

Defining Academic Spinoffs and Entrepreneurial University



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Abstract The traditional vision of the university as a teaching institution still prevails in many countries. Typical of this vision is the high-risk aversion to knowledge commercialization due to lack of institutional support and market knowledge. Therefore, university scholars and seem more interested in publishing and graduates are more interested in secured life-time employability instead of commercialising their research and ideas on the market which does not contribute to technology transfer (TT) process and economic growth.

This chapter aims at providing insights into the important success factors of creation of academic spin-offs and entrepreneurial university, by carrying out a systemic review of eclectic literature on knowledge commercialization a technology transfer. It reveals that technology transfer offices (TTOs), centres for entrepreneurship and entrepreneurship education as important success factors for academics spin-offs and knowledge commercialisation. Practical implications for entrepreneurship university and other stakeholders and discussed.

Keywords Knowledge transfer · Entrepreneurial university · Spin-offs · Knowledge commercialization · Researcher

1 Introduction

Universities are currently implementing far-reaching changes to become more entrepreneurial. Technology transfer offices (TTOs) are being set up to promote the commercialisation of the results of academic research in a form of academic spin-offs. Along with creating an entrepreneurial ecosystem in education where

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entrepreneurship skills are taught and developed, the process of knowledge commercialisation has attracted the attention of researchers and policy makers with its capacity to foster social and economic development and exploit industrial innovation.

In terms of demand for technology, the European context shows two particular features (Abramo, D'Angelo, Di Costa, & Solazzi, 2011; Abramo, D'Angelo, Ferretti, & Parmentola, 2012). The first is the high-tech de-specialisation of most industrial sectors and the consequent reduction in competitiveness in high-tech industries. The second is the sizeable presence of small and micro firms that are usually reluctant to introduce product and process innovations. Both these aspects underline the difficulty in absorbing the results of public research into the national production system. This difficulty could be amplified by university technology outputs that are often underdeveloped for industry (Markman, Phan, Balkin, & Gianiodis, 2005).

The Western European context also has some peculiarities in relation to technology supply. According to the European Knowledge Transfer Report (EC, 2013), US Public Research Organisations (PROs) show better TT performance in invention disclosures, patent applications, licence income and start-ups per capita than their European counterparts. In particular, Western PROs—including universities—are the chief suppliers of knowledge technology. Thus, university TT processes and promotion of “entrepreneurship university” are of pre-eminent importance for driving business innovation and spin-offs—which is commercialisation of ideas by scientists, graduates and entrepreneurs (Mustar, 1997; Mustar et al., 2006). This aim of this study is the systematic literature review and define the strategies which enable an increase the likelihood of academic spin-off and knowledge commercialization by universities.

The number of strategies will be discussed in this chapter to enhance knowledge commercialization including the introduction of The Bayh–Dole Act—type regulation in many other countries (Kenney & Patton, 2009; Shane, 2004) as well as further investigation of both institutional and environmental factors which support academic spin-off and knowledge commercialization. This is important task as the traditional vision of the university still prevails in many countries, including West and East Europe. Typical of this vision is the high-risk aversion due both to the negative perception of failure and long-life employment (Chiesa & Piccaluga, 2000). Therefore, researchers seem more interested in publishing instead of commercialising their research results on the market with is obviously reasonable for fundamental researches, but seems to be a barrier to TT process in applied science.

This chapter aims at providing insights into the creation of academic spin-offs and making university more entrepreneurial, by investigating the role of success factors of entrepreneurship ecosystem at a university on the base of systematic literature review. More specifically, we define important mechanism such as TTOs, centres for entrepreneurship and entrepreneurship education which are crucial success factors for academics spin-offs and entrepreneurial university.

We make the following two contributions to entrepreneurship education and knowledge transfer literature. First, it offers a synthesis of eclectic literature

examining the critical success factors of technology transfer as a critical condition for academic spin-off. Second, we build on entrepreneurship education and best practices to examine and discuss success factors of academic spin-offs at university which serve as a conduit of knowledge commercialisation: engagement of all stakeholders within university-industry-government partnership, building infrastructure and entrepreneurship community; Technology Transfer Offices (TTOs) and centres for entrepreneurship as conduits for knowledge spillover. Finally, we contend that knowledge commercialisation through academic spin-off are driven by important mechanisms: technology transfer offices and centres of entrepreneurship and expanding entrepreneurship education and skills within researchers and students, making university overall more entrepreneurial.

2 Theoretical Framework

Despite the growing interest demonstrated in recent years, there is no perfect agreement on the definition of academic spin-offs and the notion of entrepreneurial university, with a vague understanding of instruments available in the entrepreneurship ecosystem to support knowledge diffusion between business and university (Algieri, Aquino, & Succurro, 2013; Clarysse & Moray, 2004; Fontes, 2005; Mustar, 1997; Wright, Clarysse, Lockett, & Binks, 2006). Much of the disagreement is related to the relationship between the university and the new venture, especially in reference to ownership of intellectual property. Indeed, on this point, while it has been shown that an inventor ownership regime generates a greater number of spin-offs than a university ownership regime (Kenney & Patton, 2009), ownership regimes do vary across universities. Another disagreement is on the role of TTOs and centres for entrepreneurship which build entrepreneurship culture and infrastructure in the university.

In line with the definition provided by Netval (2014), an “academic spin-off” is intended as a new high-tech venture promoted and launched by an academic researcher that aims to exploit the results of previous research projects on academic spin-offs and provide insights on creating an ecosystem supporting creation of academic spin-offs in regions as a relatively recent phenomenon, which exists since the year 2000.

According to Netval (2014), a firm may be described as a spin-off from university when the following four conditions are satisfied: (1) the presence of at least one academic researcher in the shareholding; (2) performance by this academic researcher of multiannual research activities in the university of origin (at least 3 years); (3) engagement in a profit-oriented business enterprise; (4) the production and/or selling of products and/or technologies and/or high-tech services in the same field in which the academic researcher developed his/her skills.

There is still no consensus regarding how to measure the entrepreneurial university and create successful enablers of entrepreneurialism in a university. From the systematic literature review we defined that Clark (1998), Etzkowitz (2004), Hindle

(2010), and Mavi (2014) measured the Entrepreneurial University based on the level that it achieves developing the factors that foster start-up activities. In other words, they measure the factors that create the Entrepreneurial University. Other literature, for example Guerrero and Urbano (2010) and Gibb (2012) offer a set of indicators for understanding the entrepreneurial university. Former literature aligns these results with a mission of the university: teaching, research and entrepreneurship altogether. In fact, they identify different indicators for measuring the teaching outcome, research outcome and the entrepreneurship outcomes. Amongst the entrepreneurialism one can find creation of entrepreneurial infrastructure, entrepreneurial culture, and spin-offs, cooperation and formal networks between entrepreneurs and scientists. The literature review demonstrated that creating entrepreneurial culture and infrastructure is most important and is related to the economic development (Etzkowitz & Leydesdorff, 2000; Jacob, Lundqvist, & Hellsmark, 2003; Meyer, 2011), which in turn is based on academic entrepreneurship activities (Etzkowitz & Leydesdorff, 2000; Philpott, Dooley, O'reilly, & Lupton, 2011). Therefore, as entrepreneurship education is the mechanism for promoting ideas and chasing opportunities it may lead to the most appropriate Entrepreneurial University outcomes. Accordingly, a literature on academic entrepreneurship and knowledge commercialization (Caiazza, Audretsch, Volpe, & Debra Singer, 2014; Philpott et al., 2011; Siegel, Wright, & Lockett, 2007) aligned entrepreneurial education with spin-offs as outcomes, but also the importance of development infrastructure (e.g. centres for entrepreneurship, TTO, etc.) as an input. Another gap in a literature is that most of scholars have analyzed entrepreneurial universities and entrepreneurship support infrastructure based on role models from the USA and other European countries (Audretsch & Caiazza, 2016; Caiazza & Volpe, 2016; Markuerkiaga, Caiazza, Igartua, & Errasti, 2016) with few studies providing comparative analysis across countries (Etzkowitz & Leydesdorff, 2000). In addition, the notion of entrepreneurial universities could be geographically biased and is associated with Western economies (Shane, 2004), while neglecting the fact of important best practices, models and enablers while still little attention has been paid to the European countries (Audretsch & Caiazza, 2016; Markuerkiaga et al., 2016).

The importance of analysis of a spin-off and entrepreneurial university together comes from a literature review which evidenced that commercialization of university-based knowledge does not happen automatically (Audretsch & Caiazza, 2016; Caiazza, 2016; Caiazza & Volpe, 2016; Markuerkiaga et al., 2016). For example, several US states with large and prize-awarded universities demonstrate low entrepreneurship activity (Chinni & Gimpel, 2011), despite the high levels of human capital, creativity and knowledge discovery. The University's immediate business environment may not be able to help should the entrepreneurship educational be weak and prospective stakeholders be not interested or not enough motivated to engage with the university. This includes researchers, entrepreneurs and policy-makers who are often excluded from university-industry-government partnership (Giunta, Pericoli, & Pierucci, 2016).

There is growing awareness of the importance of research commercialization and entrepreneurial education as a major missing pillar for entrepreneurial university

(Audretsch, Hülsbeck, & Lehmann, 2012; Fini, Grimaldi, Santoni, & Sobrero, 2011). We found that in both developed and developing countries, universities have embarked on prioritising entrepreneurialism and students' employability with a focus on greater visibility and development of entrepreneurial skills. The system of Higher Education funding in the UK, for example, has undergone major reforms and changes in the last few years (BIS, 2014) aiming to increase employability along with facilitating knowledge transfer between university and industry under government support. In the UK, graduate employability is becoming a key factor influencing subject and university choice. As foreshadowed in the recently published green paper 'Fulfilling our Potential', the UK Government intends to further reinforce employability as a key metric' (BIS, 2015).

In addition to development of employability and entrepreneurial skills in students and faculty needs resources allocated for research funding which has also seen significant changes in the UK, most notably through the increased importance of 'impact' funding and technology co-creation between university and industry through research councils, such as Higher Education Funding Council for England, Economic and Social Research Consortium, Local Enterprise Partnerships (LEPs), Knowledge Transfer Partnership schemes and the European Union 2020 Horizon programme. Success in research translation to industry, and specifically in the commercialisation of university research, is of ever greater importance (BIS, 2015). This policy is supported by scientific evidence which demonstrates that the world's best institutions at creating impactful innovation are also the leading institutions where academics attract private funding and create spin-offs (Audretsch & Caiazza, 2016; Caiazza et al., 2014; Ewalt, 2015; Times Higher Education, 2016).

Investments in research translation initiatives and in the regional economic development in the UK regions welcome initial steps in creating the Entrepreneurial Universities and Universities' entrepreneurial ecosystem, but these investments need to be incorporated into a broader vision for entrepreneurship at the micro-level within centers for entrepreneurship, TTOs and university management.

3 Technology Transfer Offices and Entrepreneurship Centres

In entrepreneurship literature the role of the TTO and entrepreneurship centres in formation of spin-offs is sparse. It remains unclear which TTOs' structures and engagement strategies with business are most conducive to knowledge commercialization and spin-offs. It is not surprising as distilling factors may take long, given various TTOs' structures and strategies are highly correlated with each other when attempting to build a strong university-industry-government partnership (Markman et al., 2005). Our literature review reveals a complex set of relationships between TTO structure and strategies and the role that centres for entrepreneurship also known as centers for entrepreneurial excellence have played in knowledge

commercialisation, public and industry policy (Audretsch & Belitski, 2013; Audretsch & Caiazza, 2016; Markman et al., 2005).

In highly competitive environment centres for entrepreneurship foster the formation of entrepreneurial mind-set within the university ecosystem. It becomes clear that success of entrepreneurial university settings is often determined by how well technology is transferred from the labs to their startup firms. University technology transfer offices function as “technology intermediaries” in fulfilling this role expanding teaching, research and extra-curricular activities quickly and successfully. In addition to TTOs, centers for Entrepreneurship enhance university-industry-government collaboration by promoting entrepreneurial ideas and outreaching local business communities in a region. Faculty and students in the university acquire strong practical applications and co-curricular activities with support of TTOs and Centres for Entrepreneurship. Former have remained a central component of the university based entrepreneurship ecosystems, focused both on the co-curriculum activities with business community development across and beyond university campus. Business outreach is achieved through promotion of knowledge exchange activities where entrepreneurs, scientists and students participate, such as entrepreneurship days, events, engagement with TTOs, workshops for business (Lockett, Wright, & Franklin, 2003), finally, providing access to new funding opportunities to students and scientists (e.g. equity and reward-based crowdfunding, angel investments).

TTOs structures and strategies require to bridge the gap between university research and industrial testing of new technologies and business model as emphasized in Caiazza and Audretsch (2013), however a lack of funding and product developmental support remains a main challenge while spin-offs and knowledge commercialisation. We therefore draw scholars and policy-makers attention to the importance of creation of an ecosystem of entrepreneurship in education where venture initiation is supported by industry and private investors. Products and technologies which are developed outside the university are at risk to remain small and never spin-off. In their study Caiazza and Audretsch (2013) and Caiazza (2016) highlighted an importance of idiosyncratic approach to understanding and classifying spin-offs across internal, relational and external dimensions and drawing on various theoretical perspectives to explicitly distinguish important support required by the ecosystem for spin-off growth.

Entrepreneurial university aims to develop collaborative links between three major stakeholders: government, university and entrepreneurs where universities’ TTOs and centers of entrepreneurship work together and outreach local business community and policy-makers. For example, many spin-offs benefit from their collaboration with university and government, including indirect (e.g. students’ placement, internships, workshops, etc.) and direct support (e.g. funding from government consortiums, Research Councils, LEPs, European Commission and consultancy).

4 Entrepreneurship Education and Entrepreneurial University

Entrepreneurship education is at the heart of entrepreneurial university. It is seen to be a strategic blend of consulting, education, coaching and research with complementary knowledge created within an entrepreneurship ecosystem which could be further monetised. The performance enhancement in entrepreneurship education is directly related to better understanding market opportunities and hence spillovers knowledge for entrepreneurship (Audretsch & Belitski, 2013; Audretsch et al., 2012). Much of performance enhancement could be learnt from the most famous business schools, such as Harvard University, London Business School, INSEAD, Stanford, University of Pennsylvania, MIT, Cambridge, Oxford, London School of Economics and Political Science, Bocconi in Milan¹ to name a few by building on the significant foundation that has already been laid by those schools should be used.

Following the existing best practices it is important not just embrace entrepreneurship education on the surface, but to create a highly attractive campus experience to all stakeholders of entrepreneurial university, including local policy-makers, entrepreneurs and would-be entrepreneurs, students, scientists and business. Building on systematic literature review, we specify the following strategies discussed in order to increase the likelihood of academic spin-off and knowledge commercialization.

First, *expanding the footprint of entrepreneurial education across the university*. We suggest that it be made mandatory that every single undergraduate programme at the university have an entrepreneurship stream made available. This could be through increasing access to the existing university-wide general modules in entrepreneurship or by creating more subject-specific modules to be included as core within established programmes (e.g. Entrepreneurial Management for Food scientists, Entrepreneurial Management for Creative Artists, Enterprise education for Biosciences). This can be done through the introduction of theory-practice mixed learning in the respective departments. As in Gibb (2002: 258): “perhaps the foremost [purpose of raising awareness about entrepreneurship] is to move the focus of entrepreneurship teaching and research away from the narrow business orientation towards the notion of the development of the enterprising person in a wide range of contexts and the design of organizations of all kinds to facilitate appropriate levels of ‘effective’ entrepreneurial behaviour”.

Second, is *action learning and scientists’ engagement in entrepreneurial modules*. Action learning involves challenging assumptions and finding problems to solutions. Deeper learning occurs when conflict is encountered which requires specific environmental factors to be deeply considered and their impact upon theory questioned and analysed. This occurs not only in an educational learning context but also in an organisational learning context (Argyris & Schon, 1978).

¹Based on the QS World University Rankings by Subject 2016.

Actioned-based approach introduced by Babson College (Gibb, 2002; Neck & Greene, 2011) suggests that teaching should provide the experience of entrepreneurship and move from being overwhelmingly lecture-based to increasingly practice-based with a greater engagement of scientists, where students pursue projects jointly with scientists on campus or in incumbent forms or in spin-offs contributing to spin-off legacy, or in consultancy projects with start-up entrepreneurs. Evidence of the advantages of active learning is in “Entrepreneurship Theory and Action” approach, where students follow major four principles of learning: Action trumps everything, start with your means, build partnerships, do not be the best-be the only. Since 1982 this method has helped thousands of entrepreneurial educators and scientists to look different at the role of entrepreneurial education and engage in Action rather than theorization of knowledge (Neck & Greene, 2011; Neck, Greene, & Brush, 2014). ‘Entrepreneurs. . . learn by copying, by experiment. . . by problem solving and opportunity taking; and from mistakes’ with learning involves ‘reflection, theorizing, experiencing and action’ (Taylor & Thorpe, 2004: 204).

Third, *to practise theory-based capability development* is important. As Fiet (2001a) proposed that in order to assist students to become skilled in theory-based competencies, there is a need to develop new approaches to practise theory-based skills. Such approaches as Fiet (2001b) posits “should attempt to address the problem of anecdotal teaching, which is limited because the type of situation an entrepreneur is likely to encounter will probably not fit the type described in the classroom, nor will studying entrepreneurial profiles from case studies inspire potential entrepreneurs’ unless they fit the same profile”.

Pittaway and Cope (2007) suggest a suitable situation for developing entrepreneurial capabilities, for which they have empirical evidence, is in the planning and activation of new venture enterprise courses that build on the observation that ‘people learn from experience where they are involved in problem solving. Development of entrepreneurial capabilities and mind-set should improve the campus-based experience of students and businesses, but also engage would-be entrepreneurs with scientists and business to advance and promote further knowledge commercialisation.

Fourth, it is *providing infrastructure for engagement with entrepreneurial community and policy-makers*. Opening up the centers for entrepreneurship network and events to local entrepreneurship community and inviting policy-makers as keynote speakers will facilitate the knowledge exchange and transition of research initiatives from the university to incumbents and entrepreneurs. This is likely to further improve research commercialization outcomes and matches between scientists, business and government. These activities reflect the extent to which knowledge transfer and business engagement is supported by university (Fernald, Solomon, & El Tarabishy, 2005) and requires significant allocation of resources to get scientists engaged across the university departments.

Several authors have noted the importance of providing learning opportunities for entrepreneurs on campus. In so doing, entrepreneurs are able to use students and scientists to elicit feedback, whilst students and scientists can learn vicariously (Bandura, 1986) from close observation of the entrepreneur.

Fifth, it is *providing facilities for networking with students and alumni*. The traditional campus is a place that is busy during term time and deserted otherwise, a place students visit for 3 years and then return once a year for reunions in the Western system. This tradition is perishing in European and the UK universities, while still remain strong in the US top colleges. An entrepreneurial university to be able for knowledge and ideas to spin-off requires finding a space and building a network channel for ongoing engagement with businesses, scientists and alumni. In particular, along with building the number of incubators on campus and investment should be put in both development of formal infrastructure (facilities, amenities, trees, office equipment, water and electricity supply), but also informal infrastructure and network capacity building with alumni (Hayter, 2013). An impressive example is “Entrepreneurship Tuesdays” in the Engineering department at Cambridge University organized by the center for entrepreneurship Learning. At the same time a controversial study of Kolympiris and Klein (2017) on the number of incubators established in the US institution results in drop of commercialization through licensing is interesting. In particular they draw the attention on quality of innovation, but we do not find the result surprising as incubators are likely to target network capacity building and pre-start-up stage of business. Incubators became a popular tool to introduce scholars and graduates to entrepreneurial opportunities and other instruments of knowledge commercialization (e.g. pitching to investors, participating in government programs, etc.). These are important issues for both knowledge and ideas exchange as well as for financing entrepreneurship start-ups and academic spin-offs. Financing for entrepreneurship activity could be raised from various networks, including internal university entrepreneurship community for product commercialization resources, external entrepreneurship community, sponsorships from key university stakeholders such as angel investors and VCs and from donations from university alumni, government funding grants. Many universities have gone the route of alumni clubs and networking but few managed to use them for product validation experiments, external sources of fundraising, public outreach, knowledge exchange, job placements and other.

All five approaches taken together will contribute to formation of far-reaching entrepreneurship ecosystem in education. Creating an entrepreneurial university aims at easing a process of market entry, technology testing and engaging with external stakeholders (Times Higher Education, 2015). Creating an efficient entrepreneurship ecosystem in education is about changing its mode of delivery entrepreneurship education to a more practice-based approach, and enabling various forms of knowledge commercialisation e.g. start-ups, scale-ups and spin-offs, improvements in the amenities, educational infrastructure and networks with alumni and entrepreneurship society, expanding entrepreneurship education across most of departments, engaging local and national policy-makers who aim to facilitate knowledge transfer and regional economic development.

5 Conclusion

In recognizing that literature on academic entrepreneurship and entrepreneurship education remains undertheorized and fragmented (Audretsch & Caiazza, 2016; Caiazza, 2016; Markman et al., 2005), this study aimed at a review of the eclectic literature and proposes important success factors for alignment of entrepreneurial university and spin-off activity. Building on entrepreneurship theory we revised and redefined the understanding of entrepreneurial university in the extant literature, emphasizing the importance of knowledge commercialisation. TTOs, centres for entrepreneurship and entrepreneurship courses aiming at changing entrepreneurship skill-set, risk attitudes, university-business relationship and action-based entrepreneurship education approaches to more embed spin-off activity within entrepreneurial university framework (Azagra-Caro, Archontakis, Gutierrez-Gracia, & Fernández-de-Lucio, 2006; Caiazza et al., 2014; Markman et al., 2005).

First, we make a contribution to the entrepreneurial university definition and key success factors by offering eclectic literature analysis and examining the critical success factors of entrepreneurial university across countries. Our review reveals the variety of conceptualizations associated with entrepreneurial university and spin-offs as important criteria for commercialization of knowledge. Second, we determine and discuss the role of three important enablers of entrepreneurial university and spin-off activity: engagement of all stakeholders and creating an entrepreneurship culture in universities through entrepreneurship education and business outreach, creation of formal and informal infrastructure and networks; TTOs and centres for entrepreneurship to become conduits for knowledge spillover from university to market. These pillars do not depend on the location or size of university, business community or a region and go beyond identifying entrepreneurial opportunities to tacit knowledge exchange and commercialization by scientists and entrepreneurs (Fernald et al., 2005).

Third, our practical contribution is emphasizing the role of entrepreneurial university and the expansion entrepreneurship education strategies which could be extended for both developed and developing countries (Etzkowitz & Leydesdorff, 2000; Neck et al., 2014).

Future research should extend our understanding of the role of entrepreneurial education in academic spin-off (Fini et al., 2011; Mustar et al., 2006), employability and commercialization of knowledge. Building on the best entrepreneurship education practices future research may wish to explore the leading entrepreneurship university models in the developing countries aiming to synthesize the assumptions, enablers and mechanisms available to stakeholders within the university ecosystems to further develop and facilitate knowledge spillover of entrepreneurship in universities. When discussing strategies of entrepreneurship education more attention should be paid to stakeholders' connectivity and embeddedness within university-industry-government collaboration framework. We posit on the importance to include all stakeholders in the discussion on efficient criteria of entrepreneurial university.

More research on entrepreneurship education delivery methods with focus on development of entrepreneurial culture and skills, new approaches to entrepreneurship education (Caiazza & Volpe, 2016; Neck & Greene, 2011) and the importance of providing learning opportunities for entrepreneurs on campus for spin-offs.

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