theoretical

perspectives: the emergent ecosystem approach, the social network theory to entrepreneurship, and the Knowledge Spillover Theory of Entrepreneurship (KSTE) (Acs et al., 2009).

The ecosystem approach, inspired on biological theories, has grown recently in the economic literature (Moore, 1993). Defenders of this emergent approach use it to define business environments of innovation (Durst & Poutanen, 2013; Jackson, 2011; Mercan & Göktaş, 2011; Moore, 1993; 1996; Oh et al., 2016). Two main general perspectives of this emergent approach have been identified in the literature. In the first perspective, mostly adopted in the entrepreneurship literature, ecosystems are understood as communities of associated actors defined by their networks (Autio & Thomas, 2014; Graham, 2014). This perspective emphasis on the breakdown of the traditional industry boundaries and offers a new economic thinking where different agents, markets, organizations and governments interact to generate innovation (Autio et al., 2014). It focuses on questions related to access and openness, network density, or actors' centrality in a network (Clarysse et al., 2014). In the second perspective, mostly embraced in the strategy literature, ecosystem is understood as configurations of activity defined by a value proposition (Adner & Kapoor, 2010; Zahra & Nambisan, 2011). It starts with a value proposition and seeks to identify the set of actors that need to interact to come it up. According to the research gap identified and the declared aims of this work, this study contributes to the first perspective. In particular, it defines *innovation ecosystem* as a loosely interconnected network (of companies and other entities) that coevolves capacities around a shared set of technologies, knowledge, or skills; and works cooperatively and competitively to develop the next round of innovation (Moore, 1996).

In this vein, different theories have been used to conceptualise *innovation ecosystem* in academic entrepreneurship to test and extend this burgeoning approach (see Chapter 2 section 4.*1. Nature of the field* for a review). As mentioned, we built this research upon the social network theory to entrepreneurship, as part of the resource-based theory (Sirmon et al., 2011), to explain how networks enable entrepreneurs to acquire information and resources important to their firm (Brüderl & Preisendorfer, 1998). It allows us to explore how social networks arise within an *entrepreneurial innovation ecosystem* according to the different roles and position of the participants in the value

creation of a USO (Hoang & Antoncic, 2003). In addition, following the recommendation of Hayter (2013a), we combine this network approach with the Knowledge Spillover Theory of Entrepreneurship (KSTE) (Acs et al., 2009), in order to link the micro-level, the entrepreneurial behaviour of the ecosystem participants, with the macro-level, the social-economic impact of the ecosystem.

KSTE focuses on individual "agent of knowledge" and their role in the knowledge spillover (Acs et al., 2009). It embraces the assumption that new knowledge is the source of innovation, productivity and economic growth (Grant, 1996; Romer, 1990). In addition, it takes issue with traditionally theoretical assumptions that all knowledge is economically useful and spills over "automatically". It suggests that entrepreneurship is an important vehicle for the spillover of new knowledge and therefore critical to economic growth (Acs et al., 2009; Hayter, 2013a). Consequently, we base on KSTE to explain how faculty entrepreneurs produce, diffuse, absorb, and use new knowledge that become entrepreneurial initiatives (Carree et al., 2014; Guerrero et al., 2014; 2016) and understand networks as mechanisms for the knowledge spillover to occur, giving rise to an *entrepreneurial university ecosystem* with socio-economic impact.

Data and information sources

Multiple data and information sources were used in this work.

For the literature review, different strategies to find the most relevant published research were followed. As will be explained in detailed later, in Chapter 2, we conducted Boolean searches with keywords in repositories such as *ISI Web of Knowledge*, *Proquest (ABI/Inform)*, *ScienceDirect*, and *Wiley Online Library.* As a result, we found that the cutting edge scientific knowledge on the matter comes mainly from papers indexed in journals such as *Research Policy, Journal of Technology Transfer*, *Technology Forecasting and Social Change*, *R&D Management*, and *Small Business Economics*. In addition, we used direct citations (papers in the reference lists of the articles analysed) and backward citation search (papers referring to the article analysed) to complete the literature review. These strategies led also to a relevant book

(Graham, 2014) in the research field. Other information sources, such as institutional web pages (INE, 2016; UPA, 2016), were also used. Finally, feedback and comments from presentations at different conferences were particularly important.

For the empirical research, we collected qualitative data from two different regions, Andalusia in Spain and England in the UK. A total of 70 in-depth interviews (48 in Andalusia and 22 in England) were carried out over two years' period (2012 and 2013), and all of them took place in their settings. Different techniques were used to collect them. In Andalusia, we contacted the TTOs to obtain a complete list of USOs that fitted with the criteria established for the investigation. In the UK, a snowball method was used. In this regard, both my staying at University of Leeds and the collaboration of Nigel Lockett as expert in the field were fundamental for it.

Research methodologies used

This section is used to explain why we chose mix-methods to conduct this thesis dissertation and how it is embedded in a social constructionist epistemology with a subtle realist ontology (Twining et al., 2016).

The ontological question deals with the form and nature of reality, and what can be known about it (Guba & Lincoln, 1994). Basically, there is a dicothomy in ontology between two stances, the existence of one objective realility and the the existence or multiple realities (Twining et al., 2016). Our ontological answer is related to the second stance, and it is based on the belief that reality can be described as subtle realism (Hammersley, 2013). Subtle realism is defined as the belief in an external world, independent from the mind, but it can only be understood through the human mind and socially constructed meanings. Therefore, the goal of subtle realism is to describe and understand social life in terms of social actors' motives and understandings (Blaikie, 2007).

Once we answered the ontological question, we turned to the epistemological question. It gives answer to what is the nature of the relationship between the knower and what can be known (Guba & Lincoln, 1994), having also a basic dicothomy between the existence of one reality that can be known, so there is one true explanation, and the

existence of different meanings wich are defined, among others, culturally (Twining et al., 2016). Then, we understand the knowledge as socially constructed between individuals (Berger & Luckmann, 1966). We cannot separate ourselves from what we know (Hammersley, 2013). As Burr (2003) states, the understanding of the world is historically and culturally specific, and all knowledge derives from looking at the world from one vantage point or another. This in turn paves the way for the triangulation of perceptions (also termed 'critical multiplism' (Guba & Lincoln, 1994), to uncover the underlying reality.

In addition, following Blaikie (2007), the combination of subtle realist ontology and social constructionist epistemology lead the development of theory that can be elaborated iteratively by individuals.

Finally, the methodological question needs to be answered. It explains how to go about what we believe can be known (Guba & Lincoln, 1994). Based on a subtle realist ontology and a social constructionist epistemology, we see individuals as the unit of analysis and their experience as an interpretive activity mediated and sustained by signs (Baškarada, 2014). This gets into the heart of mix-methods debate regarding how data is viewed. In this sense, we see data as a symbolic representation, which need to be interpreted and thus is subjective and context dependent (Twining et al., 2016). Therefore, the strategy chosen to gather the relevant data follows a case study design (Yin, 2011). We grouped the individual accounts into cases, and dedicated one case for each country studied. Case study design is the best strategy for data collection that aims to understand a process that is embedded in a specific context (Yin, 2011) as the emergent ecosystem approach requires.

Then, based on previous findings found in the literature review, a method following a deductive approach is needed to compare the facts to existing theory and research within the analytical research framework developed in the literature review. In addition, due to the novelty of the analysed field, it is also needed a method that follow an inductive approach to conduct more exploratory research and extend this emergent ecosystem approach within the academic entrepreneurship. Therefore, we chose a mix-method approach based on a quantitative Social Network Analysis (SNA) and qualitative analysis of in-depth interviews to key participants. Firstly, the quantitative

methodology was useful to test the ecosystem approach in two different regions, Andalusia in Spain (in Chapter 3), and England UK (in Chapter 4). Using Ucinet software bundled with NetDraw (Borgatti et al., 2002) we built the visual representation of the social network of both ecosystems. In addition, we calculated a series of relationship indexes to give a deeper explanation of the network structure (Borgatti & Everett, 2000). Then, we captured network dynamics which allowed us to be more predictive of subsequent entrepreneurial outcomes (Hoang & Antoncic, 2003). Secondly, the qualitative methodology based on in-depth interviews was used to extend the emergent ecosystem approach in understanding how these interactions occur and the specific contributions of the networks, as well as why the context in which the ecosystem is embedded matters. Finally, we used the concurrent triangulation strategy to cross-validate the two databases (Creswell, 2002; Jick, 1979).

Structure of the thesis

This thesis dissertation follows the structure of compendium of three future papers. It contains an introductory chapter, three chapters outlined below and a conclusion chapter, as well as references and appendices. Additionally, to meet the requirements of the Doctoral Office of the University of Malaga, an executive summary and a concluding chapter in Spanish are also included at the end. The chapters mentioned below belong to the three future papers, which are not published yet. All of them have been submitted to high quality journals and, if we have received comments, they have been used to improve the quality of the research.

Chapter 2 is a systematic review of the literature on *innovation ecosystems* and academic entrepreneurship. It identifies the key research points to date and the challenges for future researchers interested in the field. This chapter has been continuously updated during the present research and has been decisive in guiding us in the subsequent chapters of this dissertation. Finally, chapter 2 and 3 have its own theoretical background, which are directly connected with the results of this chapter and the research questions of each investigation.

Chapter 3 shows a case of study performed in the region of Andalusia (south of Spain)

to find if the investment and creation of innovative ventures around universities leads automatically to the emergence of new *business ecosystems*. In addition, it analyses the context in which Andalusian entrepreneurial universities are embedded and their effectiveness in promoting academic entrepreneurship and achieving vibrant *entrepreneurial university ecosystems*.

Chapter 4 provides an international comparison regarding the role of the knowledge intermediaries, specifically University-focused Venture Capital firms (UVCs), in the creation of University Spin-off companies (USOs) and the dynamics of *entrepreneurial university ecosystem*s in Andalusia and England. It also explores if policies applied in Anglo-Saxon contexts can be used in other European countries, highlighting the importance of the context.

The concluding chapter summarises the main findings and contributions to the state of the art, discusses some limitations, and establishes future challenges for entrepreneurship researchers. Finally, it invites university managers and regional policymakers to think about the findings of this study to guide their decisions.

Chapter 5. Conclusions

Main findings of the study

In *Chapter 2,* we found that, although significant advances have been made in the understanding of what *innovation ecosystem* means in the academic entrepreneurship literature, many questions remain unanswered about its nature, its origins and antecedents, effects and consequences. First, building a taxonomy of *ecosystem* concepts, we identified *entrepreneurial university ecosystems* as a subsystem in the large context of entrepreneurial innovation ecosystems (Autio et al., 2014; Hayter, 2016a). Second, regarding its origins and antecedents, this concept emerged as a response of policymakers' initiatives aimed to universities (Morgan, 2007; Nicolaou & Birley, 2003), given their ability to stimulate the production and diffusion of new knowledge and act as catalysts of innovations across their regions (Nicolaou & Birley, 2003; Wright, 2014). That gave rise to a new model of university, called the *entrepreneurial university* (Guerrero et al., 2016) characterized by providing a supportive *ecosystem* to the university community and its surroundings in order to produce, diffuse, absorb, and use new knowledge that can become entrepreneurial initiatives (Carree et al., 2014; Guerrero et al., 2014). Third, as different effects and consequences were identified in the literature regarding the emergence of the *entrepreneurial university ecosystem,* we built on it a research agenda opening up new opportunities for entrepreneurship scholars on the field. Additionally, as Chapter 2 shows, little research is known about the specific role of entrepreneurial universities as anchor tenants and the dynamic of their ecosystems (Agrawal & Cockburn, 2003; Boh et al., 2016; Graham, 2014; Hayter, 2016a; Levie, 2014). Therefore, the following chapters of this thesis were focused on solving this issue.

In *Charter 3,* we analysed the political assumption, based on the example of Silicon Valley in the USA, that a tight knowledge ecosystem, in particular an *entrepreneurial innovation ecosystem*, would automatically entail the emergence of *business ecosystems* (Clarysse et al., 2014; Engel & Del-Palacio, 2009, 2011) in Andalusia region, at the south of Spain. In doing so, we responded to the call for more empirical work in different regional contexts not explored in literature. However, we found that this hypothesis is not fully supported in the Andalusia *entrepreneurial university ecosystem*. Our empirical study suggests that a tight *entrepreneurial university ecosystem* enhances already existing business ecosystems in the way of some USOs

become part of them, contributing with their innovative technologies (Clarysse et al., 2014). It is far from implying the emergence of new ones. More specifically, we found that entrepreneurs and new start-ups positioned in a tight *entrepreneurial university ecosystem* benefit from being co-located close to specialized organizations to disseminate best practices for entrepreneurship (such as universities, law firms specialized in IP right or licensing, financial institutions or investors) (Clarysse et al., 2014). The entrepreneurial process then, is accelerated by high mobility of resources (people, technology/know-how, business practice, and capital) (Mercan & Göktas, 2011) and, as a result, new technologies are rapidly developed, tested and commercialised, creating new qualified jobs and accelerating the productivity of regional economies (Hayter, 2016a; Lubik et al., 2013; Shane, 2004). However, only occasionally these technologies are acquired or shared by already established companies and integrated into their products (Engel & Del-Palacio, 2011; Clarysse et al., 2014). These established companies are located in business ecosystems which can be geographically dispersed (Moore, 1993). The connection between USOs located in *entrepreneurial university ecosystems* and established companies placed on business ecosystems generate what we termed *an expansive wave effect.* That contributes to boost these already existing business ecosystems when USOs become part of them, contributing with its innovative technology (see Illustration 3 of Chapter 3). In other words, the *expansive wave effect* refers to the powerful links among participants located in different *entrepreneurial innovation ecosystems*.

In addition, we also showed how the context (Autio et al., 2014; Carayannis et al., 2016; Leih & Teece, 2016; Nelson, 2014) influenced the effectiveness of the Andalusian entrepreneurial universities by promoting academic entrepreneurship and achieving vibrant *entrepreneurial university ecosystems* (Grimaldi et al., 2011; Maia & Claro, 2013; Siegel & Wright, 2015; Wright et al., 2008a). Concerning this matter, our study supports that the differences found between the effectiveness of the same policies applied to successful entrepreneurial universities, such as Silicon Valley, and less commercially oriented universities, such Andalusian entrepreneurial universities, can be explained by the context in which those universities are embedded (Carayannis et al., 2016; Leih & Teece, 2016; Nelson, 2014). The context is defined as the combination of technological/industrial, organizational, institutional, and social

singularities, overlaid by the spatial and temporal characteristics of the area where the university is located (Autio et al., 2014). In Andalusia, we found both a well-connected social context, and an industrial/technological context highlighted by the important role of entrepreneurial universities in the society (Guerrero et al., 2016) and USOs as a mechanism to bring to the market what is discovered by researchers (Grimaldi et al., 2014; Siegel & Wright, 2015). However, the organizational and institutional context was not proactive enough in encouraging the creation of USOs (Carayannis et al., 2016; Nelson, 2014). Consequently, this study highlights the importance of the context (Autio et al., 2014; Leih & Teece, 2016), specially the organizational and institutional context (Carayannis et al., 2016; Nelson, 2014), giving light to the study presented in Chapter 4.

In Chapter 4, we answered the call for more specific and in-depth research on the role of knowledge intermediaries, specifically the UVCs, analysing how they support USOs success in the dynamics of *entrepreneurial university ecosystems* (Graham, 2014; Hayter, 2016a; Siegel & Wright, 2015). For that, we ran an internationally-cross comparison between Andalusia, in Spain, and England, in the UK. In this context, we highlighted the role of financial intermediaries (Audretsch et al., 2014), specifically UVCs (Graham, 2014), as relevant participants in *entrepreneurial university ecosystems* for USOs success (Hayter, 2016a). The main contribution of this study has been the identification of English UVCs (Graham, 2014) as key players in the development of dynamic relationships within the ecosystem. Unlike what happens in Andalusia, where UVCs grant their support in a unique event, in England they contribute to the exchange of knowledge and resources in a cyclical way. English UVCs play a critical role that goes beyond creation, training, and business financing. Its contribution extends to the maintenance of lasting relationships between the TTOs and the entrepreneurs of the USOs. That gives rise to what we called a *boomerang effect* through a constant commercialization of intellectual property within the *entrepreneurial university ecosystems*. This effect means that the investment made in university research returns to these institutions once the USOs commercialise the university IP and becomes part of the *entrepreneurial university ecosystem.* In doing so, the income generated will be invested again in new university technology (metaphorically, as a boomerang that comes back). In Andalusia, on the contrary,

UVCs are located in the peripheral area of the ecosystem network due to the passive role of the TTOs in entrepreneurial activities and then, they do not produce the mentioned boomerang effect (see Illustration 3 of Chapter 4).

In this Chapter, we also highlighted the importance of the context in the dynamic of *entrepreneurial university ecosystems* (Autio et al., 2014; Carayannis et al., 2016) showing how similar policies implemented in Anglo-Saxon contexts were not exportable to other European countries (Audretsch et al., 2014; Maia & Claro, 2013; Siegel & Wright, 2015; Wright et al., 2008a).

Main contributions to the literature

The main contributions of this thesis are three, as explained below. In the first place, we provide evidence of the emergent ecosystem approach and expand it within the entrepreneurship literature. Firstly, we conducted a systematic review of the existing literature and built a taxonomy of concepts identifying the concept of *entrepreneurial university ecosystem* as a subsystem in the area of academic entrepreneurship. Then, we contributed to reduce the gap of what is termed as *entrepreneurial university ecosystem* (Hayter, 2016a) and helped scholars to differentiate this concept from other ecosystem concepts mentioned in entrepreneurship literature, such as *entrepreneurial innovation ecosystem*, *business ecosystem* or *knowledge ecosystem* (Autio et al., 2014; Clarysse et al., 2014; Oh et al., 2016). In addition, we ran two empirical analysis of the dynamics of the *entrepreneurial university ecosystem*, testing and expanding this emergent theory.

Secondly, we also contributed to the entrepreneurship literature in the area of social network and Knowledge Spillover Theory of Entrepreneurship (KSTE) (Acs et al., 2009), by analysing how actors interact (Hayter, 2013b; Nicolaou & Birley, 2003; Stuart & Sorenson, 2007) and how knowledge dissemination occurs for USO success in two *entrepreneurial university ecosystems*, Andalusia (in Spain) and England (in the UK). In this vein, we showed the importance of building a connected ecosystem with a variety of participants (Lubik et al., 2013). Specifically, we highlighted the role of the English UVCs (Graham, 2014) and defined its <u>*boomerang effect*</u> in

commercialising university IP and promoting USOs success in *entrepreneurial university ecosystems*. In turn, it produces, what we termed, an *expansive wave effect* by which participants from different entrepreneurial innovation ecosystems get connected generating social and economic growth.

Thirdly, we contributed to the academic debate about how far models applied to elite entrepreneurial universities, such as MIT or Stanford University in the USA or University of Cambridge in the UK (Graham, 2014), can be implemented in other less commercially oriented universities to successfully promote academic entrepreneurship and achieve a vibrant *entrepreneurial ecosystem* (Grimaldi et al., 2011; Maia & Claro, 2013; Siegel & Wright, 2015; Wright et al., 2008a). We provided insight to this debate through an internationally-cross comparison analysis of entrepreneurial universities located in new contexts not explored in the literature (Andalusia, in Spain) and entrepreneurial universities recognised in the literature as examples of success (England, in the UK) (Graham, 2014). We found that *entrepreneurial university ecosystems* are strongly influenced by the context in which the entrepreneurial university is embedded (Grimaldi et al., 2011), which make each ecosystem evolve differently (Autio & Thomas, 2014; Jackson, 2011) and thus, those similar policies used in Anglo-Saxon contexts do not have the same effect when they are applied in other European countries (Audretsch et al., 2014; Maia & Claro, 2013; Siegel & Wright, 2015; Wright et al., 2008a).

Limitations and future research

This doctoral thesis is not exempt from limitations, which leads to future research studies, as explained below.

Firstly, our systematic literature review is focused on a very specific and recent area of the entrepreneurship literature, in particular, in the study of innovation ecosystems and academic entrepreneurship. As a result, the sample of publications identified was based on a relatively small number of studies (34 publications, 33 papers and 1 book). While it is true that systematic reviews of the literature often include more publications, it is usually because they focus on a more mature field of research.

However, we do not believe that this represents a problem, since what really matters is whether this topic raises sufficient interest in its field of research (Baldacchino et al., 2015). We identified the *ecosystem* theme in the context of academic entrepreneurship as both very recent and rapidly increasing in popularity, which in turn, is indicative of a promising and emerging research area. Therefore, we developed a research agenda to provide scholars the main research avenues on the field. In this thesis dissertation, we only analysed some of them, but a big array of opportunities is open to entrepreneurship researchers (see Table 5 of Chapter 2: *Prospective agenda for future research*).

Secondly, in the two empirical studies of this thesis, the size of our sample can be considered as relatively small (48 interviews in Andalusia case, and 70 interviews in the international comparative Andalusia vs. England). However, in both cases, we conducted an exploratory study, firstly, analysing the connexion between *entrepreneurial university ecosystems* and business ecosystems and, secondly, identifying the role of knowledge intermediaries, especially UVCs, and how they support the USOs success in the dynamic of such ecosystem. Then, future research studies, based on a larger number of observations, coming from more regions and countries, might improve the generalization of these results, as well as provide more knowledge about the importance of the context. It would also be interesting to focus their attention on other knowledge intermediaries, such as TTOs or Accelerators, which might complete the puzzle for the full understanding of the dynamic of *entrepreneurial university ecosystem*.

Final remarks

In addition to the theoretical contributions mentioned above, this thesis shows important implications at managerial and political levels. In this sense, we draw the attention of university managers and regional policymakers to think about the findings of this study in order to guide their decisions and improve regional socio-economic development.

Finally, we offer two recommendations. First, managers of entrepreneurial universities should promote *incentives* to motivate institutions involved in the process of developing and supporting *entrepreneurial university ecosystems.* In particular, TTOs and UVCs should take a more proactive role in entrepreneurship, so the *boomerang effect* could be achieved by commercializing IP. Second, both university directors and regional policymakers should develop programs that ensure the *expansive wave effect*. In order words, teachers and students interested in commercializing their innovation technologies should have access to the necessary university resources, both inside and outside the university, to successfully develop USOs and connect them to different entrepreneurial innovation ecosystems.

Executive summary (in Spanish)

Resumen

Experiencia laboral: Contratos OTRIs de investigación

Esta tesis doctoral tiene su origen en las actividades de Transferencia de Tecnología y Conocimiento entre la Universidad de Málaga y la Industria. Mi colaboración con el Departamento de Economía y Administración de Empresas de la Universidad de Málaga comenzó en 2011 cuando fui contratada por la Oficina de Transferencia de Resultados de Investigación (OTRI) para ayudar al grupo de investigación Ebusiness a llevar a cabo diferentes proyectos de investigación. Durante dos años trabajé con ellos realizando tareas de documentación, análisis estadísticos de datos empíricos y redacción de informes científicos, entre otros cometidos. La mayoría de estos proyectos estaban relacionados con actividades de Transferencia de Conocimiento y Tecnología entre la Universidad y la Industria y con Spin-off Universitarias (SPUs), dada su importancia como mecanismos de promoción del emprendimiento académico. Esto me proporcionó el primer contacto con esta área de investigación.

Máster Oficial y Doctorado

La colaboración con el grupo de investigación de Ebusiness fue decisiva para inscribirme en el Máster Oficial de Cooperación Internacional y Políticas de Desarrollo con acceso a un programa de doctorado en la Universidad de Málaga (curso académico 2011-2012). Estos estudios fueron muy útiles para darme a conocer otras áreas de investigación y para completar mis habilidades de investigación. Dos eventos importantes ocurrieron durante el mismo. En primer lugar, obtuve una beca de la Oficina de Relaciones Internacionales de la Universidad de Málaga para realizar prácticas de campo en la ONG *Point d'Appui* en la región de Oruro, en Bolivia. Esto, a su vez, me dio la oportunidad de contactar con la Universidad Técnica de Oruro y la Federación de Emprendedores Privados de esta provincia boliviana. Como resultado, pude desarrollar un estudio empírico sobre los factores que influyen en las actividades de Transferencia de Conocimiento y Tecnología en Oruro y su impacto en el desarrollo regional. La presentación de este trabajo empírico me permitió obtener la suficiencia investigadora y concluir así el Máster Oficial, obteniendo la calificación de Matrícula de Honor. Dos años más tarde, este estudio fue publicado bajo el título: *Colaboración Universidad-Empresa y desarrollo Regional. El caso de Oruro, Bolivia* (Padilla-

Meléndez & Fuster-Martín, 2014) en la Revista Venezolana de Gerencia.

Posteriormente, una vez inscrita en el programa de doctorado (curso académico 2013-2014), se establecieron varias reuniones y charlas con el director de tesis y otros expertos cualificados en el área de Organización de Empresas para reflexionar sobre las posibles líneas de investigación de este proyecto de tesis. Una vez definido, se presentó en dos congresos diferentes: *Ingenio PhD Days 2013: Nuevas perspectivas en Ciencia, Tecnología e Innovación* (Valencia, mayo 2013), *y XXIII Congreso Nacional de ACEDE* (Málaga, septiembre 2013) en la sección especial para proyectos de tesis. Los alentadores comentarios recibidos en estos dos congresos fueron claves en mi decisión de llevar a cabo este estudio.

Estancia Internacional de Investigación

La estancia internacional de investigación es uno de los requisitos del Comité de Doctorado de la Universidad de Málaga para la concesión de la mención de "Doctorado Internacional". A tal efecto, tuve el honor de ser invitada por la Universidad de Leeds (Reino Unido) desde el 1 de septiembre al 30 de diciembre de 2013, para trabajar en estrecha colaboración con el Prof. Nigel Lockett, experto en el tema de esta tesis doctoral. El objetivo principal de la estancia fue avanzar en el conocimiento científico de este estudio utilizando metodologías teóricas y empíricas apropiadas, así como consolidar los lazos internacionales con los investigadores. Cuatro actividades específicas tuvieron lugar durante este periodo, como se explica a continuación.

En primer lugar, poner en común la bibliografía internacional existente sobre la materia y realizar un estudio comparado entre las diferencias que pudieran existir entre las SPUs y su impacto en los *ecosistemas regionales de innovación* de ambos países.

En segundo lugar, obtener una muestra para el estudio comparativo internacional a través de una serie de entrevistas previamente concertadas con empresarios de SPUs e intermediarios clave en diferentes regiones del Reino Unido (Cardiff, Leeds, Londres, Oxford, Sheffield y Southampton).

En tercer lugar, programar reuniones de colaboración con el objeto de publicar en

revistas de impacto internacional un trabajo de investigación relacionado con el tema a tratar.

Finalmente, desarrollar una línea de investigación conjunta entre la Universidad de Leeds y la Universidad de Málaga en el desarrollo de metodologías apropiadas para el estudio de la innovación relativo a las SPUs a nivel internacional, la Transferencia de Conocimiento y Tecnología, y el emprendimiento académico. Parte de esta tesis doctoral es el resultado de esta colaboración.

Últimas investigaciones en la materia

Desde la promulgación de la *Ley Bayh-Dole* en los Estados Unidos en 1980, ha habido un aumento sustancial en la comercialización de conocimientos y tecnologías creadas por las universidades en Estados Unidos (Grimaldi et al., 2011) y también en otros países de Europa (Maia & Claro, 2013; McAdam et al., 2016) y Asia (Zhang et al., 2013). Estas actividades comerciales son conocidas como *emprendimiento académico,* consisten en acciones de Transferencia de Conocimiento y Tecnología entre la universidad y la industria, y constituyen la tercera misión de las universidades, junto con la enseñanza y la investigación (Clark, 1998; Etzkowitz, 1998). Se definen como el intercambio de nuevos conocimientos, productos o procesos de una organización a otra para el beneficio económico de ambas partes (Decter et al., 2007). Esto incluye la generación de nuevas ideas, la creación de SPUs, la propiedad intelectual y las licencias de tecnología.

En los últimos veinte años, debido a la crisis financiera mundial y a un mercado internacional cada vez más competitivo, los responsables políticos llevaron a cabo una serie de decisiones para estimular la innovación a través de iniciativas empresariales con la esperanza de producir crecimiento económico. Atendiendo a este principio, las universidades han sido el foco de atención de estas políticas (Morgan, 2007; Nicolaou & Birley, 2003), dada su gran capacidad para estimular la producción y difusión de nuevos conocimientos y actuar como catalizadores de innovación en sus entornos geográficos (Nicolaou & Birley, 2003; Wright, 2014). Como consecuencia de estas políticas, las universidades están adoptando, cada vez más, un perfil empresarial e

innovador con el fin de brindar un mayor beneficio social y económico a su región (Siegel & Wright, 2015), surgiendo así la *universidad emprendedora* (Guerrero et al., 2014; 2016). Este nuevo modelo de universidad se caracteriza por proporcionar un *ecosistema* de apoyo a la comunidad universitaria y su entorno, para producir, difundir, absorber y utilizar nuevos conocimientos que puedan convertirse en iniciativas emprendedoras (Carree et al., 2014; Guerrero et al., 2014). Estas iniciativas son en su mayoría SPUs, que consisten en la creación de empresas con fines de lucro basadas en la investigación universitaria (Philpott et al., 2011). Poco se ha investigado en la literatura sobre estos *ecosistemas de innovación empresarial* creados por universidades emprendedoras. No obstante, recientes corrientes de investigación los sitúan como un área de investigación prometedora y emergente (Autio et al., 2014; Graham, 2014; Hayter, 2016a; Siegel & Wright, 2015).

Objetivos de la tesis

El objetivo principal de esta tesis doctoral es ampliar nuestro conocimiento sobre los *ecosistemas de la innovación* y el emprendimiento académico en tres direcciones. En primer lugar, revisar la literatura existente sobre este fenómeno para familiarizarse con las últimas aportaciones en esta materia. En segundo lugar, evaluar el efecto de las SPUs como mecanismo más utilizado en la Transferencia de Conocimiento y Tecnología entre la universidad y la industria. Y, en tercer lugar, arrojar luz sobre el dinamismo y el funcionamiento de los *ecosistemas de innovación empresarial*.

En particular, el objetivo general de esta tesis se divide en cinco objetivos específicos, explicados a continuación. En primer lugar, en relación con la primera dirección, identificar los temas clave de investigación hasta la fecha y los desafíos para la investigación futura. En segundo lugar, en relación con la segunda dirección, se establecen dos objetivos específicos. En primer lugar, analizar si la inversión y creación de empresas innovadoras alrededor de las universidades lleva a la aparición de nuevos ecosistemas de negocio. En segundo lugar, estudiar la importancia del contexto en el que se asienta la universidad emprendedora en la promoción de actividades de emprendimiento académico para lograr el desarrollo de un ecosistema de innovación empresarial. Por último, en cuanto a la tercera dirección, se establecen

otros dos objetivos específicos. En primer lugar, examinar el papel de los agentes implicados en la dinámica de los *ecosistemas empresariales universitarios,* prestando especial atención a los intermediarios. Y, en segundo lugar, realizar una comparación internacional para lograr una mejor comprensión del papel del contexto en la dinámica de los *ecosistemas empresariales universitarios*.

Por último, en este estudio hay que mencionar que no todos *los ecosistemas de innovación empresarial* son iguales. Por lo tanto, los hallazgos aportados por este trabajo podrán ser probados en otras regiones y países para generalizar los resultados.

Aproximación teórica

Cuando se estudia un área de investigación compleja y emergente, una combinación de perspectivas teóricas ofrece un punto de vista más amplio y explicaciones más sólidas que la utilización de una sola (Van de Ven & Poole, 1995). En este sentido, para analizar los *ecosistemas de innovación* en el emprendimiento académico, se combinan tres perspectivas teóricas: el enfoque emergente de ecosistemas, la teoría de redes sociales para el emprendimiento y la *Knowledge Spillover Theory of Entrepreneurship* (KSTE) (Acs et al., 2009), o Teoría del Efecto Desbordamiento del Conocimiento en el Emprendimiento. Este efecto desbordamiento de conocimiento se diferencia de la transferencia de conocimiento en que no es intencionado. Y es que el conocimiento que se produce en las universidades se transfiere a su entorno por diversos mecanismos, explícitos (transferencia de conocimiento) y tácitos, generando externalidades positivas (*spillovers* o efectos desbordamiento). Al igual que ocurre cuando una empresa innova, desarrollando conocimiento, existen conocimientos que no quedan 'encerrados' en la propia empresa o en la propia Universidad, sino que desbordan o rebosan sus límites y pasan a ser, aunque estas no lo quieran y sin que puedan evitarlo, de dominio público, de manera que otras empresas o instituciones puedan aprovecharlos.

El enfoque emergente de ecosistema, inspirado en teorías biológicas, ha crecido recientemente en la literatura económica (Moore, 1993). Los defensores de este enfoque emergente lo utilizan para definir entornos empresariales de innovación

(Durst & Poutanen, 2013; Jackson, 2011; Mercan y Göktaş, 2011; Moore, 1993; 1996; Oh et al., 2016). En la literatura se han identificado dos grandes perspectivas generales de este enfoque emergente. En la primera perspectiva, adoptada principalmente en la literatura emprendedora, los ecosistemas son entendidos como comunidades de actores asociados definidos por sus redes (Autio & Thomas, 2014; Graham, 2014). Esta perspectiva enfatiza el desglose de los límites tradicionales de la industria y ofrece un nuevo pensamiento económico en el que interactúan diferentes agentes, mercados, organizaciones y gobiernos para generar innovación (Autio et al., 2014). Se centra en cuestiones relacionadas con el acceso y la apertura, la densidad de la red o la centralidad de los actores en una red (Clarysse et al., 2014). En la segunda perspectiva, en su mayoría abarcada en la literatura de estrategia, el ecosistema se entiende como la configuración de actividades definidas por una proposición de valor (Adner & Kapoor, 2010; Zahra & Nambisan, 2011). Comienza con una propuesta de valor y busca identificar el conjunto de actores que necesitan interactuar para llegar a él. De acuerdo con la brecha de investigación identificada y los objetivos declarados de este trabajo, este estudio contribuye a la primera perspectiva. En particular, define el ecosistema de innovación como una red de empresas y otras entidades que co-desarrollan capacidades en torno a un conjunto compartido de tecnologías, conocimientos o habilidades, y trabajan de manera cooperativa y competitiva para desarrollar la siguiente ronda de innovación (Moore, 1996).

En este trabajo se han utilizado diferentes teorías para conceptualizar los ecosistemas de innovación en el emprendimiento académico, y así, probar y extender este enfoque floreciente (véase el capítulo 2, sección 4.1, Naturaleza del campo para una revisión). Como se mencionó, construimos esta investigación sobre la teoría de redes sociales para el emprendimiento, como parte de la teoría basada en recursos (Sirmon et al., 2011), para explicar cómo las redes permiten a los empresarios adquirir información y recursos importantes para su empresa (Brüderl & Preisendorfer, 1998). Ésta, nos permite explorar cómo surgen las redes sociales dentro de un ecosistema de innovación empresarial según los diferentes roles y posición de los participantes en la creación de valor de una SPU (Hoang & Antoncic, 2003). Además, siguiendo la recomendación de Hayter (2013a), combinamos este enfoque de redes con la *Knowledge Spillover Theory of Entrepreneurship* (KSTE) (Acs et al., 2009), o Teoría del Efecto Desbordamiento

del Conocimiento en el Emprendimiento, para vincular el nivel micro, el comportamiento empresarial de los participantes del ecosistema, con el nivel macro, el impacto socioeconómico del ecosistema.

KSTE se centra en el individuo "agente del conocimiento" y su papel en el *knowledge spillover* (efecto desbordamiento del conocimiento) (Acs et al., 2009). Se basa en la suposición de que el nuevo conocimiento es la fuente de la innovación, la productividad y el crecimiento económico (Grant, 1996; Romer, 1990). Además, se opone a los supuestos tradicionalmente teóricos de que todo conocimiento es económicamente útil y se derrama de forma "automática". Sugiere que el emprendimiento es un vehículo importante para el desbordamiento de nuevos conocimientos y, por lo tanto, crítico para el crecimiento económico (Acs et al., 2009; Hayter, 2013a). En consecuencia, nos basamos en el KSTE para explicar cómo los emprendedores académicos producen, difunden, absorben y usan nuevos conocimientos que se convierten en iniciativas empresariales (Carree et al., 2014, Guerrero et al., 2014, 2016) y entendemos las redes sociales como mecanismos para el *knowledge spillover* (desbordamiento del conocimiento), dando lugar a un ecosistema empresarial universitario con impacto socioeconómico.

Datos y fuentes de información

En esta tesis doctoral se emplearon múltiples fuentes de información y de datos.

En cuanto a la revisión de la literatura, se siguieron diferentes estrategias para encontrar la investigación publicada más relevante. Como se explicará más adelante, en el Capítulo 2, realizamos búsquedas booleanas con palabras clave en repositorios como *ISI Web of Knowledge*, *Proquest (ABI/Inform)*, *ScienceDirect*, and *Wiley Online Library*. Como resultado, encontramos que el conocimiento científico de vanguardia en la materia proviene principalmente de artículos indexados en revistas como *Research Policy, Journal of Technology Transfer*, *Technology Forecasting and Social Change*, *R&D Management*, y *Small Business Economics*. Además, utilizamos citas directas (artículos en las listas de referencias de los artículos analizados) y búsqueda de citas hacia atrás (artículos referentes al artículo analizado) para completar la

revisión de la literatura. Estas estrategias de búsqueda nos permitieron la identificación de un libro relevante (Graham, 2014) clave en este estudio. También se usaron otras fuentes de información, como páginas web institucionales (INE, 2016; UPA, 2016). Por último, también fueron muy útiles los distintos comentarios obtenidos en las presentaciones de diferentes conferencias.

En cuanto a la investigación empírica, se recogieron datos de dos regiones diferentes, Andalucía, España e Inglaterra, Reino Unido. Un total de 70 entrevistas en profundidad (48 en Andalucía y 22 en Inglaterra) fueron llevadas a cabo en el periodo de dos años (2012 y 2013). Todas ellas tuvieron lugar dentro de su contexto. Se utilizaron diferentes técnicas para recolectar los datos. En el caso de Andalucía, nos pusimos en contacto con las OTRIs para obtener una lista completa de SPUs que encajaban con la investigación. En el caso del Reino Unido se utilizó el método del informante clave. Para ello, fue esencial la estancia de investigación internacional y la colaboración de Nigel Lockett como experto en la materia.

Metodologías de investigación utilizadas

Esta sección se utiliza para explicar por qué elegimos métodos mixtos para llevar a cabo esta tesis doctoral, y cómo está incrustada en una epistemología construccionista social con una ontología realista sutil (Twining et al., 2016).

La cuestión ontológica se refiere a la forma y la naturaleza de la realidad, y lo que se puede saber sobre ella (Guba & Lincoln, 1994). Básicamente, la ontología plantea la dicotomía entre la existencia de una única realidad objetiva y la existencia de varias realidades múltiples (Twining et al., 2016). Nuestra respuesta ontológica se relaciona con la segunda postura, y se basa en la creencia de que la realidad puede ser descrita como realismo sutil (Hammersley, 2013). El realismo sutil se define como la creencia en un mundo externo, independiente de la mente, pero sólo puede entenderse a través de la mente humana y de los significados socialmente construidos. Por lo tanto, el objetivo del realismo sutil es describir y comprender la vida social en términos de motivaciones y entendimientos de los actores sociales (Blaikie, 2007).

Una vez respondida la pregunta ontológica, nos dirigimos a la cuestión epistemológica.

Ésta, da respuesta a cuál es la naturaleza de la relación entre el conocedor y lo que puede ser conocido (Guba & Lincoln, 1994), planteando también una dicotomía básica entre la existencia de que la realidad puede ser conocida, existiendo una explicación verdadera, y el que existen distintos significados que vienen definidos, entre otros, culturalmente (Twining et al., 2016). En este sentido, entendemos el conocimiento como socialmente construido entre individuos (Berger y Luckmann, 1966). No podemos separarnos de lo que sabemos (Hammersley, 2013). Como Burr (2003) indica, la comprensión del mundo es histórica y culturalmente específica, y todo conocimiento deriva de mirar el mundo desde un punto de vista u otro. Esto, a su vez, allana el camino para la triangulación de las percepciones (también denominado "multiplicismo crítico" (Guba y Lincoln, 1994)), para descubrir la realidad subyacente.

Además, siguiendo a Blaikie (2007), la combinación de la ontología realista sutil y la epistemología constructiva social lideran el desarrollo de teorías que puede ser elaborada iterativamente por los individuos.

Por último, respondemos a la pregunta metodológica. Ésta explica cómo analizar lo que creemos que se puede conocer (Guba & Lincoln, 1994). Basándonos en una ontología realista sutil y una epistemología constructiva social, vemos a los individuos como la unidad de análisis y su experiencia como una actividad interpretativa mediada y sostenida por signos (Baškarada, 2014). Esto se introduce en el corazón del debate de los métodos mixtos y sobre cómo estos visualizan los datos. En este sentido, vemos los datos como una representación simbólica, que necesitan ser interpretados y, por lo tanto, son subjetivos y dependientes del contexto (Twining et al., 2016). De esta manera, la estrategia elegida para reunir los datos pertinentes es el diseño del estudio del caso (Yin, 2011). Para ello, agrupamos a los individuos en casos y dedicamos un caso a cada país estudiado. El diseño de un estudio de caso es la mejor estrategia para la recolección de datos que tiene como objetivo comprender un proceso que está embebido en un contexto específico (Yin, 2011), como lo requiere el enfoque emergente del *ecosistema*.

Luego, basándonos en los hallazgos previos encontrados en la revisión de la literatura, necesitamos aplicar un método que sigua un enfoque deductivo para comparar los hechos con la teoría y la investigación existentes dentro del marco de investigación

analítica desarrollado en la revisión de la literatura. Además, debido a la novedad del campo analizado, también se necesita un método que siga un enfoque inductivo para realizar más investigación exploratoria y extender este enfoque emergente de ecosistema dentro del emprendimiento académico. Por lo tanto, optamos por un método mixto basado en un análisis cuantitativo de redes sociales (SNA) y en el análisis cualitativo de entrevistas en profundidad a participantes clave. En primer lugar, la metodología cuantitativa fue útil para explorar el enfoque de ecosistema en dos regiones diferentes, Andalucía en España (en el capítulo 3) e Inglaterra, Reino Unido (en el capítulo 4). Usando el software Ucinet incluido con NetDraw (Borgatti et al., 2002) construimos la representación visual de las redes sociales de ambos ecosistemas. Además, calculamos una serie de índices de relaciones para dar una explicación más profunda de la estructura de la red (Borgatti y Everett, 2000). De esta manera, captamos la dinámica de la red lo que nos permite ser más predictivos en posteriores resultados empresariales (Hoang & Antoncic, 2003). En segundo lugar, se utilizó la metodología cualitativa basada en entrevistas en profundidad para ampliar el enfoque emergente de ecosistemas en la comprensión de cómo estas interacciones ocurren y las contribuciones específicas de estas redes, así como por qué el contexto en el cual el ecosistema está inmerso es importante. Por último, se utilizó la estrategia de triangulación concurrente para validar cruzadamente las dos bases de datos (Creswell, 2002; Jick, 1979).

Estructura de la tesis

Esta tesis doctoral sigue la estructura del compendio de tres futuros artículos. Por tanto, ésta incluye, en primer lugar, un capítulo de introducción, tres capítulos que se esbozan a continuación, un capítulo de conclusiones, referencias y apéndices. Además, a fin de cumplir con los requisitos de la Comisión de Doctorado de la Universidad de Málaga para la concesión de la mención de “Doctorado Internacional” se han incluido también un resumen ejecutivo y un capítulo final en español a continuación de las conclusiones. Los tres capítulos que se mencionan a continuación pertenecen a los tres futuros artículos, los cuales, aún no se han publicado. Todos ellos han sido enviados a revistas de alto impacto y, si hemos recibido comentarios, estos se han utilizado para mejorar

la calidad de la investigación.

El *Capítulo 2* es una revisión sistemática de la literatura sobre los *ecosistemas de innovación* y el emprendimiento académico. Identifica los temas clave hasta la fecha y los principales retos para los futuros investigadores interesados en esta área de análisis. Este capítulo ha sido continuamente actualizado durante el tiempo que ha durado la presente investigación. Esto ha sido fundamental para conocer los últimos estudios en esta materia y para orientar los siguientes capítulos de esta tesis. Éstos incluyen, a su vez, su propia revisión de la literatura, la cual está basada en los resultados obtenidos en este capítulo y directamente relacionada con las preguntas de investigación de cada estudio.

El *Capítulo 3* muestra un estudio del caso, llevado a cabo en la región de Andalucía (sur de España), al objeto de comprobar si la inversión y la creación de empresas innovadoras alrededor de las universidades generan la aparición de nuevos ecosistemas de negocios. También analiza el contexto en el que se localizan las universidades emprendedoras andaluzas y su efectividad en la promoción de actividades de emprendimiento académico y lograr *ecosistemas empresariales universitarios* dinámicos.

En el *Capítulo 4* se ofrece una comparativa internacional sobre el papel que juegan los intermediarios del conocimiento, especialmente las empresas de Capital Riesgo Universitario (CRUs), en el éxito de las SPUs y en la dinámica de los *ecosistemas empresariales universitarios, tanto* en Andalucía como en Inglaterra. También explora si las políticas aplicadas en contextos anglosajones pueden implementarse en otros países europeos y resalta la importancia del contexto.

Finalmente, el capítulo de conclusiones resume los principales hallazgos y contribuciones a la literatura, menciona las limitaciones y anticipa retos futuros para los investigadores del emprendimiento. Por último, invita a los directivos de las universidades y a los responsables de la política regional a reflexionar sobre los resultados de este estudio de forma que guíen sus decisiones futuras.

Conclusions (in Spanish)

Conclusiones

Principales hallazgos del estudio

En el *Capítulo 2* hemos visto que, aunque en la literatura sobre el emprendimiento académico se han llevado a cabo avances significativos en cuanto a la comprensión del concepto de ecosistema de la innovación, permanecen sin respuesta muchas preguntas sobre su naturaleza, sus orígenes y antecedentes, así como sobre sus efectos y consecuencias. En primer lugar, construyendo una taxonomía de los conceptos de ecosistema reconocida en la literatura del emprendimiento académico, identificamos los *ecosistemas empresariales universitarios* como un subsistema dentro del gran contexto de los ecosistemas de innovación empresarial (Autio et al., 2014; Hayter, 2016a). En segundo lugar, en cuanto a los orígenes y antecedentes, el concepto de ecosistema nace como respuesta a las iniciativas legislativas dirigidas a las universidades (Morgan, 2007; Nicolaou & Birley, 2003), dada su habilidad para estimular la producción y difusión de nuevos conocimientos y para actuar como catalizadores de innovación en sus contextos geográficos (Nicolaou & Birley, 2003; Wright, 2014). Esto ha dado lugar a un nuevo modelo de universidad, denominada *universidad emprendedora* (Guerrero et al., 2016), caracterizada por proveer a la comunidad universitaria y a su entorno de un *ecosistema* de apoyo para producir, difundir, absorber y usar nuevos conocimientos que puedan traducirse en iniciativas empresariales (Carree et al., 2014; Guerrero et al., 2014). Por último, tras identificar en la literatura diferentes efectos y consecuencias del surgimiento de *ecosistemas empresariales universitarios*, hemos creado una agenda de investigación que abre nuevas oportunidades a los académicos emprendedores en este campo. En el *Capítulo 2*, se da cuenta de la poca investigación existente sobre el papel de las universidades emprendedoras como organizaciones líderes en *ecosistemas empresariales universitarios* y de su dinámica (Agrawal & Cockburn, 2003; Boh et al., 2016; Graham, 2014; Hayter, 2016a; Levie, 2014). Por este motivo, los capítulos siguientes de esta tesis doctoral se han centrado en resolver esta cuestión.

En el *Capítulo 3*, analizamos la presunción política, basada en ejemplos como Silicon Valley (en EEUU), de que un ecosistema de conocimiento "ajustado", en particular un *ecosistema empresarial universitario*, conduce automáticamente a la emergencia de ecosistemas de negocios innovadores (Clarysse et al., 2014; Engel & Del-Palacio, 2009, 2011). Este supuesto es examinado en la región de Andalucía, al sur de España.

Al hacerlo, hemos respondido a la necesidad de realizar más trabajos empíricos en diferentes contextos regionales. El principal hallazgo fue que, en el caso del *ecosistema universitario empresarial* andaluz, esta hipótesis no se sostiene completamente. Nuestro estudio empírico confirma que un "ajustado" *ecosistema empresarial universitario* fortalece los ecosistemas de negocio innovadores preexistentes. Así, algunas Spin-off Universitarias (SPUs) se convierten en parte de ellos contribuyendo con sus tecnologías de innovación (Clarysse et al., 2014). Sin embargo, esto dista aún de liderar la aparición de nuevos ecosistemas de negocios innovadores. Concretamente, hallamos que los emprendedores y las nuevas empresas radicadas en un *ecosistema empresarial universitario* se benefician de su proximidad a organizaciones especializadas para difundir las mejores prácticas en cuanto a emprendimiento (universidades, organizaciones especializadas en derechos de propiedad intelectual o licencias, instituciones financieras o inversionistas) (Clarysse et al., 2014). De este modo, el proceso empresarial se ve acelerado por la alta movilidad de recursos (personas, tecnología / know-how, prácticas empresariales y capital) (Mercan y Göktas, 2011) y, como resultado, las nuevas tecnologías son rápidamente desarrolladas, probadas y comercializadas creando nuevos puestos de trabajo cualificados y acelerando la productividad de las economías regionales (Hayter, 2016a; Lubik et al.; 2013; Shane, 2004). Sin embargo, estas tecnologías sólo en ocasiones son adquiridas o compartidas por empresas establecidas, integrándolas en sus productos (Engel & Del-Palacio, 2011; Clarysse et al., 2014). Las empresas establecidas están ubicadas en ecosistemas de negocios innovadores que pueden estar geográficamente dispersos (Moore, 1993). Por ello, la conexión entre SPUs ubicadas en *ecosistemas empresariales universitarios* y las empresas establecidas generan lo que hemos denominado un *efecto de onda expansiva* que contribuye a fortalecer el ecosistema empresarial existente. Esto se hace más patente cuando las SPUs pasan a formar parte del ecosistema de negocio innovador, contribuyendo con su tecnología innovadora (Véase la ilustración 3 del capítulo 3). En otras palabras, el *efecto de onda expansiva* se refiere a los vínculos de intensidad entre los participantes ubicados en diferentes ecosistemas de innovación empresarial (Autio et al., 2014).

En el *Capítulo 3* también analizamos la importancia del contexto (Autio et al., 2014, Carayannis et al., 2016; Leih & Teece, 2016; Nelson, 2014) en la efectividad de las

universidades emprendedoras andaluzas a la hora de promover el emprendimiento académico y de lograr ecosistemas emprendedores universitarios dinámicos (Grimaldi et al., 2011; Maia & Claro, 2013; Siegel & Wright, 2015; Wright et al., 2008a). En este sentido, nuestro estudio apoya la idea de que las diferencias halladas entre la eficacia de unas mismas políticas aplicadas a universidades emprendedoras de éxito, como en el caso de Silicon Valley, y en universidades menos orientadas comercialmente, se explican por el contexto en el cual tales universidades se encuentras localizadas (Carayannis et al., 2016). Este contexto está formado por la combinación de características tecnológicas/industriales, organizativas, institucionales y sociales superpuestas por singularidades espaciales y temporales, dentro del área en el cual se ubica la universidad (Autio, 2016; Et al., 2016).

En este sentido, podemos afirmar que hemos encontrado un contexto social bien relacionado y un contexto industrial/tecnológico destacado. Las universidades emprendedoras juegan un importante papel en la sociedad (Guerrero et al., 2016) y las SPUs se confirman como el principal mecanismo de transferencia de las innovaciones generadas por los investigadores al mercado (Grimaldi et al., 2014, Siegel & Wright, 2015). Sin embargo, encontramos un contexto organizativo e institucional no proactivo en el fomento y la creación de SPUs (Carayannis et al., 2016; Nelson, 2014). Precisamente este hecho ha motivado el estudio presentado en el *Capítulo 4*, donde se pone de relieve la importancia del contexto organizacional e institucional en la dinámica de *ecosistemas empresariales universitarios*.

En el *Capítulo 4* se aborda la necesidad de una investigación más específica y profunda sobre el papel de los intermediarios del conocimiento, concretamente de las empresas de Capital Riesgo Universitario (CRU), y en cómo su apoyo favorece el éxito de las SPUs en la dinámica de los *ecosistemas empresariales universitarios* (Graham, 2016a; Siegel & Wright, 2015). Para ello se llevó a cabo una comparativa internacional entre Andalucía, España e Inglaterra, Reino Unido. En este contexto, destaca el rol que desempeñan los intermediarios financieros (Audretsch et al., 2014), concretamente los CRUs (Graham, 2014), como actores relevantes en los *ecosistemas empresariales universitarios*. La principal contribución de este estudio ha sido la identificación de los CRUs ingleses (Graham, 2014) como actores clave en el desarrollo de las relaciones dinámicas dentro del ecosistema. A diferencia de lo que sucede en

Andalucía, donde los CRUs prestan su apoyo en un evento único, en Inglaterra contribuyen al intercambio de conocimientos y recursos de una forma cíclica. Los CRUs ingleses desempeñan un papel crítico que va más allá de la formación y financiación de empresas. Su contribución se extiende al mantenimiento de relaciones duraderas entre las Oficinas de Transferencia de Resultados de Investigación (OTRIs) y los emprendedores de las SPUs, dando lugar a lo que hemos denominado un *efecto bumerán* mediante una constante comercialización de la propiedad intelectual dentro de los *ecosistemas empresariales universitarios*. Este efecto consiste en que la inversión realizada en las investigaciones universitarias retorna a estas instituciones una vez que las SPUs comercializan su propiedad intelectual y forman parte del ecosistema empresarial universitario, generando una serie de ingresos que volverán a ser invertidos en la producción de nueva tecnología en las universidades. En Andalucía, por el contrario, debido al papel pasivo de las OTRIs en cuanto a actividades de emprendimiento, los CRU se encuentran ubicados en el área periférica de la red del ecosistema empresarial y, por tanto, no producen el mencionado *efecto bumerán* (véase la ilustración 3 del Capítulo 4). Asimismo, en el *Capítulo 4*, se destaca la importancia del contexto en la dinámica de los *ecosistemas empresariales universitarios* (Autio et al., 2014; Carayannis et al., 2016) y se muestra cómo similares políticas implementadas en el contexto anglosajón no son exportables a otros países europeos (Audretsch et al., 2014; Maia & Claro, 2013; Siegel & Wright, 2015; Wright et al., 2008a).

Principales contribuciones a la literatura

Las principales contribuciones de esta tesis son tres, según explicamos a continuación.

En primer lugar, proporcionamos evidencia sobre el enfoque emergente de ecosistema y lo expandimos dentro de la literatura emprendedora. En primer lugar, realizamos una revisión sistemática de la literatura existente y construimos una taxonomía de conceptos que identifican el concepto de *ecosistema empresarial universitario* como un subsistema en el área del emprendimiento académico. A continuación, contribuimos a reducir la brecha de lo que se denomina como *ecosistema universitario emprendedor* (Hayter, 2016a) y ayudamos a los académicos a diferenciar este concepto de otros

conceptos de ecosistemas mencionados en la literatura emprendedora, como ecosistema de innovación empresarial, ecosistema de negocio o ecosistema de conocimiento (Autio et al., 2014; Clarysse et al., 2014; Oh et al., 2016). Además, realizamos dos análisis empíricos de la dinámica de los *ecosistemas empresariales universitarios*, probando y ampliando esta teoría emergente.

En segundo lugar, también contribuimos a la literatura de emprendimiento en el área de redes sociales y la *Knowledge Spillover Theory of Entrepreneurship* (KSTE) (Acs et al., 2009), o Teoría del Efecto Desbordamiento del Conocimiento en el Emprendimiento, analizando cómo interactuan los participantes del ecosistema (Hayter, 2013b, Nicolaou & Birley, 2003; Stuart & Sorenson, 2007) y cómo se produce la difusión de conocimiento entre ellos, en dos ecosistemas universitarios emprendedores, Andalucía (en España) e Inglaterra (en el Reino Unido). En este sentido, este trabajo destaca la importancia de construir un ecosistema fuertemente conectado con una variedad de participantes (Lubik et al., 2013). En concreto, destacamos el papel de los CRU ingleses (Graham, 2014) y definimos su *efecto boomerang* en la comercialización de la propiedad intelectual de las universidades y en la promoción del éxito de las SPU en los *ecosistemas universitarios empresariales*. Esto, a su vez, produce, lo que denominamos en este trabajo, un *efecto de onda expansiva* por el cual los participantes de diferentes ecosistemas de innovación empresarial conectan generando crecimiento social y económico.

En tercer lugar, contribuimos al debate académico de hasta qué punto se pueden implementar los modelos de las universidades empresariales de élite, tales como el MIT, la Universidad de Stanford en los Estados Unidos, o la de Cambridge en el Reino Unido (Graham, 2014) en otras universidades con una orientación menos comercial con el fin de favorecer el éxito en el emprendimiento académico y conseguir un ecosistema empresarial más dinámico (Grimaldi et al., 2011; Maia & Claro, 2013; Siegel & Wright, 2015; Wright et al., 2008a). Hemos proporcionado una visión interna de este debate mediante el análisis de una comparación internacional entre universidades emprendedoras ubicadas en contextos no explorados en la literatura (Andalucía, España) y universidades emprendedoras reconocidas en la literatura como ejemplos de éxito (Inglaterra, Reino Unido) (Graham, 2014). Se llega así a la conclusión de que los *ecosistemas empresariales universitarios* están fuertemente

influenciados por el contexto en el que se asienta la universidad emprendedora (Grimaldi et al., 2011). De ahí la importancia del contexto en el desarrollo de ecosistemas de innovación empresarial (Autio et al., 2014) haciendo que cada ecosistema evolucione de manera diferente (Autio & Thomas, 2014; Jackson, 2011) y, por tanto, que políticas similares utilizadas en contextos anglosajones no tengan el mismo efecto cuando se aplican en otros países europeos (Audretsch et al., 2014; Maia y Claro, 2013; Siegel & Wright, 2015; Wright et al., 2008a).

Limitaciones y futuras investigaciones

Esta tesis no se halla exenta de limitaciones, lo que da luz a futuros estudios de investigación, tal como se explica a continuación.

En primer lugar, la revisión sistemática de la literatura emprendedora se ha centrado en un área muy específica y reciente, concretamente en los ecosistemas de la innovación y el emprendimiento académico. La muestra de publicaciones identificadas está basada en un número pequeño de estudios (34 publicaciones, 33 artículos y 1 libro). Si bien es cierto que las revisiones sistemáticas de la literatura suelen incluir más publicaciones es porque, a menudo, se centran en un campo de investigación más maduro. No obstante, no creemos que esto represente un problema, dado que lo que realmente importa es si esta materia suscita suficiente interés en su campo de investigación (Baldacchino et al., 2015). En este sentido, en este trabajo identificamos el concepto de ecosistema dentro de la literatura sobre emprendimiento académico como reciente y que ha experimentado un rápido aumento en popularidad. Esto es un claro indicativo de su potencial como área de investigación prometedora y emergente. Como resultado, hemos desarrollado una agenda que proporciona a los académicos las principales vías de investigación en el campo. En esta tesis doctoral sólo analizamos algunas de ellas, por tanto, un gran mapa de oportunidades se abre para los investigadores del emprendimiento (ver Tabla 5 del Capítulo 2: Programa prospectivo para futuras investigaciones).

En segundo lugar, el tamaño de la muestra escogida para los dos estudios empíricos de esta tesis doctoral puede considerarse relativamente pequeño (48 entrevistas en el caso de Andalucía, y 70 entrevistas en el comparativo internacional). Sin embargo, en

ambos casos acometimos un estudio exploratorio, primero analizando la conexión entre los *ecosistemas empresariales universitarios* y los ecosistemas de negocio innovadores, para a continuación explorar el papel de los intermediarios del conocimiento, concretamente los CRU, en el apoyo y soporte del éxito de las SPUs dentro de la dinámica de dicho ecosistema. Futuros estudios de investigación basados en un mayor número de observaciones y en una mayor diversidad de regiones y países podrán mejorar la generalización de estos resultados, así como proporcionar un mayor conocimiento sobre la importancia del contexto. Sería también interesante que centraran su atención en otros intermediarios del conocimiento, tales OTRIs o aceleradores, lo que permitiría aumentar la comprensión de la dinámica de *ecosistemas empresariales universitarios*.

Observaciones finales

Además de las contribuciones teóricas mencionadas anteriormente, esta tesis doctoral muestra importantes implicaciones a niveles directivos y políticos. En este sentido, llamamos la atención de los directivos de las universidades y de los responsables de la política regional para que reflexionen sobre los resultados de este estudio, de forma que puedan orientar sus decisiones y mejorar el desarrollo socioeconómico regional.

Por último, se proponen dos recomendaciones. En primer lugar, los directivos de universidades emprendedoras deberían promover *incentivos* para motivar a las instituciones que intervienen en el proceso de creación y desarrollo de *ecosistemas empresariales universitarios.* En particular las OTRIs y las CRUs, podrían adoptar un papel más proactivo en el espíritu empresarial y así conseguir *el efecto bumerán* por el cual se mantiene la comercialización de la propiedad intelectual en los *ecosistemas empresariales universitarios*. En segundo lugar, tanto los directores de las universidades como los responsables de la política regional deberían mantener su atención en el desarrollo de *programas* que garantizaran el *efecto de onda expansiva*, es decir, que los profesores y estudiantes interesados en comercializar sus tecnologías innovadoras tuvieran acceso a los recursos universitarios necesarios, tanto dentro como fuera de la escuela, para desarrollar con éxito la SPU, y conseguir su conexión con los distintos *ecosistemas de innovación empresarial*.

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Appendices

Annex 1. Database of the analysed papers

Classification	Author & year published	Journal published	Research aim/ objectives	Theory & approaches	Methodology	Data sources, type, size and country	Key findings/contributions
Nature	Autio et al. (2014)	Research Policy	Examine the role of context in stimulating the extent and variety of entrepreneurial innovation ecosystems, and its impact on outcomes in terms of the types of entrepreneurial innovation and subsequent venture performance	n.a.	Conceptual	n.a.	• They coined the term entrepreneurial innovation to explain the disruption of existing industries and the creation of new ones. • They built a framework that integrate the NSI and entrepreneurship literature, and the importance of the context in which entrepreneurial innovation occurs. It consist on the interrelation of industrial, organizational, institutional, and social contexts overlaid by temporal and spatial contexts, constituting different entrepreneurial innovation ecosystems that generate different types of entrepreneurial innovation
Nature	Gür et al. (2016)	Technological Forecasting and Social Change	Present a new performance measurement concept and a relevant methodology for entrepreneurial universities putting forward the view of the entrepreneurial university ecosystem	n.a.	Conceptual	Analyse the Entrepreneurial and Innovative Universities index of Turkey based on top 50 entrepreneurial and innovative universities aiming to foster the development of entrepreneurship ecosystems within and around higher education institutions, which include 23 quantitative indicators	• A new approach based on systems thinking is proposed in order to understand dynamic relationship between several variables in entrepreneurial university ecosystem • System thinking clearly take into consideration the distinguishing parameters of the university's origin, domains of excellence, mission, context, resource allocations, and strategic directions • The results of entrepreneurial university performance are presented as spin-off survival/growth, employment created by those new entrepreneurial activity, stakeholder evaluation, and level of their satisfaction, societal benefits, awards, additional funding, and reputation received, and overall regional economic development.

Classification	Author & year published	Journal published	Research aim/ objectives	Theory & approaches	Methodology	Data sources, type, size and country	Key findings/contributions
Nature	Kanter (2012)	Harvard Business Review	Develop an agenda for strengthening the links between key institutions in innovation ecosystems in the USA, providing the most successful examples	n.a.	Conceptual	n.a.	Identify four kinds of linkages as essential in facilitating competitiveness across innovation ecosystems and increase economic growth: linkages that generate ideas and turn them into market-ready enterprises; linkages between small enterprises and large companies; linkages between education and jobs; and cross-sector linkages among leaders to develop ecosystem strategies.
Nature	Oh et al. (2016)	Technovation	Critical review of the innovation ecosystem idea, and its compilation to the more traditional notion of innovation ecosystem	n.a.	Literature Review	n.a.	• It finds innovation ecosystem idea are insufficiently differentiated from NIS and RIS notions, and the risks of using it outweigh the benefits. • Innovation ecosystem is not yet a clearly defines concept, much less a theory.
Nature	Silva et al. (2016)	Technological Forecasting and Social Change	Describes a new method for combining innovation foresight, international innovation indices, and decision analysis to identify the best combination of investments to improve national innovation ecosystem	n.a.	Quantitative (The PortMan decision-making process)	Apply the new method to the nine sub-pillar of Human Factors in Innovation from The Global Innovation Index in Brazil	The main result of this paper is the proof-of-concept of a new methodology
Antecedents	Brodhag (2013)	Studies in Higher Education	This article considers the role of research universities, and how they can interact with key actors and institutions involved in 'innovation ecosystems'	n.a.	Conceptual	n.a.	Universities should consider their relationships with each component of complex innovation ecosystem. For training purposes, they should prepare actors of innovation ecosystems, able to manage relationships with various stakeholders and rationalities

Classification	Author & year published	Journal published	Research aim/ objectives	Theory & approaches	Methodology	Data sources, type, size and country	Key findings/contributions
Antecedents	Carayannis & Campbell (2009)	International Journal of Technology Management	Provide a better conceptual framework for understanding knowledge-based and knowledge-driven enriching the system theory, resulting the *Mode 3* Innovation Ecosystem	Knowledge production theory and Quadruple Helix approach	Conceptual	n.a.	*Mode 3*, in combination with the Quadruple Helix perspective, emphasize an Innovation Ecosystem that encourage the co-evolution of different knowledge and innovation models as well as balances non-linear innovation modes in the context of multi-level innovation system. Hybrid innovation networks and knowledge clusters tie together universities, commercial firms and academic firms.
Antecedents	Frenkel et al. (2015)	International Journal of Innovation and Technology Management	Review the literature on demand-driven innovation, using a generic national innovation ecosystem map as a unifying framework	n.a.	Literature Review	Analyse the key "quality anchors" and "processes and trends" of driving innovation through creating workshop of around 15–30 experts or more with proven field experience in academe, industry and government in each of the 8 selected countries and regions	Each nation must adapt its arsenal of innovation policies to its own culture and history, learning from other nations and pioneering with its own experiments, building on what is known and at times, even, experimenting with what is not known
Antecedents	Grimaldi et al. (2011)	Research Policy	Describe the evolving role of universities in the commercialisation of research	n.a.	Literature Review	n.a.	• It address various aspects of academic entrepreneurship in the 30th anniversary of the Bay-Dole act • It describes the evolving role of universities in the commercialisation of research results over the last 30 years
Antecedents	Miller et al. (2016a)	R&D Management	Reviews Mode 2 UTT from a quadruple helix perspective to identify key themes to develop a research agenda which reflects progression from a triple into a quadruple helix ecosystem	Knowledge production theory and Quadruple Helix approach	Literature Review	n.a.	From the SLR, it was found that closer collaboration of societal based innovation user stakeholders identifies the need to not only re-develop Mode 2 UTT processes but the need to align institutional culture, department climate, performance mechanisms and support mechanisms throughout the university to meet this goal.

Classification	Author & year published	Journal published	Research aim/ objectives	Theory & approaches	Methodology	Data sources, type, size and country	Key findings/contributions
Antecedents	Miller et al. (2016b)	R&D Management	Analyse how knowledge can be effectively transferred between universities and their constitute stakeholders within an open innovation quadruple helix ecosystem	Absorptive capacity theory and Quadruple Helix approach	Qualitative (Case study using Nvivo 10 software)	Semi-structured interviews to 24 core stakeholders involved in diverse quadruple helix stakeholders, observations over a period of three years, and document analysis in the UK	• The proposed model identifies five interdependent factors that enable or restrain KT effectiveness, namely human centric factors, organizational factors, knowledge characteristics, power relationships and network characteristics • These factors were found to both determine the initial decision to engage in KT and mediated the acquisition, assimilation, transformation and exploitation of knowledge when quadruple helix stakeholders are engaging in commercialisation activities.
Antecedents	Siegel & Wright (2015)	British Journal of Management	The authors assert that the time is ripe to rethink academic entrepreneurship. Specifically, theoretical and empirical research on academic entrepreneurship needs to take account of these changes, so as to improve the rigour and relevance of future studies on this topic.	Evolutionary approach	Literature Review	n.a.	Academic entrepreneurship has changed dramatically in recent years. Two key consequences of this change are that more stakeholders have become involved in academic entrepreneurship and that universities have become more 'strategic' in their approach to this activity.
Antecedents	Wright (2014)	Journal of Technology Transfer	Outline a synthesis of micro and macro levels that attempts to provide a broader conceptualization of academic entrepreneurship and an appreciation of the contextual heterogeneity of academic entrepreneurship and the implications for how it occurs	Resource-based theory	Literature Review	n.a.	• The micro-level concerns how firms orchestrate their resources and capabilities, specifically knowing where resources come from and how to accumulate, bundle and configure them to generate sustainable returns. • At the macro level, I analyse four different dimensions of context: temporal, institutional, social and spatial. • He argues that there is a need for a reconciliation of utilitarian and education-for-education's sake perspectives on the role of universities.

Classification	Author & year published	Journal published	Research aim/ objectives	Theory & approaches	Methodology	Data sources, type, size and country	Key findings/contributions
Outcomes-Micro Level	Gianiodis et al. (2016)	Small Business Economics	Analyse key conditions under which university scientists act opportunistically within an entrepreneurial ecosystem	Agency theory	Quantitative (Ordinary Least Squares (OLS) and Arellano–Bond models)	Analyse 73.603 scientists from 105 US research universities which participated in Association of University Technology Managers' (AUTM) Licensing Survey during the years 1999-2008 in the USA	• They found that some scientists privately leak discoveries invented while working for their universities. And the scientists who are embedded in a vibrant entrepreneurial ecosystem, are more likely to act overt opportunistically • In addition, they found that overt opportunism occurs even in the presence of monitoring, incentivizing, and high stakes, and that universities seem unable to confront scientists who seen to violate their employment contracts
Outcomes-Micro Level	Hayter (2016b)	Research Policy	Analyse the composition, contributions, and evolution of social networks among faculty entrepreneurs whose USO are within various phases of entrepreneurship	Knowledge Spillover Theory of Entrepreneurship (KSTE) and Network approach	Mix-method (Social network analysis (SNA) using graphics)	Interview to 76 academic entrepreneurs who founded a USO between the years 1996 and 2011 from 9 research universities located in New York State during late 2011	• The study affirms that social networks provide valuable resources and contacts within the unique context of academic entrepreneurship. However, because of this unique context, early entrepreneurship networks are generally constraining, widening the social distance between academic entrepreneurs and networks important to the success of their USO • The study also shows that academic entrepreneurs must rely even more on network intermediaries—boundary spanners—and, potentially, policy innovations to improve entrepreneurial development among USOs.
Outcomes-Micro Level	Leih & Teece (2016)	Academic of Management Perspectives	Explores relationships between campus leadership and the organizational level dynamic capabilities that underpin the management of research universities	n.a.	Qualitative (Cross-case analyses)	Interview to key stakeholders including campus leaders, scientists, and technology transfer specialists from Stanford University and the University of California, Berkeley in the USA	• The presence of leaders who marry strategic thinking and capabilities development enhance the likelihood of a university's competitive fitness and long-term survival • It is timely for university presidents to begin to manage proactively the university and, to the extent possible, its innovation ecosystem to increase the chances that their institutions will continue to prosper in an increasingly competitive environment that is also exposed to uncertainty and change

Classification	Author & year published	Journal published	Research aim/ objectives	Theory & approaches	Methodology	Data sources, type, size and country	Key findings/contributions
Outcomes-Micro Level	Nelson (2014)	Research Policy	Analyse how organizational context shapes entrepreneurship´ behaviours and perceptions during the course of the commercialisation process	n.a.	Qualitative (Case study)	Interview to 17 key players in the physical modelling (PM) commercialisation process of Stanford University, in addition access to its case file by The Stanford Office of Technology Licensing in the USA	Different organizational context shape in meaningful ways the actions of individuals within them, and thus, different elements of organizational context can be mutually reinforced in order to influence in their behaviours
Outcomes-Micro Level	Zang et al. (2013)	Asia-Pacific Journal of Accounting & Economics	Analyse the level of desire entrepreneurship among students in China and the USA and their perception on the availability innovation resources in maintaining an effective innovation ecosystem	n.a.	Quantitative (Statistical analysis)	Questionnaire to 453 engineering students from 3 top tier Chinese universities and to 350 engineering undergraduates students at Stanford University	• US and Chinese students are roughly equivalent in their desire to form or join start-up ventures. Far more US students, however, plan on actually doing so. • In contrast, Chinese students are more likely to join the state/government sector. • Our results also reveal a wide gap in perceptions on the availability of financing, mentorship, and other innovation resources. • The findings suggest that the innovation ecosystem in China remains underdeveloped in certain important respects.
Outcomes-Macro Level (industry/technology & spatial)	Carayannis et al. (2016)	Journal of Technology Transfer	Analyse how the institutional context of a region influences new ventures' knowledge acquisition actions during its growth, and in turn the level of sustained entrepreneurial activity within the entrepreneurship ecosystem	Organizational theory	Quantitative (Simulation methodology)	n.a.	• Institutions vary in their influence on regional levels of sustainable entrepreneurship. • Institutions that contribute to the variety of specialized knowledge present in a market, such as universities or R&D funding directed towards expanding scientific knowledge, are more likely to make positive impacts on a region's ability to foster and sustain an entrepreneurial climate. • By contrast, institutions that constrain the flows of knowledge in a region drive entrepreneurial ventures to pursue knowledge acquisition activities more distantly and in turn create instability in the entrepreneurial climate of the region.

Classification	Author & year published	Journal published	Research aim/ objectives	Theory & approaches	Methodology	Data sources, type, size and country	Key findings/contributions
Outcomes-Macro Level (organizational)	Guerrero et al. (2016)	Small Business Economics	Analyse the role of entrepreneurial universities exploring the way they interact with other stakeholders in their regions and on the impacts produced by those interactions on the regional innovative/entrepreneurial capacity toward sustained socio-economic well-being.	n.a.	Literature Review	Analyse 7 papers published in a special issue of Small Business Economics Journal in 2016 that combines diverse theoretical and methodological approach to analyse the emerging models of the entrepreneurial universities in the USA and European context	Highlight the relevance of entrepreneurial universities in the development of innovation and entrepreneurship activities and the emerging entrepreneurship ecosystem literature
Outcomes-Macro Level (organizational)	Graham (2014)	Book - Massachusetts Institute of Technology	Two phases benchmarking study in which, firstly, identified the world´s most highly-regarded entrepreneurial universities, and secondly, draw on the experiences of a small group of emerging leader universities analysed the context within which these universities became entrepreneurial and develop their innovation ecosystem	n.a.	Qualitative (Multiple case study)	The two phases of the study are informed by almost 200 interviews with individuals with an in-depth knowledge of some of the world's most highly-regarded university-based entrepreneurial and innovation ecosystems	The phase 1 of this study identified MIT and Stanford Universities in the USA and University of Cambridge in the UK as the world´s most highly-regarded University-based entrepreneurial ecosystems; and, recognized five success factors that support the development of University-based entrepreneurial ecosystem: university senior management, university departments, university-led entrepreneurial and innovation functions, student-led entrepreneurship activities and the external entrepreneurial and innovation community. The phase 2 emphasised the feature of two different models of University-based entrepreneurial ecosystem emergence based on a small group of emerging leader universes. These two models face the next two challenges: (i) connect the community-driven entrepreneurship and innovation with the formal university channel for research commercialisation, and (ii) the integration of entrepreneurial culture into the university´s mission, policies and inventive system.

Classification	Author & year published	Journal published	Research aim/ objectives	Theory & approaches	Methodology	Data sources, type, size and country	Key findings/contributions
Outcomes-Macro Level (organizational)	Samila & Sorenson (2010)	Research Policy	Explores the extent to which the local availability of venture capital might act as a catalyst to technology commercialisation	n.a.	Quantitative (Ordinary Least Squares (OLS))	Data set of 328 Metropolitan Statistical Areas in the United States from 1993 to 2002	• Public research funding generates more patents and start-ups in regions rich in venture capital. • Whereas federal research grants generally fund academic research – the creation of ideas – venture capital supports the development of these ideas and helps to train and encourage a community of entrepreneurs capable of bringing those ideas to market. • Point to the importance of ecosystem for supporting innovation and entrepreneurship
Outcomes-Macro Level (institutional)	Boh et al. (2016)	Journal of Technology Transfer	Analyse of the university USO development process, focusing in particular on student involvement in the initial phases of these technology commercialisation and on the impact of the larger university ecosystem	n.a.	Qualitative (Multiple case study)	Interview to 130 individuals, including founders of 47 USOs, directors and staff of TTOs, Entrepreneurship Centre Directors, faculty engaged in entrepreneurship education, students and faculty who have tried to commercialise their university inventions, and other key parties related to technology transfer from 8 the USA Universities	• Graduate and post-doctoral students are critical participants in university USOs. • They offer a typology of USO development with four pathways, based on the varying roles of faculty, experienced entrepreneurs, PhD/post-doctoral students, and business students. • Highlight the effects of the larger university ecosystem, beyond the university technology transfer office and the university's commercialisation policies, including an examination of programs and practices that may influence this process.
Outcomes-Macro Level (institutional)	De De-Filippo et al. (2015)	Technological Forecasting and Social Change	Analyses Spain's Campus of International Excellence (CEI) Programme and its potential for raising the visibility of the country's universities, optimising resources and intensifying interaction with the local surrounds	n.a.	Qualitative (Cross-case analyses)	Analysis of two CEIs: UAM–CSIC (Autonomous University of Madrid + National Research Council) and EUSKAMPUS (University of the Basque Country + Donostia International Physics Centre) in two periods of time: 2004–2008 (before institution of the CEI) and 2009–2013 (during the CEI programmes) in Spain	CEI programme has emphasised the creation of voluntary strategic alliances of different actors in universities´ local surrounds, contributing to economic and social development in the respective area. This alliance membership included governments, research bodies and technology transfer institutions, which together build what in the CEI Programme are called knowledge and innovation ecosystem.

Classification	Author & year published	Journal published	Research aim/ objectives	Theory & approaches	Methodology	Data sources, type, size and country	Key findings/contributions
Outcomes-Macro Level (institutional)	Fernández-Fernández et al. (2015)	The Service Industries Journal	Analyse the role and the process of delivery of services provided by business incubators inside the entrepreneurship ecosystem	n.a.	Qualitative (Cross-case analyses)	Analyse data of 255 business incubators with a wide coverage in 78 countries worldwide from InfoDev network and two case study of two Spanish business incubators	• Business incubation is an innovative tool where services delivery has a certain future. • The contribution of business incubators is essential and is also a challenge for continuing innovation in services. • Some positive actions for reinforcing the service-based EE would have a holistic approach through an effective strategic networking, with as many stakeholders as possible (public, private, academia, NGOs), ensuring that services provided are the most advanced ones and that are being provided in the best conditions according to proposed standards or procedures. If all these considerations are taken, the dynamic process of business incubation and its benefits through the application of the best services will be guaranteed. • However, standardized procedures should be revised with the dynamics of other cases.
Outcomes-Macro Level (institutional)	Levie (2014)	Journal of Technology Transfer	Examine how successful technology commercialisation education is deeply dependent on the state of the university's entrepreneurial ecosystem	n.a.	Qualitative (Case study)	Analyse the emergence and support of University of Strathclyde´s entrepreneurial ecosystem in the UK	The entrepreneurship ecosystem that enables technology commercialisation at Strathclyde relies on cooperation and coordination between service and academic department working together on many different projects and on leveraging the goodwill and energy of students, staff and alumni. However, teaching activities form just one stand of this ecosystem, on their own, they would have little impact.
Outcomes-Macro Level (institutional)	Maia & Claro (2013)	Journal of Technology Transfer	Analyse if and how Proof of Concept Centres (PoCCs) can positively impact different university ecosystems, through an exploratory case study of the role for a PoCC in the ecosystem of University of Coimbra (Portugal)	n.a.	Qualitative (Case study)	Interview to persons holding the key leadership position of 8 TT and technology commercialisation organization identified in the University of Coimbra ecosystem in Portugal	There is in fact a possible role for a Proof of Concept Centre in the regional ecosystem of the University of Coimbra, with a potentially very relevant impact in the technology commercialisation process, through networking outside academia and research environments, funding of Proof of Concept activities, and technology entrepreneurship education for the development of entrepreneurial skills for researchers

Classification	Author & year published	Journal published	Research aim/ objectives	Theory & approaches	Methodology	Data sources, type, size and country	Key findings/contributions
Outcomes-Macro Level (institutional)	McAdam et al. (2016)	Technovation	Use a stakeholder lens to explore University Incubation models within unique regional and organizational characteristics and constraints	Stakeholder theory and Quadruple Helix approach	Qualitative (Cross-case analyses)	Interview to 21 stakeholders involved in the TT and incubation processes of Russell Group University and University UK group university	• Variances existed in relation to the two universities incubation models which were found to result from both regional (macro environment) and organization (meso environment) influences • That variances was influenced by their corresponding culture, internal mechanisms and engagement with quadruple helix stakeholders
Outcomes-Macro Level (institutional)	Rogova (2014)	The International Journal of Technology Management & Sustainable Development	Analyse the effectiveness of business incubator as a part of innovation-based start-ups support and eco-systems creation.	Stakeholder theory	Quantitative (Statistical analysis)	Questionnaire to 27 to managers of business incubators located in eight Russian cities	• The study revealed some problems connected with the performance of universities' business incubators • Business incubators have learned how to support start-ups in general, but they do not promote spin-offs and technology transfer processes. • The results demonstrated that there is a lack of commercial stimulus and entrepreneurial approach in relations between universities and business incubators, as well as between business incubators and their residents.
Outcomes-Macro Level (social & temporal)	Chen & Lin (2016)	Technological Forecasting and Social Change	Analyse the dynamic role of universities in developing an emerging high-tech sector, in particular examine the R&D collaboration networks between the universities and the other actors in the biotechnology sectoral innovation ecosystem	Triple Helix approach	Mix-method (Social network analysis (SNA) using Ucinet software programme)	Empirical longitudinal data of 125 IPO biotechnology firms and interview to 7 technology transfer officers in the academia in three time period: 2000, 2006 and 2012 in Taiwan	While the innovation ecosystem is ready for academia-industry collaboration, universities not only take charge of disseminating knowledge but also serve as the major intermediaries in the process of commercialising science and technologies developed through the universities

Classification	Author & year published	Journal published	Research aim/ objectives	Theory & approaches	Methodology	Data sources, type, size and country	Key findings/contributions
Outcomes-Macro Level (social & temporal)	Clarysse et al. (2014)	Research Policy	Provide empirical evidence to the policy maker hypothesize that a tight knowledge ecosystem automatically lead to the emergence of a business ecosystem	Business ecosystems approach	Quantitative (Social network analysis (SNA) using Ucinet software programme)	Analyse a database of 138 innovative start-ups in the region of Flanders (Belgium), founded between 2006 and 2011	• In contrast to policy maker expectations, a tight knowledge ecosystem does not automatically lead to the emergence of a business ecosystem. • Mostly public financiers play a role in supporting innovative start-ups, while private sector is only marginally involved. The majority of that public investors are closely linked to the leading PROs and/or universities. • Then, the financial agents in the ecosystem do not form a mechanism of cross real transposition • For a knowledge network to evolve into a business ecosystem, private financial agents should take over the lead of public sector organizations and be the first mechanism of cross realms transposition
Outcomes-Macro Level (social & temporal)	Hayter (2016a)	Small Business Economics	Analyse the composition, contributions, and evolution of social networks among faculty/student entrepreneurs and the role of knowledge intermediaries in entrepreneurial university ecosystems	Network approach	Mix-method (Social network analysis (SNA) using graphics)	Two rounds of interviews to 23 nascent faculty and graduate student entrepreneurs who have stablished USO companies based on technologies stemming from federally funded research and others 15 interviews to different knowledge intermediaries from 9 research universities in New York State between 2010 and 2013, in order to understand how their networks evolve over time	• Affirm the importance of organizational 'cross logics' for obtaining valuable resources and contacts within the unique context of academic entrepreneurship • Due to this context academic entrepreneurs must rely on knowledge intermediaries (network boundary spanners) to improve the developmental chances of their USO • The specific structure and contributions of intermediary networks relate to the likelihood and speed of USO development • The collective and strategic actions of multiple academic and non-academic knowledge intermediaries appear to be the foundation for vibrant entrepreneurial university ecosystems, compared to other, single intermediary structures

Classification	Author & year published	Journal published	Research aim/ objectives	Theory & approaches	Methodology	Data sources, type, size and country	Key findings/contributions
Outcomes-Macro Level (social & temporal)	Guerrero & Urbano (2016)	Technological Forecasting and Social Change	Analyse the effects produced by the links of enterprises with other enterprises, universities and government on their innovation performance, as well as, the moderation effects generated when those enterprises have a high-growth orientation	Triple Helix approach	Quantitative (Tobit regression)	Analyse a cross-section dataset of 19.188 Mexican enterprises from the 2006, 2008, 2010 and 2012 Research and Technological Development Survey	• Enterprise in emerging economies cooperates with their parent (intrapreneurially), other enterprises involved in the system (commercially), universities and research centres (scientifically) and also develop mixed cooperation, which have a positive effect on their innovation performance and reinforced when the enterprise has a high-growth orientation. • Enterprises analysed are more likely to use internal sources for developing innovation than external sources, even when they have a high-growth orientation. They innovation performance is affected positively when they access to external fund from other enterprises • Positive effect of government subsidies on innovation performance is only evidenced when enterprises collaborate with universities and have a no high-growth profile • Socio economic context of the period analysed has a negative impact on innovation performance of enterprises interviewed
Outcomes-Macro Level (social & temporal)	Lubik et al. (2013)	R&D Management	Analyse the types of partners most common among science-based USOs and which partnerships are being pursued by those achieving greater than average commercial success	Resource-based theory and business ecosystem approach	Qualitative (Multiple case study)	Interview to key personnel, generally founders, chief executive officers or other top management of 7 USOs from UK universities	Building an interwoven ecosystem with a variety of partners is time and resource intensive but can provide the science-based USO with the range of complementary and commercial resources it requires to get its innovation into use

Annex 2. SNA survey and interview protocol (Spanish version)

Investigación del Grupo de Investigación Ebusiness de la Universidad de Malaga conjuntamente con la Universidad de Leeds (Reino Unido)

La transferencia de tecnología o de conocimiento se define como el intercambio de nuevos conocimientos, productos o procesos de una organización a otra para el beneficio económico de las partes implicadas.

Este trabajo se centra en la transferencia de tecnología como mecanismo formal y se define como aquella que se basa en la firma de un contrato entre el investigador, bien nombre propio o bien en nombre de un grupo de investigación, con una empresa pública o privada o cualquier organización, con la finalidad de prestarle servicios de investigación o consultoría. En dicho contrato se fijan las condiciones legales, organizativas y económicas de la TT. Dentro de dichas actividades se incluye la realización de un proyecto bajo contrato para un tercero; la licencia de una patente o el participar como emprendedor de una idea de negocio basada en su actividad investigadora, es decir, en una USO. En esta investigación se emplean indistintamente los términos transferencia de tecnología y transferencia de conocimiento.

Guía para realizar las entrevistas (dirigidas a responsables en Universidades y a directivos/as de empresas que hayan firmado un contrato de investigación a través de la Oficina de Transferencia de Resultados de Investigación [OTRI] de una Universidad)

En primer lugar, dejar claro si le importa al entrevistado/a el hecho de grabar la encuesta.

Información General:

1. Nombre:
   Organización:
   Localización:
   Breve descripción de las tareas desempeñadas y responsabilidades:
2. Sector de actividad de la empresa:
3. ¿Los socios de su empresa son mayoritariamente profesores/investigadores universitarios? Spin-off académica/ Spin-off no académica

Definición:

4. ¿Qué opina sobre la transferencia de tecnología/conocimiento desde la Universidad (en general)?

Actividades:

5. ¿Qué actividades de transferencia de tecnología/conocimiento se están realizando en su organización en estos momentos? ¿En cuáles esta personalmente involucrado?
6. ¿En qué otras actividades de transferencia de tecnología/conocimiento tiene experiencia?
7. ¿Cuáles fueron las de mayor éxito? ¿Por qué?
8. ¿Cuáles fueron las de menor éxito? ¿Por qué?
9. ¿Cómo lo sabe? ¿Utiliza algún método de evaluación de la transferencia de tecnología/conocimiento?

Redes de contacto:

10. ¿Con que personas o instituciones suele contactar para realizar actividades de transferencia de tecnología/conocimiento? Indíquelas en este listado:
    a. Oficina OTRI de su Universidad más cercana.
    b. Centro de Investigación.
    c. Spin-offs académicas.
    d. Spin-offs no académicas.
    e. Otras empresas.
    f. Otras instituciones públicas.
11. ¿Con que frecuencia suele contactar con ellos?
12. ¿Qué espera obtener? ¿En qué medida lo está obteniendo?
13. ¿Qué personas o instituciones suelen contactar con usted para realizar actividades de transferencia de tecnología/conocimiento?
    a. Oficina OTRI de su Universidad más cercana.
    b. Centro de Investigación.
    c. Spin-offs académicas.
    d. Spin-offs no académicas.

e. Otras empresas.
f. Otras instituciones públicas.

14. ¿Con que frecuencia suelen contactar con usted?
15. ¿Qué esperan obtener? Cree que suelen cumplirse esas expectativas, ¿Cómo lo sabe?
16. Si distinguimos entre redes de contactos formales e informales
    a. *Red formal*: aquellas personas con las que mantiene una relación laboral
    b. *Red informal*: aquellas personas que provienen del ámbito personal, como familiares, amigos, antiguos compañeros de trabajo o antiguos empleados.

    ¿Dónde incluiría a las personas o instituciones con las que suele contactar para realizar actividades de transferencia de tecnología/conocimiento? Exprese qué importancia (en porcentaje) tiene cada grupo para la transferencia de tecnología.
17. De ambos tipos de relaciones nombrados (formales e informales) ¿Cuáles cree que fomentan más el descubrimiento de oportunidades de negocio/creación de empresas? Señale un porcentaje aproximado a cada grupo.
18. ¿Qué actividades de emprendimiento se fomenta más con cada tipo de red, formal e informal (ejemplos de actividades de emprendimiento: nuevos contactos, nuevas ideas de negocio, recursos, reconocimiento)?
19. ¿Y cómo afectan estas redes a la transferencia de tecnología y/o conocimiento?

Beneficios:

20. ¿Por qué cree que es importante la transferencia de tecnología/conocimiento de las Universidades a las empresas?
21. ¿Cuáles son los beneficios potenciales para las Universidades que realizan transferencia de tecnología/conocimiento?
22. ¿Cuáles son los beneficios de la transferencia de tecnología/conocimiento para las empresas?
23. ¿Quién más se beneficia de la transferencia de tecnología/conocimiento?

24. ¿Cree que existe algún coste de oportunidad relacionado con la transferencia de tecnología/conocimiento (para investigadores/empresas/Universidad/ sociedad)?

Barreras:

25. ¿Cuáles son, si existen, las barreras de transferencia de tecnología/conocimiento que ha encontrado? ¿y en cuanto a la creación de la USO?
26. ¿Cómo, si las hubo, consiguió superar dichas barreras?
27. ¿Ha tenido algún problema a la hora de realizar transferencia de tecnología/conocimiento? ¿y en cuanto a la creación de la spin-off?

Apoyo:

28. ¿Qué más podría usted o su organización hacer para apoyar la transferencia de tecnología/conocimiento?

Annex 3. SNA survey and interview protocol (English version)

Ebusiness research group University of Malaga (Spain) and Leeds University (the UK)

Technology or Knowledge transfer is defined as the interchange of new knowledge, products or processes from one organization to another for the economic benefit of both parts.

This work is centred in the technology transfer as formal mechanism and it is defined as the one based on signing a contract between the researcher, in their behalf or on behalf of a research group, with a public or private company or organization, with the aim of giving research or consulting services.

In that contract the legal, organizational and economic conditions of the technology transfer are fixed. In these activities, they are included executing a Project under a contract for a third part, paten license or taking part as entrepreneur in a business idea based on their research activity (spin off). In this research, they are used as synonymous technology transfer and knowledge transfer.

Guide to conduct the interviews (addressed to Universities' managers, and to businesses' managers that have signed a research contract thorough a University Technology Transfer Office [OTRI])

Firstly, it is important to clarify to the interview that if he/she has to agree to record the interview.

General information:

1. Name:
   Organization:
   Year of set up the company:
   Address:
   Brief description of the job and main responsibilities:
2. Activity sector of the company:
3. Are the partners of your company mainly professors/university research? Academic spin-off/ Non academic spin off

Definition:

4. What do you think about technology/knowledge transfer from the University (in general)?
5. What do you think about starting companies from the University's knowledge?

Activities:

6. In what technology/knowledge transfer activities have you experience? Which of them were more/less successful? Why?

Contacts networks:

Firstly, we are going to talk about the institutions you contact yourself. Secondly, we will talk about the institutions that contact you.

7. What of the people or institutions from the next list *do you contact* to conduct these technology/knowledge transfer activities?
    a. UTTO of the nearest University.
    b. Research centre.
    c. Academic Spin-offs.
    d. Non-academic Spin-offs.
    e. Other companies.
    f. Other public institutions.
8. What is the frequency of these contacts in each case?
9. What people or institutions *contact with you* to conduct these technology/knowledge activities?
    a. UTTO of the nearest University.
    b. Research centre.
    c. Academic Spin-offs.
    d. Non-academic Spin-offs.
    e. Other companies.
    f. Other public institutions.
10. What is the frequency of these contacts in each case?
11. If we consider formal and informal contacts networks as:
    a. *Formal network*: those people who engage in a working relation with you.

b. *Informal network*: those people that came from your personal sphere, such as relatives, friends, old workmates or old employees.

Where would you include those people or institutions with which you usually contact to conduct technology/knowledge transfer activities? Please, indicate the importance (in percentage) that has each group for the technology/knowledge transfer.

12. We would like to know your opinions about both types of relationships regarding entrepreneurial activities, such as new contacts, new business ideas, resources, and recognition. What do you think that promote the most the discovery of business opportunities/starting new companies? Indicate an approximate percentage to each group.

Benefits:

13. In your view, what are the main benefits of technology/knowledge transfer from Universities to businesses?
    If you are a University…
    If you are a Spin-off...
14. In your view, what are the main benefits of Universities being involved in entrepreneurial activities?
    If you are a University…
    If you are a Spin-off...

Barriers:

15. In your view, what are the main barriers of technology/knowledge transfer from Universities to businesses?
    If you are a University…
    If you are a Spin-off...
16. In your view, what are the main barriers of Universities being involved in entrepreneurial activities?
    If you are a University…
    If you are a Spin-off...

Support:

17. What else could you or your organization do to support technology / knowledge transfer?

Annex 4. Email contact in Andalusia (Spain)

Estimado Sr./Sra._____,

Hemos obtenido su dirección de correo electrónico de directorios públicos disponibles en internet.

Nuestro grupo de investigación, de la Universidad de Málaga (www.gieb.uma.es) está realizando una investigación sobre los "Factores que afectan a la Transferencia de Tecnología/Conocimiento desde la Universidad y la creación de empresas", en colaboración con el Leeds Enterprise Centre de la Universidad de Leeds (http://lec.leeds.ac.uk/).

El estudio va dirigido a empresas Spin-off de Universidades andaluzas que realicen actividades de transferencia de tecnología/conocimiento con las mismas (contrato OTRI, proyecto común, patente, etc.).

En dicho contexto, le solicitamos su colaboración para que podamos visitarle para una entrevista personal de una duración total estimada de 45 minutos. Los datos obtenidos serán tratados de forma agregada y cómo máximo se identificará que las respuestas provienen de una Universidad, un centro/grupo de investigación o una empresa, dependiendo de cuál sea su caso.

Algunas de las preguntas que le haremos son:

- ¿Qué actividades de transferencia de tecnología/conocimiento se están realizando en su organización en estos momentos?
- ¿Cuáles fueron las de mayor éxito? ¿Por qué? / ¿Cuáles fueron las de menor éxito? ¿Por qué?

El *miércoles 23/10/2012*, Elena Fuster, miembro del grupo de investigación estará realizando entrevistas en *Sevilla*. Le pedimos por favor, que nos indique su disponibilidad para poder atendernos en esta fecha, o si proponen alguna fecha posterior (le agradeceríamos que nos enviaran sus datos de contacto para facilitar la confección de la agenda).

Le rogamos que nos confirme, a la mayor brevedad posible, por correo electrónico su disponibilidad para colaborar en la investigación.

Le agradecemos de antemano la atención prestada y su colaboración. Reciba un cordial saludo.

Elena Fuster
Investigadora Grupo de Investigación GiEb, Universidad de Málaga
Email: e.fuster.martin@gmail.com

Responsable del Grupo de Investigación:
Antonio Padilla
Email: apm@uma.es
Teléfono: ***, ***

Annex 5. Email contact in England (the UK)

Dear Sr/Sra,

We have been given your contact details by _____.

Leeds Enterprise Centre from Leeds University (the UK) (http://lec.leeds.ac.uk/) and Ebusiness research group from University of Malaga (Spain) (www.gieb.uma.es) are working on a research project about *the factors which affect the Technology or Knowledge Transfer from University to companies and the creation of University Spin-off*

We are in Leeds collecting data for this research project. We have interviewed some university USO companies (academic and non-academic) and intermediaries of Technology/Knowledge Transfer located in *England Region*. Thus, we email you because your opinion and you experience in running university USO companies can add value to our project.

In this context, we will be grateful if you can collaborate with us through a personal interview. The duration is about 45 minutes. The information will be taken as a whole and we will identify just the institution where it came from (University, R&D Centre, TTO, Incubator or Spin-off)

Some questions from the questionnaire are:

- What do you think about technology/knowledge transfer from the University (in general)?
- What do you think about starting companies from the University´s knowledge?
- In what technology/knowledge transfer activities have you experience?

We will be in *Leeds* from the *1st of September to the 30th of November*. We will appreciate if you let us know your availability on these dates.

We are looking forward your replay in order to set the time of the interview.

Elena Fuster

Researcher of University of Malaga

Ebusiness Research Group, University of Malaga
Email: e.fuster.martin@gmail.com
Tel: ***

Antonio Padilla
Professor of University of Malaga
Head of Ebusiness Research Group
Email: apm@uma.es
Tel: ***

Nigel Lockett FRSA
Professor of Enterprise, Leeds University Business School
Head of Management Division

Annex 6. Database of Andalusian Companies

Cases analysed	Type of participant	Province	Gender	Interviewee to	Sector of the USO	Use a formal mechanism	Year of set up	Funding source			
								Own resources	University founded	Private UVC	Public UVC
Case 01-SP	USO	Malaga	Female	CEO	IT	x	2007	x		x	x
Case 02-SP	Private UVC	Malaga	Male	CEO	IT	n.a.	1993	x			
Case 03-SP	RDC	Malaga	Male	Manager	IT	n.a.	n.a.	n.a.	n.a	n.a	n.a
Case 04-SP	USO	Malaga	Male	Academic entrepreneur	IT	x	2008	x			
Case 05-SP	USO	Malaga	Male	CEO	IT	x	2007	x	x		x
Case 06-SP	Incubator	Malaga	Female	Manager	Multi sector	n.a.	n.a.	n.a.	n.a	n.a	n.a
Case 07-SP	USO	Malaga	Male	Academic entrepreneur	IT	x	2011	x			
Case 08-SP	Private UVC	Malaga	Male	Manager	IT	n.a.	1993	x			
Case 09-SP	TTO	Malaga	Female	Manager	multi sector	n.a.	n.a.	n.a.	n.a	n.a	n.a
Case 10-SP	USO	Malaga	Male	CEO	IT	x	2001	x	x		
Case 11-SP	Public UVC	Malaga	Male	Manager	multi sector	n.a.	n.a.	n.a.	n.a	n.a	n.a
Case 12-SP	USO	Malaga	Male	CEO	Neurotechnology	x	2008	x	x		x
Case 13-SP	USO	Malaga	Male	Academic entrepreneur	IT and health	x	2008	x	x		x
Case 14-SP	USO	Malaga	Female	Academic entrepreneur	IT	x	2009	x			
Case 15-SP	RDC	Malaga	Male	Manager	IT	n.a.	n.a.	n.a.	n.a	n.a	n.a
Case 16-SP	USO	Malaga	Male	CEO	IT	x	2002	x	x		x
Case 17-SP	USO	Malaga	Male	CEO	IT	x	2005	x		x	x
Case 18-SP	USO	Malaga	Male	Academic entrepreneur	Archeology	x	2003	x	x		x
Case 19-SP	USO	Huelva	Male	CEO	Services	x	2007	x	x		
Case 20-SP	USO	Huelva	Male	Academic entrepreneur	IT	x	2009	x	x		x
Case 21-SP	USO	Huelva	Male	CEO	Nuclear	x	2010	x	x		x
Case 22-SP	TTO	Huelva	Female	Manager	multi sector	n.a.	n.a.	n.a.	n.a	n.a	n.a
Case 23-SP	USO	Seville	Male	Academic entrepreneur	IT	x	2010	x			
Case 24-SP	USO	Seville	Male	Academic entrepreneur	IT	x	2010	x	x		x
Case 25-SP	USO	Seville	Male	CEO	Energy, environment	x	2007	x	x		x
Case 26-SP	USO	Seville	Male	CEO	Biomedicine	x	2009	x			
Case 27-SP	USO	Seville	Male	Academic entrepreneur	Technology for agrifood	x	2007	x			x
Case 28-SP	USO	Seville	Male	CEO	Engineering	x	2007	x	x		x
Case 29-SP	RDC	Seville	Male	Manager	Biomedicine	n.a.	n.a.	n.a.	n.a	n.a	n.a

continuation of table Annex 6. Database of Andalusia companies

Cases analysed	Type of participant	Province	Gender	Interviewee to	Sector of the USO	Use a formal mechanism	Year of set up	Funding source			
								Own resources	University founded	Private UVC	Public UVC
Case 30-SP	USO	Seville	Male	CEO	Agriculture	x	2011	x			
Case 31-SP	USO	Granada	Male	CEO	Biotechnology and food	x	2006	x			x
Case 32-SP	USO	Granada	Female	CEO	Biotechnology	x	2008	x	x		x
Case 33-SP	USO	Granada	Male	CEO	Biotechnology	x	2006	x			x
Case 34-SP	USO	Granada	Male	CEO	Health	x	2009	x			
Case 35-SP	USO	Granada	Male	CEO	Biotechnology	x	2011	x	x		
Case 36-SP	USO	Granada	Female	CEO	Biotechnology	x	2010	x			x
Case 37-SP	USO	Almeria	Male	Academic entrepreneur	IT	x	2009	x	x		x
Case 38-SP	USO	Almeria	Male	CEO	Services	x	2007	x			x
Case 39-SP	USO	Almeria	Male	CEO	Services	x	2008	x	x		x
Case 40-SP	USO	Almeria	Female	Academic entrepreneur	Services	x	2006	x	x		x
Case 41-SP	USO	Almeria	Male	Academic entrepreneur	Services	x	2006	x			
Case 42-SP	USO	Almeria	Female	CEO	Health	x	2007	x			x
Case 43-SP	USO	Almeria	Female	CEO	Health	x	2008	x	x		x
Case 44-SP	USO	Almeria	Male	CEO	Engineering	x	2006	x	x		x
Case 45-SP	USO	Cádiz	Female	CEO	Renewable energies	x	2009	x	x		x
Case 46-SP	USO	Cádiz	Male	Academic entrepreneur	Engineering	x	2006	x	x		x
Case 47-SP	USO	Cádiz	Female	CEO	Services	x	2005	x	x		x
Case 48-SP	USO	Cádiz	Male	CEO	Agrofood	x	2008	x			x

n.a.: not applicable

Annex 7. Database of English Companies

Cases analysed	Type of participant	Province	Gender	Interviewee to	Sector of the USO	Use a formal mechanism	Year of set up	Funding source			
								Own resources	University founded	Private UVC	Public UVC
Case 1-UK	TTO	Leeds	Male	Manager	Multi sector	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Case 2-UK	RDC	Leeds	Female	Manager	Health	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Case 3-UK	USO	Leeds	Male	CEO	Military	x	2001	x	x		
Case 4-UK	USO	Oxford	Male	CEO	Photovoltaic	x	2009	x	x	x	
Case 5-UK	Incubator	Oxford	Female	Manager	Multi sector	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Case 6-UK	Incubator	Oxford	Male	Manager	Multi sector	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Case 7-UK	USO	Oxford	Male	CEO	Engineering	x	2000	x	x	x	
Case 8-UK	Incubator	Leeds	Female	Manager	Multi sector	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Case 9-UK	TTO	Leeds	Male	Manager	Multi sector	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Case 10-UK	UVC	Leeds	Male	Manager	Multi sector	n.a.	2000	x			
Case 11-UK	USO	Leeds	Male	CEO	Health	x	2010	x	x		
Case 12-UK	USO	Leeds	Male	CEO	IT	x	2007	x	x	x	
Case 13-UK	USO	Sheffield	Male	CEO	IT	x	2006	x		x	
Case 14-UK	UVC	Sheffield	Male	Manager	Multi sector	n.a.	2001	x			
Case 15-UK	USO	Sheffield	Male	Manager	Health	x	2012	x	x	x	
Case 16-UK	USO	Sheffield	Male	CEO	Health	x	2006	x	x	x	
Case 17-UK	UVC	Sheffield	Male	CEO	Multi sector	n.a.	2001	x			
Case 18-UK	USO	Cardiff	Male	CEO	Health	x	2004	x	x		
Case 19-UK	UVC	London	Male	Manager	Multi sector	n.a.	2005	x			
Case 20-UK	USO	Southampton	Male	CEO	Biotechnology	x	2003	x	x		
Case 21-UK	USO	Sheffield	Male	CEO	Industrial design	x	2005	x		x	
Case 22-UK	USO	London	Male	CEO	Engineering	x	2004	x		x	

n.a.: not applicable