Chapter 4

The role of universities as catalysts within entrepreneurial ecosystems

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Introduction

Universities are one of the world's oldest and most enduring institutions. Their antecedents can be traced back at least as far as the 12th Century when autonomous, self-governing institutes of higher learning began to emerge across Europe. The original "business model" of the early universities as they developed in the Western tradition was to provide a place for scholars from all parts of the Christian world to come together for learning in Latin. However, as the medieval world transitioned into the Reformation, and with the rise of nation states, universities were challenged and even began to decline as the "scientific revolution" of the Enlightenment in the 18th Century placed them at risk of disappearing altogether (Perkin, 2007).

Despite these challenges universities survived and spread globally, becoming among the key institutions that define a modern nation state. By the end of the 19th Century universities were the focal points for professional education and scientific research usually funded by government grants and student fees. During the 20th Century the demand for higher education increased, and the perceived role of universities as critical components of a National Innovation System (NIS) emerged within the public policy dialogue (Galli & Teubal, 1997; OECD, 1997).

Today, universities around the world are recognising the significant contributions that they can make regionally, nationally and internationally through their three core functions of education, research and economic development (OECD, 2009). As providers of tertiary education, the university sector contributes to the development of current and future leaders, employees and citizens. University academics also conduct original research in their specific disciplines. These new insights and research findings are typically disseminated via publications, conferences, symposia, seminars, courses, and other media. More recently, the role of universities in economic development and wealth creation has been recognised by governments, scholars and policy makers (OECD, 2009; Dennis, 2011a, 2011b; Wells, 2012; O'Neal & Schoen, 2013).

The entrepreneurial ecosystem framework provides a helpful structure for analysis of the many factors that contribute to economic growth and development (Isenberg, 2010; ANDE, 2013; WEF,

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2013). The six core domains, as introduced in chapter 1 include: government policy, the regulatory framework and infrastructure; funding and finance; culture; mentors, advisors and support systems; educational institutions, human capital and workforce as well as local and global markets (Mazzarol, 2014a; 2014b).

As educational institutions, universities are included explicitly in this framework for their potential as catalysts[4] within the entrepreneurial ecosystem. Universities can contribute as potential catalysts for change in a number of different ways. Through their academic programmes, universities provide graduates with knowledge and skills to contribute to growth of new and existing companies. In addition, universities can foster and support the creation of new ideas, innovation and commercialisation. They also have an important role to provide research into entrepreneurship and growth of small to medium enterprises (SMEs).

The purpose of this chapter is to examine the role of universities within the human capital domain of the entrepreneurial ecosystem framework (Isenberg, 2010). We specifically examine how universities can act as catalysts through their three core functions of education, research and economic development.

The key themes that we address include:

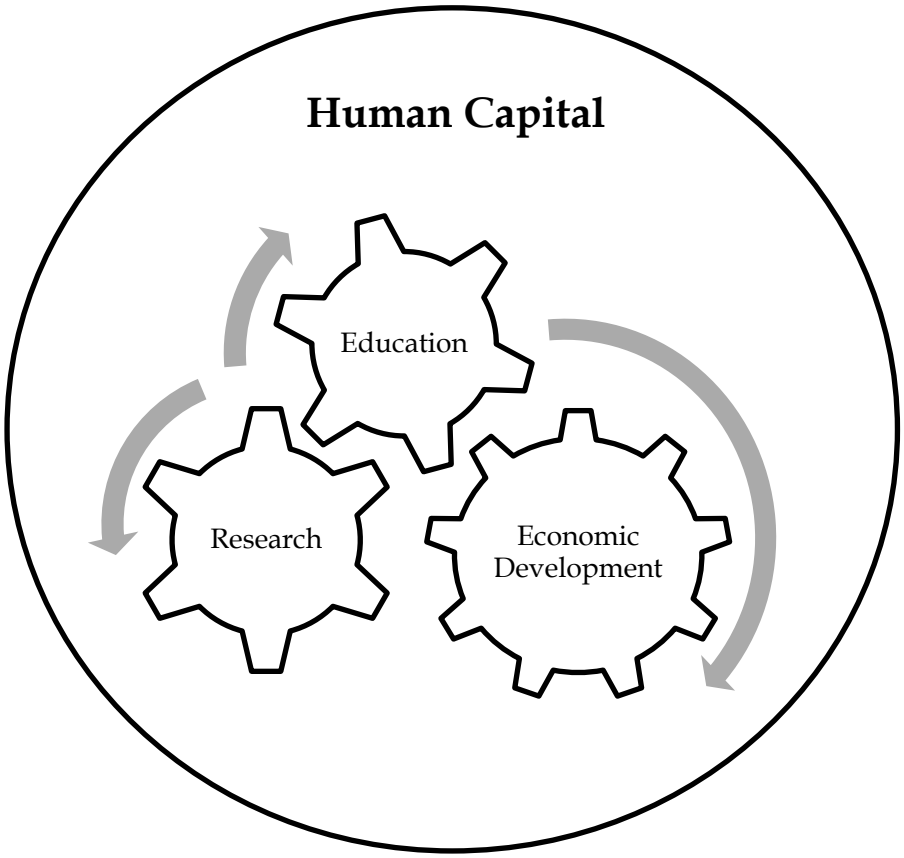
- The changing nature of entrepreneurship education.
- The empirical evidence of the effectiveness of entrepreneurship education at the micro as well as macro-level.
- The opportunities and challenges universities face in generating innovation through commercialisation.
- The implications that can be drawn for further research, policy and practice.

Figure 4.1 illustrates the conceptual framework that will guide the structure and discussions in this chapter. First, we consider the role of universities as educators of entrepreneurs by describing the current status quo in relation to program design and delivery as well as discussing the changing nature of entrepreneurship programmes. Second, we explore the role of universities as creators of knowledge about entrepreneurship. In particular we discuss the empirical evidence on the effectiveness of entrepreneurship education at the micro and macro level. Thirdly, we examine the commercialisation of innovations by universities across the world and identify ways to increase industry engagement. Next, an exemplar case study of the University of Waterloo is outlined to illustrate how the university acts as a catalyst within the regional entrepreneurial ecosystem. Lastly, we conclude the chapter and outline a series of implications for further research, policy, and practice.

Given the considerable scope of the topic, this chapter is not meant to provide a comprehensive review of the literature. Nor does it present original research. Instead, the chapter tries to unpack some of the complexities that are inherent in an ecosystem perspective by highlighting key issues and using illustrative examples to critically assess the role of universities as catalysts within entrepreneurial ecosystems.

[4] A catalyst is a factor (substance, person or thing) that speeds us a reaction of causes a change to occur i.e. is an agent for change.

Figure 4.1: Conceptual framework of the role of universities within the human capital domain of the entrepreneurship ecosystem.



Universities as educators of entrepreneurs

Universities have opportunities to make direct and significant impacts within entrepreneurial ecosystems by providing high quality academic programmes which equip graduates with the knowledge and skills to lead and manage entrepreneurial firms. University level education aims to be transformational for individuals and their future careers. From a national policy perspective, university graduates are recognised as key members of the workforce for a knowledge economy and human capital is a key driver of economic growth (Lundvall, 2007).

The field of entrepreneurship as a topic for teaching at university is however relatively new. The first university-level course in entrepreneurship was reportedly run at Kobe University, Japan in 1938 (McMullan & Long, 1987). Harvard University pioneered the first university course in entrepreneurship in the United States in 1947. However, progress was slow and by 1977 there were still less than 100 university business schools offering courses in small business or entrepreneurship (Katz, 2003). The field was pioneered in Australia during the 1970s by the late Professor Geoffrey Meredith at the University of New England (Gillin, 1991).

By 1979 there were still only 127 university level courses in entrepreneurship across the United States (Katz, 2008). However, things changed after 1979 following the publication of the research report undertaken by Birch (1987) into job creation in the USA. This suggested that most new jobs were coming from start-ups and small firms rather than large companies. This stimulated an

interest by governments in entrepreneurship and small business development. In response the universities began to teach and research the topic. In the USA by the mid-1980s there were 586 university-level courses being offered in the fields of entrepreneurship and small business management (Katz, 2008). Similar patterns took place in Australia (Gillin, 1991) and the United Kingdom (UK) (Blackburn & Smallbone, 2008).

By the early years of the 21st Century the field of entrepreneurship had become established as a distinct academic domain (Shane & Venkataraman, 2000; Shane, 2012). For example, in the United States over 2,200 courses in entrepreneurship were being offered across 1,600 business schools (Landström, Harichi & Åström, 2012).

The design and delivery of entrepreneurship programmes at universities has traditionally been centred within the business schools, and business schools are also the place where the development of pedagogies relating to entrepreneurship education is typically located (Solomon et al., 1999). However, this has been questioned by some academics who argue that there are limitations in the "Business School Model" when approaching the education of entrepreneurs. For example, Vesper, McMullan and Ray (1989) were among the first to challenge the relevance of entrepreneurship education within standard MBA programmes. They contrasted the opportunistic, creative, highly dynamic and flexible thinking required by managers seeking to launch new, innovative business ventures, with the more standardised, routine focused and control oriented nature of most management skills required for managers of large firms. According to Vesper et al., (1989):

> "The essence of entrepreneurship is doing something that has not been done before or doing something conventional in an original and unique fashion. Can a standardised educational path nurture the creativity and innovation that is required of entrepreneurship? Does a standardised path not run the risk of destroying the eclecticism which may be so vital to entrepreneurship?" (pp. 63-64)

Despite having been written almost three decades ago this concern by Vesper et al. (1989) that conventional business school education paradigms may not be the best environment for the fostering of entrepreneurs has continued to remain a subject of debate to the present day. For example, Binks and Starkey (2006) trace the history of the modern Business School and its "struggle to establish academic legitimacy, particularly the research-led university" (p. 8). They note that this has had "unintended consequences", specifically the movement away from application to theory. Within the realm of entrepreneurship and small business education the key focus is – or should be – on application and outcomes rather than the scholastic investigation into the theory of what motivates and drives entrepreneurs. As noted by Binks and Starkey (2006, p. 15):

> "By its very nature entrepreneurial activity occurs in response to changing and uncertain conditions. The pervasive dynamism of the entrepreneurial environment raises considerably the need for contemporary 'live' approaches to learning rather that an over reliance upon historical observation. While many past experiences of the entrepreneurial process and the various contextual characteristics that may emerge can be learned with reference to and through discussion of historical and existing knowledge and understanding, there is also a strong need to give learners access to the tacit as well as explicit elements of entrepreneurial behaviour. This has implications both for the approach to process learning and contextually based operations learning."

Is there a 'good practice' approach in educating entrepreneurs?

As the preceding discussion shows, the development of entrepreneurship education at universities remains an ongoing discussion within academic circles. While some technical skills can be readily taught (e.g. business model design, financial management etc.) there are many "soft skills" that are more difficult to address in conventional classroom environments (e.g. networking, emotional resilience, creativity and innovative thinking). A central issue is whether the purpose of entrepreneurship education is to foster new venture creation by students, or simply to enhance

their awareness of the importance of entrepreneurial behaviour and to foster enterprising thought and action (Jones, 2010).

Academics also disagree as to the best to approach to take in relation to the design and delivery of entrepreneurship courses. For example, should it be a traditional conceptual, process-based pedagogy, or an applied, experiential approach (Crispin, et al., 2013). There is also an ongoing debate over whether entrepreneurship can even be taught in the first place (Henry, Hill & Leitch, 2005a; 2005b). Entrepreneurship is being promoted to university students as a legitimate career option, with degree programmes designed to encourage the launch of new business ventures, and then connecting students to support and mentoring networks in the local business community (Green & Amat, 2012). As discussed in the previous section, this may or may not be a good strategy.

To provide more active learning experiences, universities are beginning to move away from traditional lecturing modes of teaching and learning towards a broad array of learning exercises that occur both within class and outside of class. Curriculum design advocates active learning experiences to ensure students are engaged, motivated and inspired by their academic coursework (Rasmussen and Sørheim, 2006).

The use of digital technologies such as online learning management systems (LMS), are also offering academics the opportunity to engage students via the 'flipped classroom' approach (Bergmann & Sams, 2012; Dodd, 2015). As the name suggests, this involves students reviewing the course content at home (online using videos, readings, cases and exercises) and then using the classroom for more interactive exercises on the topic area. Although there are many different formats for online learning, this approach blends technology with interactive learning in groups.

In Australia, this approach is being implemented in teaching entrepreneurship and allows the local teaching staff to bring in videos from international sources (Bliemel, 2014). In addition, interviews with entrepreneurs and industry specialists are included 'live' within class and the recordings added to the course resources folders for future reference. To implement this approach requires a significant up-front investment by students to prepare the materials for each session.

An internship offers a student the opportunity to learn from a fixed period of time based within a specific company or organisation. This provides the student with valuable practical experience working in their disciplinary field. It also provides the opportunity to develop new networks, increase self-confidence, and improve employability. At the same time, the sponsoring company gains access to specialised expertise for a particular project, plus new ideas, knowledge and enthusiasm. It also develops relationships with the students and their institution, and receives a final report and presentation of findings, and contributes to the development of future managers.

The OECD (2010) suggests that "good practice" in how universities might facilitate entrepreneurship is to integrate it into the curricula and make use of entrepreneurial pedagogies across faculties. There should also be an encouragement of entrepreneurship education for all students and a broad range of courses with different teaching approaches tailored to the needs of undergraduate, graduate and post-graduate students. Programmes should encompass all stages of the business lifecycle (e.g. pre-start-up, start-up and growth). There should also be active "outreach" programmes designed to draw into the institution business leaders and alumni who have successfully developed their own entrepreneurial ventures. Further, applied research into entrepreneurship should be integrated back into these education programmes.

This "spin-in" activity sees successful entrepreneurs from amongst the university's alumni returning to the institution to deliver lectures, or bring their business skills and even business projects, into the classroom for students to work on. Alternatively the university can encourage "spin-out" activity through the support of start-up activities by students and staff. This requires the entrepreneurship education programmes to be closely integrated with the start-up programmes, and to have university staff involved in facilitation of such activities providing teaching, mentoring and assistance with networking (OECD, 2010b).

It is important that universities have a strategy for such activity. They should also take into account in any recruitment, reward and promotion decisions relating to academic staff the need to foster entrepreneurial activities (both low and high-tech in nature). This requires resources and a high degree of collaboration between faculties with the support of senior management (OECD, 2009).

Oslo Agenda for Entrepreneurship Education

In the Oslo Agenda for entrepreneurship education in Europe some specific activities for higher education institutes are identified. These include:

- Integrate entrepreneurship across different subjects of their study programme.
- Bring entrepreneurs into the classroom and involve students directly in enterprise projects.
- Increase the production of European case studies for use in the classroom.
- Give entrepreneurship more academic esteem – to encourage more quality research and PhD programmes in entrepreneurship.
- Encourage students, graduates and researchers with commercially viable business ideas to develop them into companies; and
- Engage alumni in the activities of the university and in the classroom.

Source: European Commission (2006)

The European Commission provides support for a series of projects to help improve, promote and assess the impact of entrepreneurship education in Europe (EC, 2015). This initiative, which has been in place for over 10 years, includes resources for teachers and reports on entrepreneurship in higher education, as well as vocational training, primary and secondary education. Under the Oslo Agenda for Entrepreneurship Education universities and colleges are encouraged to adopt a range of 'best practice' principles.

Universities around the globe offer a broad array of academic programmes in entrepreneurship. The OECD (2010) advocates that entrepreneurship support programmes at university level be considered as part of an overall strategy that provides top-down support for activities to foster entrepreneurial mindsets and a positive outlook for new venture creation (high-tech or low-tech enterprises). Entrepreneurship should be integrated into the curriculum and available at all levels. Courses should focus on all aspects of enterprise growth from pre-start-up, start-up, growth and consolidation stages (Mazzarol, 2014c). To illustrate the strategies, structures and practices to support entrepreneurship, examples of good practice initiatives have been documented from 20 universities in Germany, England, Finland, France, Poland, South Africa and the Unites States (OECD, 2009). This identified four key goals that universities should aim to achieve if they wish to have a strong and effective presence in relation to entrepreneurship:

- There should be a broad understanding that entrepreneurship is a strategic objective of the university, and that there is top-down support for it.
- The university should include as objectives of its entrepreneurship education and start-up support programmes the generation of entrepreneurial attitudes, behaviour and skills, as well as enhancing growth-focused entrepreneurship across both low and high-tech sectors.
- There should be clear incentives and rewards for entrepreneurship educators, professors and researchers, who actively support graduate entrepreneurship including mentoring, sharing of research results and other activities.

- Recruitment and career development of academic staff should take into account entrepreneurial attitudes, behaviour and experience, as well as entrepreneurship support activities.

Entrepreneurship education in Australia

The global trends and issues discussed in the previous sections have been largely replicated in Australia. Recent studies on the status of entrepreneurship education programmes in Australia highlight the range, scope and nature of such courses.

Table 4.1: Teaching and learning methods in entrepreneurship courses

Teaching Method	Percentage of Universities
Lectures	89
Cases	82
Business plans	80
Textbooks	77
Guest speakers	75
Readings	73
Research projects	59
Videos	52
Interviews	45
Actual business start-ups	43
Live cases	39
Business simulations	39
Field trips	34
Business games	27
Small business consulting	23
SME internships	21
Role playing	Reported*
Presentations and pitches	Reported*
Reflection – self discovery	Reported*

Source: Crispin et al. (2013). Notes: * these methods were reported in the open ended questions but not included in the survey for all respondents to consider

Entrepreneurship units were available in 95% of the Australian universities at undergraduate level, and at postgraduate level in 90% of institutions (Mazzarol, 2014c). This rise is reflected in the increasing interest by students in studying entrepreneurship (89%), as well as an increase in entrepreneurship majors (66%). While the entrepreneurship courses are offered by the business schools, they are also increasingly available to non-business students e.g. from engineering, science, arts, agriculture, law, and medicine. In terms of teaching and learning, the traditional process-based approach appeared to be the dominant pedagogy. However, the experiential approach which coaches students to 'try entrepreneurship' was also advocated. A blended approach that combines these two modes of teaching and learning was also evident. The teaching

and learning methods that were being used in these entrepreneurship courses are summarised in Table 4.1 (Crispin et al., 2013).

Table 4.2 Entrepreneurship education offerings in Australian universities

Entrepreneurship Offerings	Tallies
Full programs including postgraduate degrees	13
Bachelor degree with entrepreneurship specialisation	12
Master's degree combined with an entrepreneurship program	1
Minors, majors or specialisations on entrepreneurship	24
Subjects about entrepreneurship (e.g. entrepreneurship theory/practice)	307
Subjects related to entrepreneurship (e.g. design thinking, creativity)	277

Source: Maritz et al. (2015)

Maritz, Jones and Shwetzer (2015) also studied entrepreneurship curricula and programs of all the Australian universities from their website information. As shown in Table 4.2, they reported the numbers of specialist degrees and subjects identified from institutions across the country. The 13 programs with at least 50% entrepreneurship content were offered at nine Universities (as some institutions had more than one entrepreneurship program). Most of the bachelor degrees were Bachelor of Business (Entrepreneurship) or Bachelor of Commerce (Entrepreneurship); other specific bachelor degrees were either named as a Bachelor of Innovation and Entrepreneurship (at University of Adelaide) or as a Bachelor of Entrepreneurship and Innovation (at the University of Canberra and Swinburne University of Technology). This analysis found a breadth of offerings but noted a fragmented approach to entrepreneurship education with a lack of national academic standards and graduate student outcomes for entrepreneurship.

These studies indicate that the majority of Australian universities have established academic programs and courses in entrepreneurship at both undergraduate and postgraduate levels.

One of the issues for further consideration by both universities and academics is how to avoid compartmentalisation of entrepreneurship within Business School programmes. With most academic degree courses having pre-requisites, entrepreneurship tends to be treated the same as other fields which establish course content within a staircase or hierarchical cognitive structure. This approach typically leads to exclusion of non-business students from the regular course offerings. However, such compartmentalisation of entrepreneurship is a problem if students from other faculties are excluded from these courses.

Although Crispin et al. (2013) reported evidence that non-business students were taking entrepreneurship courses this is an important topic for review by many business schools. With governments in the UK, Australia and New Zealand (as well as many other countries) prioritising STEM disciplines, there is a specific target market here to be addressed either with customised courses or with revised curricula. One alternative approach may be to create a university-wide "College of Entrepreneurship" that serves as the research hub and academic home for entrepreneurship programs.

Although universities can develop specific entrepreneurship programs and courses, it is also appropriate to identify the entrepreneurial knowledge and skills in university graduates on a more general basis. This can be achieved by including entrepreneurial learning attributes in the basic business degrees and diplomas and ensuring they are routinely evaluated.

Universities as creators of knowledge about entrepreneurship

Entrepreneurship as a discipline or field of research has evolved over the past 25 years with an increasing emphasis on developing theory to explain entrepreneurial activities, rather than just reporting and describing them e.g. in case studies. In academic circles the pursuit of entrepreneurship as a field of research has grown with national and international academies, specialist journals and professorial chair appointments.

In Australia for example, dedicated centres for entrepreneurship research and outreach programs were found in 21% of the Universities; these are shown in Table 4.3. A further five universities had centres undertaking some research or engagement linked to small business and four operate research groups or clusters in entrepreneurship and small business. Notably, four universities had closed their centres in entrepreneurship or small business which reflects a change in institutional priorities and staffing.

Table 4.3 Entrepreneurship and small business centres: research and outreach

University	**Centre**
Bond University	Australian Centre for Family Business
Curtin University	Centre for Entrepreneurship
Flinders University	New Venture Institute
Queensland University of Technology	Australian Centre for Entrepreneurship
University of Adelaide	Entrepreneurship, Commercialisation and Innovation Centre
University of the Sunshine Coast	Innovation Centre
University of New South Wales	Centre for Innovation and Entrepreneurship
University of Wollongong	Centre for Small Business and Regional Research

Source: Mazzarol (2014c)

As it is impossible to review the entire body of entrepreneurship research conducted at universities, we specifically focus on research on the impact of entrepreneurship education programmes at the micro as well macro level.

At the micro level, research suggests that there are still many concerns over the way in which universities have been engaging with entrepreneurship education (Matlay, 2005; 2008; Landström and Halarsson, 2006; Neck and Greene, 2010; Duval-Couetil, 2013; Rideout and Gray, 2013; Vanevenhoven, 2013). For example, Matlay (2005), in a review of the extant literature, found significant "inherent definitional, conceptual and contextual issues" relating to the effectiveness of entrepreneurship education within business schools in the UK. He concluded that:

> "In the UK, there is a paucity of conclusive and empirically rigorous research to link entrepreneurship education and the relevant curriculum to a significant and sustainable increase in nascent graduate entrepreneurs. The international literature on this topic suffers from various shortcomings and it is doubtful that the US, Canadian, Australian and New Zealand experience would prove more useful that the European literature on the topic." (p. 637)

Pittaway and Cope (2007) conducted a detailed analysis of the delivery of entrepreneurship education by universities within the United Kingdom (UK). They found that while some evidence existed that such education had a positive impact on enhancing the propensity for students to consider entrepreneurship, there was a lack of evidence as to whether this actually translated into entrepreneurial behaviour or new venture creation. Further, this same study found that while research had been undertaken into the different forms of pedagogy for the teaching of entrepreneurship, much of these discussions had taken place in isolation from how such education

might be translated into graduate employment and career development. Finally, there was a lack of understanding of how such entrepreneurship education contributed to the wider policy frameworks at the national, regional and local levels.

In subsequent research involving a longitudinal study of 64 university graduates who had undertaken entrepreneurship education programmes Matlay (2008) found that after ten years 26.5% were sole traders in self-employment, 53% were owner-managers of their own micro-business, 6% had managed to grow their business from micro to small size, and the remaining 14.5% had become partners in new or established firms. He concluded that this may suggest the entrepreneurship education they received at university made a contribution to their career paths.

A more recent assessment of the academic literature relating to the benefits of entrepreneurship education was undertaken by Rideout and Gray (2013). This study conducted a review of entrepreneurship education research over the period 2007-2011 and asked the fundamental question of whether entrepreneurship education actually works? They drew the conclusion that there was still insufficient reliable evidence to answer their question. As they summarised in their paper:

> "Our thorough review and methodological critique of the empirical research literature attempted to assess how much scholarly support there is for the implicit belief that entrepreneurs are not just born but also can be manufactured via E-ed and thereby affect societally beneficial outcomes. Unfortunately, although some progress has been made, E-ed scholarship continues to be at a very early stage of development, and we have a long way to go before we can confidently answer questions like, 'Does E-ed work?', let alone 'If it works, how does it work?' In truth, E-ed appears to be one of those phenomena where action and intervention have raced far ahead of the theory, pedagogy and research needed to justify and explain it." (Rideout and Gray, 2013; p.346)

Vanevenhoven (2013) concluded his review of the issue by suggesting that universities should stop theorising about entrepreneurship and do more to work within the real world. In his view universities that teach entrepreneurship; "need to kick students out of the classroom", and the professors also need to leave their offices and join their students, to work in the actual environment of an entrepreneurial business. He likened the current approach taking place within business schools as the equivalent of having a medical faculty that did not actually treat patients.

This lack of hands on, real world engagement with entrepreneurs has occurred as the academic discipline of entrepreneurship has worked to build up its credibility within the scholarly academy. As noted above, the academic discipline or "domain" of entrepreneurship was not initially considered a suitable subject for university research (Gillin, 1991). However, the pursuit of academic theory has come at a cost of losing touch with the real world of hands on application, and this has drawn criticism. For example, Meyer (2011) argued that the field of entrepreneurship within universities had "stalled" due to its focus on econometric methodologies and the analysis of secondary databases. This, he argues, has placed a distance between the researcher and the entrepreneur that is detrimental to a complete understanding of how entrepreneurship works. Rosa (2013) raised similar concerns, suggesting that the field of entrepreneurship, as expressed by the leading academic journals, was losing touch with the real world of policy and practice, focusing instead on a search for "grand theories".

At the macro level, a major factor driving this enthusiasm for entrepreneurship and start-up programmes at universities is the desire by national, state and local governments to address the challenges of high graduate unemployment and flagging economic growth. As outlined in the preceding sections, the academic field of entrepreneurship has grown rapidly since the publication of the study undertaken by Birch (1987) in the late 1970s that highlighted the apparent nexus between start-up activity and employment growth.

However, many academics caution the wisdom of encouraging too much start-up activity. For example, Shane (2009) has argued that it is "bad public policy" for governments to invest too much time and money into fostering more start-up activity. He points to the inability of government

officials to "pick winners" and suggests that the jobs new business start-ups typically create are of low quality and that such firms generally do little to stimulate economic growth.

This has been echoed by other entrepreneurship research academics who suggest that an average self-employed person will earn around 35% less than they would had they remained employed. Further, even university graduates in the science, technology, engineering and mathematics (STEM) fields are typically going to earn around 15% less from a start-up entrepreneurial venture than if they remained in full-time employment over their working life (Acs, et al., 2016). As explained in the study:

> "Overall, the earnings data paint a picture of people behaving as if they were playing poker at the casino. Most lose money, but there is a small percentage of people that make a whole lot more money as entrepreneurs than they would as wage workers. A policy conclusion from these data is that subsidizing entrepreneurship would be like collecting taxes so we could give out free poker chips to encourage more people to play poker. This does not look like sound public policy." (Acs, et al., 2016, p. 12)

This concern over the cost-benefit of entrepreneurship activity relates to the difference between high-growth and "Gazelle" firms, and the majority of ordinary SMEs. The reality is that most start-up firms don't grow, or grow only modestly (Reedy and Litan, 2011). Nightingale and Coad (2014) reviewed the available evidence on the role of entrepreneurial start-up activity as a major driver of economic and job growth. Their conclusion was that there is little hard evidence to show that entrepreneurial start-ups are significant contributors to economic growth. The main issue is a paucity of reliable data and too much attention focusing on the handful of highly successful "Gazelles" that are young firms with less than 5 years of history, but average annual growth rates of more than 20% over a consecutive 3 years period (OECD, 2010a).

Despite these reservations there is evidence that job growth is significantly impacted by a small number of young, high-growth "Gazelle" firms. For example, an analysis of Australian business and employment creation over the period 2001-2013 found that a relatively small proportion of young "Gazelle" firms contributed about 40% of all new job creation, even though they employed only 15% of the total workforce (Hendrickson et al., 2015). Such firms were also found to exist across all industry sectors not just high-tech sectors, suggesting that an undue focus on STEM areas as a means of enhancing economic and employment growth may be misguided.

Further evidence of this can be found in a study of more than 158,000 firms across 10 countries and eight separate industry sectors. It tracked the establishment and growth of these firms over a five year period from start-up, finding that while a small number of firms enjoyed rapid growth the majority either did not grow or suffered declines. By the end of the five year period of study the net annual job creation across the entire sample was only 35% (Davila et al., 2015). A key conclusion drawn from this study was that policy makers should invest less into trying to grow the total number of start-ups and focus more on helping firms survive their early years and be able to manage the process of scaling-up. As the authors explain in the paper:

> "Policy makers who promote the early-stage sector as a key growth engine in the economy are in a better position to develop policies to increase the net contribution of this sector if they recognize the potential areas of lost contributions. An overemphasis on policy decisions during the start-up era of early-stage companies and an under emphasis on the higher priority continued scaling era can result in lost opportunities from this vitally important sector of economies. A better understanding of corporate destruction, especially for previously high growth start-ups, can assist in the making of better policy decisions as regards the scaling era of early-stage companies." (Davila et al., 2015; p. 30)

So the role of university-based entrepreneurship education as a stimulus for encouraging students into self-employment should be approached with caution. There is no doubt that entrepreneurship education is likely to be of value to students, whether they launch their own start-up companies or remain employed. However, the reality of launching, sustaining and in particular trying to grow a business is that it requires hard work and there is no "magic sauce" that can be applied to a new

business to guarantee its success. Learning to start-up a business is easy; learning to grow and scale a business is much harder and requires a wider range of skills in management, marketing, financial and operational areas as well as legal and strategy issues.

Universities as contributors to economic development

Another key way in which universities can serve as catalysts is to facilitate the generation of innovation through commercialisation of their research (Harman & Harman, 2004; Wells, 2012). A country's National Innovation System (NIS) operates within a contextual framework that embraces entrepreneurship and entrepreneurial innovation, thereby closely connecting it with the entrepreneurial ecosystem (Autio et al., 2014). Universities and specialised research centres have been identified as important actors in the NIS (Porter, 2001; Porter and van Opstal, 2001).

This role of the university as a "hub" or "catalyst" for innovation is a key part of the role they are viewed as playing within the NIS. For example, a review of the regional innovation clusters within the United States undertaken in the late 1990s found that:

> "Universities and specialized research centers are the driving force behind innovation in nearly every region: Although companies and individuals do create a large number of innovations, universities and research centers institutionalize entrepreneurship and ensure a steady flow of new ideas." (Porter, 2001 p. xiii)

A nation's universities are viewed as part of the "common innovation infrastructure" that provides the NIS with both human capital (e.g. scientists, engineers, managers), and the fundamental research that can be translated into applied outcomes such as new technologies (Porter and Stern, 2001). However, a key issue is the ability of universities to contribute significantly to the NIS is their ability to collaborate with industry, translate their research into useable outcomes for managers, and transfer technologies generated from their research into commercial outcomes (OECD, 1997).

Each country has evolved its own unique NIS with the antecedents being traceable back as far as the 17th Century (Freeman, 2002). However, the concept grew strongly in the 1980s and 1990s with the work of Freeman (1987), Lundvall (1992) and Nelson (1992; 1993). There are numerous models of what constitutes an NIS (Sharif, 2006), but most include the nation's investment in R&D, the number of researchers and STEM graduates produced each year, the transfer of technology from universities and other publicly funded institutions, the and then the commercialisation of research (Balzat & Hanusch, 2004).

A critical element of this process of connecting universities into the NIS is the role of the commercialisation or technology transfer offices (TTO) (Siegel, et al., 2004). The nature of this commercial activity can take several forms including contract research, licensing, spin-outs and joint ventures.

Rasmussen, Moen and Gulbrandsen (2006) examined the commercialisation activities of Chalmers University of Technology in Sweden, the Norwegian University of Science and Technology (NTNU), the University of Oulu in Finland, and Trinity College Dublin in Ireland. Each of these four universities is different in many respects. However, a number of common patterns emerged.

First, all universities have strong links to industry, with a number of research centres and science parks connected to all four institutions. Second, all four universities had seen a strong focus on and support for commercialisation over time. This commenced with an external orientation focused on science parks to bring industry closer to the universities during the 1980s in what was described as a "first wave" of commercialisation. It then moved into an internally driven "second wave" focused on spin-outs, patenting and licensing, and more involvement by students.

A third pattern observed across the four universities was that in response to national policy initiatives all had increased their internal commercialisation activities. This assisted them to take advantage of government funding mechanisms and legislative changes. A fourth pattern was that

at all four institutions the opportunity to secure additional income from applied research was viewed as important to keeping skilled people, particularly those with an orientation towards business. With academic salaries relatively modest in comparison to industry, the option for staff to spend "one day a week" undertaking consulting was informally accepted.

However, there were some concerns. For example, the total number of actors involved in the commercialisation ecosystems found in relation to these four universities was large, often with unclear roles and interference taking place between them. In addition, some of these elements were fully owned by the universities, others only partly, and some were owned by public or private organisations. The location of these actors was generally fairly close to the universities with some based on the campus and others physically nearby. The need for these different actors to generate their own income – through advising or taking equity positions in spin-outs – meant that the interrelationship between the various actors across the ecosystems was complex. As noted by Rasmussen et al. (2006):

> "For the individual entrepreneur, this might lead to uncertainty regarding motivation, the economic situation and advice imparity during his contact with 'the commercialization system' in or next to the university." (p. 529)

Another common characteristic of the four universities was that none of them had any complete, official statistics on the overall commercialisation activities taking place within or around them. While each of the many small and often overlapping groups within the system kept their own data records of their individual activity, this had not been captured or aggregated. Even though the national governments of each of the four universities were placing pressure on them to raise their overall commercialisation outputs, the ability to make objective and reliable assessments of the actual impact this activity was having remained difficult to achieve. This ability to make reliable assessments was complicated by the fact that the impact universities have on their local and national economies occur at many levels and cannot be easily quantified. In many cases the impacts are not seen until after a significant time lag (Rasmussen et al., 2006).

Universities and innovation – the case of Australia

The university sector plays a significant role in the NIS within both Australia due to the relative absence of large firms that engage in significant R&D or commercialisation programs. However, this is heavily dependent on the provision of government funding for research and the university sector's ability to actively pursue research that might lead to future commercialisation is challenged with government funding is reduced (Harman & Harman, 2004).

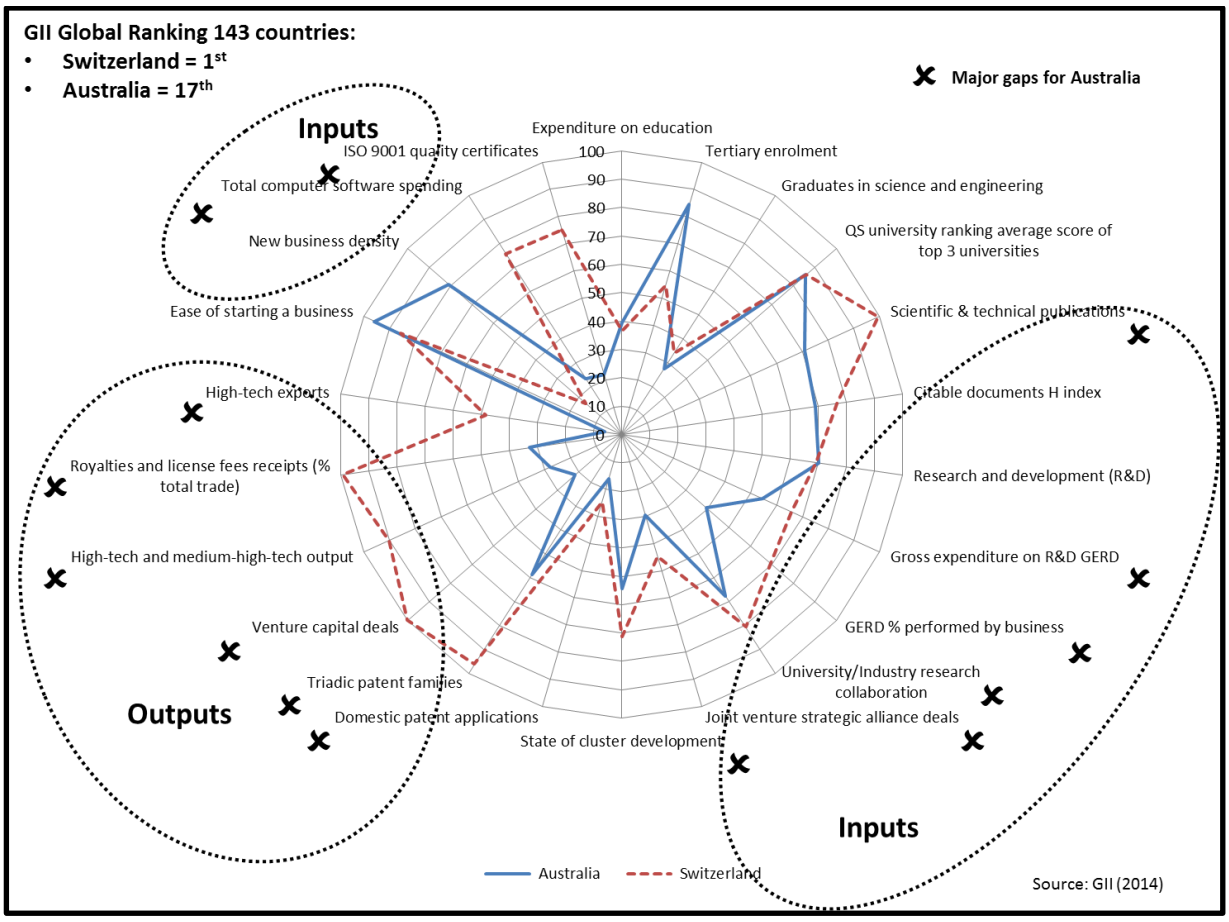
In seeking to understand the nature of universities within the NIS we can examine the case of Australia and how it compares to a country like Switzerland. Figure 4.1 illustrates the comparison of Australia and Switzerland on key criteria used by the Global Innovation Index (GII) to measure a country's international performance of their NIS (Dutta et al., 2015).

As shown in Figure 4.1 Australia was ranked 17th out of 143 countries in 2014 by the GII, with Switzerland ranked 1st at the global level. Australia is considered an "inefficient innovator" due to the gaps that appear between the factors that comprise key inputs and key outputs to the NIS (Dutta, et al., 2015). For example, there are weaknesses in the overall level of Government Expenditure on R&D (GERD) in Australia as well as the proportion of GERD that is performed by business. Other input areas where Australia lags Switzerland at a significant level are in the level of joint venture, strategic alliance deals and university-industry collaboration over research and the state of cluster development and generation of scientific and technical publications. Investment in quality assurance (e.g. ISO 9001 quality certification) and expenditure on computer software are also inputs where Australia lags.

These relative weaknesses in in key inputs translate into a series of major gaps in terms of key output measures. As shown in Figure 4.2 these include the number of high tech exports a royalty or licence fees from such exports, as well as both high and medium technology outputs. Australia

also lags Switzerland significantly in the area of venture capital investment deals, plus the generation of patents from local sources and the lodgement of patents across the "triadic patent families" databases of the USA, European Union and Japan. This means is that Australia's NIS, while still placing it into the bottom of the top group of innovation led nations, remains well below Switzerland, which is the world's leader in this area.

Figure 4.2: Australia versus Switzerland National Innovation Systems



Over the period 1981-2008 Australia's spending on R&D as a percentage of GDP rose steadily but has fallen significantly against the OECD average during the past decade. Australia spends around 2.13% of GDP on R&D, which is below the OECD average of 2.63%, and well below nations such as South Korea, which spends 4.15% of GDP on R&D. Australia also has about 8.6 people working in R&D related jobs per 1,000 people employed. To put this into context Singapore has around 10.17 people in R&D per 1,000 people employed, Denmark 14.9 people, and Finland 15.7 people.

In terms of innovation commercialisation, in 2013 Australia had some 304 patents registered across the "triadic patent family" databases. However, this compared to Switzerland with 1,206 patents, South Korea with 3,154 patents and Japan with 15,970 patents (OECD, 2015; Dutta, et al., 2015).

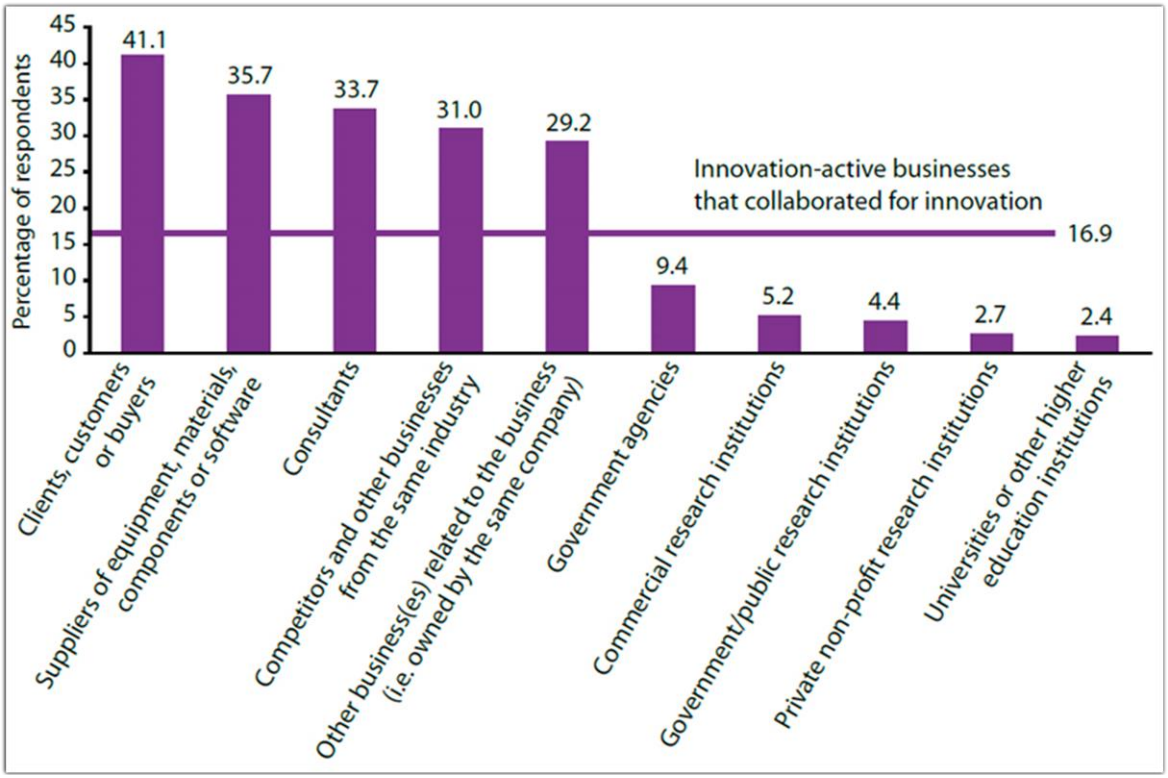
However, in relation to universities as "catalysts" for innovation, Australia ranks at the bottom of the OECD (BCA, 2015; Dutta, et al., 2015). This is illustrated in Figure 4.3. Where collaboration takes place the most appears to be in fields such as agriculture, forestry and fishing, construction, professional, scientific and technical services, health care and social welfare sectors (ABS, 2014).

According to the Business Council of Australia (BCA, 2015) the causes of this low level of engagement between universities and industry can be attributed to factors on both sides. First, the metrics those guide and shape academic performances are focused predominately on the publication of research in a narrow range of academic journals rather than focusing on more

applied outcomes. This is not necessarily the fault of the academic community but a reflection of their performance metrics and the way in which they are rewarded and recognised. As the BCA (2015 p. 4) observed:

> "A significant proportion of the allocation of funds to public research institutions, including through the Excellence in Research for Australia (ERA) initiative is determined based on publishing research in well regarded academic journals. Engagement and collaboration with industry, despite the benefits, is often either completely overlooked or represents only a minor component of the formula used to determine funding allocation to research institutions. For academics, career progress is also heavily determined based on published research. Together, these factors mean that researchers do not have a strong fundamental incentive to engage with industry."

Figure 4.3: Industry engagement with third parties over R&D



Source: ABS (2014)

However, the lack of engagement between universities and industry is also caused by factors on the industry side. For SMEs the problem is related to their having a lack of money and time to actively engage with universities. For many there is a need for a combination of management skills development combined with innovation and R&D. Here, the owner-manager or entrepreneur can come into the university not as a formal student but as a participant either in an outreach program or as an "industry project owner" who has university students working with them to help solve problems (Mazzarol, 2014c; Wells, 2012).

In the case of large firms there are also several reasons that explain the poor connectivity with universities. First, the high level of foreign ownership of many companies in Australia means that much of the R&D undertaken by these companies in not done locally but overseas. There is also an historical lack of federal government pressure on large firms, particularly foreign owned ones, to undertake R&D within Australia. The Australian market is also small and the local manufacturing sector has not sufficiently developed strategies for finding competitive niches in global markets (Wood, 1992).

Among the main issues that are often overlooked in relation to the enhancement of university to industry engagement is the level of investment that is made, or not made, by large companies in R&D. The majority (70%) of Australia's research community are employed by the public sector with 60% located in the universities and 9% in government research agencies (e.g. CSIRO). Only 31% of Australia's researchers are employed by industry and it may lead to many businesses not fully understanding how to engage with universities in R&D (BCA, 2015). As noted above, this also reflects the relatively low level of R&D investment by large firms in Australia.

A key challenge facing a country like Australia is how to maintain high levels of innovation whilst simultaneously losing much of its manufacturing industry. As a high labour cost country Australia has seen a steady decline in manufacturing jobs since the 1980s. However, there is strong evidence to suggest that manufacturing industries are major generators of patents and other formal intellectual property (IP) rights that provide high quality jobs, enhanced productivity, as well as high rates of GDP growth and value added (Crosby, 2000; Soames et al., 2011; DIISR, 2011).

Despite this, the level of collaboration and networking by Australian firms with each other is low. This is particularly the case for SMEs in Australia which ranked 24th out of 31 OECD countries for collaboration in the period 2008-2010, while large firms ranked a mere 29th place (OCE, 2014). In essence the business community in Australia is not strongly collaborative and most collaboration relating to R&D and innovation takes place with private sector consultants than universities (OCE, 2014).

Can universities be a source of innovation?

Lundvall (2007), who has pioneered much of the research into NIS, suggests that universities should not be viewed as "immediate sources of innovation". He argues that they are not really configured to play the role of being R&D centres for the commercialisation of new technologies. Rather than viewing the university as a generator of scientific and technological innovation, it may be better to view their role in the NIS as a centre of education and a focal point for basic research and knowledge exchange. He also cautions against seeing the NIS in a narrow way in which science and technology are all that matters. The development of the NIS, like any entrepreneurial ecosystem, needs to be viewed as a broad environment with attention given to low and mid-tech as well as the high-tech industries.

In his analysis of the evolution of NIS Lundvall notes that the new ideas and knowledge required for innovation don't come directly from universities or publicly funded research centres. The most common sources that stimulate innovation within industries are customers, marketing professionals and production engineers (Lundvall et al., 2002). The lack of a strong nexus between universities and industry highlighted in Australia, and viewed with deep concern by government and industry groups such as the Business Council of Australia (BCA, 2004; 2015), was not found to be an issue for Denmark, a country that consistently ranks in the top 10 best performing nations on the Global Innovation Index (GII) (Dutta et al., 2015).

A longitudinal study of Denmark's NIS identified several lessons. One of the key lessons is the importance of developing a learning economy in which knowledge is shared via interpersonal networks and reinforced by strong social capital. Firms that become learning organisations are more likely to be innovative, more productive and able to offer more sustainable employment. A key role for universities is to help students learn how to learn. Many firms in Denmark are SMEs and there is an absence of university academics engaged with them. Many are also operating in low to mid-tech industries, but still able to demonstrate high levels of innovation (Lundvall et al., 2002).

What these findings from Denmark may suggest is that the role of universities in the NIS is likely to be more indirect than direct in nature. One of the challenges facing university-industry engagement is the different strategic objectives of the two parties. This was highlighted in a paper by Berman (2008) into the experiences of academics at the University of Western Australia (UWA) seeking to engage with industry via Australian Research Council (ARC) Linkage grants.

The ARC Linkage grant is designed specifically to enhance collaboration between universities and industry. Its primary purpose is to undertake applied research that can be of direct benefit to the industry partners. However, as Berman (2008) highlights, the ability of the academics and their industry partners to work collaboratively together was negatively impacted by the different perspectives the two sides took in approaching the project. For example, she quotes one of the academic researchers engaged in the project as saying:

> "Industry isn't concerned with science – only with the practical solution to the specific industry problem. They need persuading that the scientific work is essential". (p.167)

In contrast to this the view from the industry partners was that the Linkage grant (to which they had to contribute cash funding and time), was a potentially useful way to undertake research that could result in commercially useful outcomes. Major issues that caused problems between the university and industry partner were the ownership of IP rights to research outcomes, and the ability of the academics to manage the research project in an efficient and timely manner.

The industry partners were critical of the university for taking too long to negotiate basic IP rights agreements, and for the researchers to complete the study. The academics did not seem to view the project as of the same order of priority as did the industry partner. This is reflected in the follow comment from an industry partner cited by Berman (2008):

> "Academics are notorious for taking a long time to do research, whether it's due to teaching commitments or because the work is linked to the requirements of a PhD... two months of work with a professional agency is closer to two years for academics... this is a big issue." (p.170)

Not all university-industry collaboration is that difficult and there are many examples of successful research partnerships at UWA and many other Australian universities. However, the issues raised by Berman (2008) underlie the importance of helping academics become more attuned to the needs of industry, and for industry to gain a stronger appreciation of how best to work with and engage the skills of academics.

Enhancing university-industry collaborations

Plewa et al. (2013) have proposed a framework for enhancing the collaboration between industry and universities. The framework has five distinct phases each with its own specific success factors, and several major drivers of success.

The initial phase "pre-linkage" requires the university and industry partners to develop a sufficient level of active engagement and understanding of each other's needs and requirements that a meaningful commercial agreement can be reached. It typically requires a lengthy period of development to get this level of understanding. Industry partners are often unaware of the way that an academic research team can be best employed. At the same time, the academics need to get a sound appreciation of the specific needs and requirements of the industry partner before any worthwhile collaboration can commence.

In the second phase "establishment" the two parties enter into a contract. Here issues associated with the ownership of IP rights, and how much of the work can be published in peer reviewed journals are likely to be important. Many academics lack the necessary experience to know how to cost a project, and many government funding arrangements (e.g. ARC Linkage grants), can complicate the time it takes to get a project scoped and approved.

Once the contract is signed the "engagement" phase commences. Here the problems found by Berman (2008) can arise. Academics have multiple responsibilities and most Professors are tied up with administrative tasks, teaching, supervision of doctoral students, and numerous other projects including the need to publish in peer reviewed journals. All of this takes time and unless the agreement and funding is able to include sufficient project management support, the time delays in getting research completed can be frustrating for the industry partners. It is also worth

recognising that universities are not set up as commercial R&D centres. They are best used for doing more fundamental or "basic" research work that requires more time.

Assuming the project goes smoothly the "advancement" phase is reached. Here the two parties may forge a long-term and ongoing relationship that can prove mutually beneficial. It can also lead to the industry partner helping to attract additional links with other industry partners. In the final "latent" phase the project having ended is able to lead to future cooperation around new projects. In fact, if the relationship between the academics and their industry counterparts is sufficiently strong, they will typically exchange ideas and effectively "co-create" innovative outcomes through addressing specific problems.

As Plewa et al., (2013) suggest the most important ingredients driving successful collaboration between university and industry partnerships is are an open and two-way communication that enhances understanding and mutual trust between the two partners. Personal relationships and a clear definition of the project's goals, timelines and outcomes are essential. Both sides must recognise the other's requirements, strengths and limitations. Any lack of communication, understanding and trust between the individuals engaged in the process will most likely end in failure.

Another framework for facilitating the commercialisation of university generated research is that proposed by Collier (2007). He points to the relative importance of university-based R&D to the Australian NIS, as well as the challenges that need to be overcome to help unlock the potential of the university sector in this regard. According to his analysis the key factors that need to be addressed are:

- *Taxation and fiscal reforms* – Australia needs to review the way that taxation and fiscal policies are applied so that there are more incentives to encourage universities to commercialise their research and transfer this into industry partnerships.
- *Early stage seed funding* – there is also need for early seed and pre-seed capital funding to help kick-start the innovation cycle. This is how promising ideas can be brought more quickly from concept, through proof-of-science stage and then to a prototype stage.
- *Simplification of IP rights agreements* – it is also important to streamline the way that the IP rights of university researchers, industry partners and potential venture financing parties are negotiated.
- *Changes to the missions of universities* – there is a further need for universities to give more recognition to and place more value on commercial and applied industry work when making academic appointments and promotions. Such work is risky, complex and time consuming, and frequently ignored by promotions and appointments committees that are often focused on academic publishing in well-regarded journals.
- *Recognition of the importance of applied universities* – there is an "apparent bias" in favour of the established, research intensive (as measured by peer reviewed papers) universities at the expense of newer and regional institutions. The latter can play a key role in their own local communities.
- *The need to measure the impact of university research on the national economy* – there is also a need to undertake research to measure the economic benefits of the university sector on the national economy in relation to the research it undertakes. Only by doing this can the full value of the university sector within the NIS be known.
- *Evaluate the success of university technology transfer offices* – the effectiveness of the TTOs in helping disseminate research from Australia's universities requires review. The existing system is fragmented and its effectiveness poorly measured.
- *Assess the value of technology parks and incubators* – many universities are co-located with or adjacent to science or technology parks. However, while these are viewed as potential hubs

of innovation and commercialisation, with incubators often established there to help facilitate new technologies, there is a lack of reliable data on their real value.

- *Use intermediaries to help fast track commercialisation* – finally, there is need to make better use of intermediaries, who are often consulting or advisory firms with expertise in IP management, commercialisation and venture financing, to help bridge the gap between the research being undertaken within the universities and the industry partners that may commercialise it.

University of Waterloo: A case study

In this section we use the University of Waterloo as a case study to illustrate how the university successfully brings together the three previously discussed functions of teaching, research and economic development to act as a catalyst within their regional entrepreneurial ecosystem.

Background

The University of Waterloo was founded in 1957 by a group of business leaders from the region. Their first 74 students enrolled without any guarantee of a university degree, but hopeful that some employers would be willing to participate in a work-study program in applied science – which would later become known as the co-operative education model. The introduction of this experiential and work-integrated learning approach was an entrepreneurial act in itself and formed the foundation based on which the University of Waterloo has since become the engine of Canada's entrepreneurial ecosystem (McLaughlin, 2015).

Today, the University of Waterloo has 30,600 undergraduate and 5,300 graduate students with 1,139 full-time staff in six faculties – Arts, Applied Health Sciences, Engineering, Environment, Mathematics and Science. Notably, the university has no faculty of business and this will be discussed later on. The university was ranked as Canada's most innovative university for the 23rd consecutive year and is also globally recognised for its excellence (University of Waterloo, 2015).

Waterloo region

Waterloo region has a population of about half a million people, but is considered to be one of the fastest growing regions in Canada. German-speaking Mennonites were amongst the early settlers and they still own much of the farmland surrounding the region. Their influence is still evident today through their presence at local farmer's market. The region traditionally relied on manufacturing, but globalisation has increasingly pushed manufacturing jobs overseas and the region was struggling economically. In 2000, the region had about 50 technology-based companies that employed 1,800 people and generated $100 million in total revenues.

Today, the Waterloo region has Canada's fastest growing technology sector with more than 1,000 companies that created 30,000 new jobs and generate $30 billion in total revenues. Moreover, the region has got about 1,100 active start-ups which translate into the second highest start-up density in the world after Silicon Valley.

As a result, the Waterloo region ranks amongst the top 25 start-up ecosystems in the world. It is, however, not all about start-ups. The region also has a proven track record for growing technology companies. Eight of Canada's largest technology companies started, grew and are headquartered in the Waterloo region (Armitage, 2015).

The university as a catalyst for the entrepreneurial ecosystem

The University of Waterloo is considered to be a key catalyst for growth in the high-technology sector. In 2013, the University of Waterloo set out to quantify the role they play in the region's entrepreneurial ecosystem by assessing the university's economic impact form its operation as well as its spin-offs and associated companies. Results indicated that the total annual economic impact of the University of Waterloo was $2.614 billion.

For every dollar of investment by the Ontario Government, the university returns nearly nine times in economic impacts to the region. More specifically, the university is the source for over 20,000 jobs each year and $1.4 billion in labour income. It also contributes about 6% of the region's total GDP.

The results of the economic impact study further showed, that 72% of companies in the region depend on the university's graduates and students as a source of employment with 30% of companies in the Waterloo region relying on them for more than half of their workforce.

Finally, 47% of local companies indicated that they had strong links to the University of Waterloo. Overall, the report concluded that the University of Waterloo (2013) plays a central and critical part in anchoring the regional entrepreneurial ecosystem.

What makes the University of Waterloo a catalyst for its entrepreneurial ecosystem?

Co-operative education

What was initially considered an approach doomed to fail is now the largest co-operative education program of its kind in the world. Today, the co-operative education consists of more than 120 programs with 19,000 students and 6,300 employers.

Co-operative education integrates academic studies with practical work experience allowing students to alternate academic terms with work terms. Some students can even pursue their own entrepreneurial venture as part of their work terms. As a result, students graduate with up to two years of relevant work experience as the total amount of co-operative experience has to be between 30 and 50 percent of the time spent in academic study (University of Waterloo, 2015).

This seems to directly address the increasing concerns of students and their parents, but also employers and governments in relation to employability. In 2016, the QS Graduate Employability has ranked the University of Waterloo #1 in Canada and #25 in the world. The key difference to more commonly found internship programs is that the University of Waterloo's co-operative education model requires employers to remunerate all students.

According to Armitage (2015) the key benefit of the remuneration is that majority of students graduate with no or almost no student debt. In combination with the work experience that allowed students to experience 'where the pain is' graduates are then more likely to pursue entrepreneurial opportunities.

Through the co-operative education model, students are constantly exposed to ideas and innovation of a range of employers. They are also encouraged to introduce new ideas from the university at their workplaces, thus facilitating collaboration and change in both directions. Overall, the co-operative education model has gained the university a reputation of producing top talent, particularly entrepreneurial talent.

Entrepreneurship programmes

The University of Waterloo provides the full spectrum of entrepreneurship support programmes that range from inspiring students to support them in the discovery and exploration of their ideas to more targeted programmes like incubation, acceleration and venture capital support.

Inspiration is offered through a variety of events such as guest lectures and speaker series, Start-up Weekends, Hackathons and entrepreneurship societies. To help students explore new ideas, the University of Waterloo has created dedicated workspaces for up to 120 student start-ups. More tailored support is provided through the university's accelerator and incubator programs as well as its commercialisation office that provide financial support, mentorship and expertise to grow entrepreneurial ventures.

Finally, the University of Waterloo is part of an international network that provides entrepreneurial students and staff with access to valuable resources from around the globe. More formally, the University of Waterloo offers a Minor in Entrepreneurship that is open to all students across all disciplines, a Graduate Diploma in Business and Entrepreneurship, Certificates, a Master in Business, Entrepreneurship and Technology as well as specialised entrepreneurship programs for e.g. engineering.

What differentiates the University of Waterloo's support program from other universities is that it is open to all students and staff and provides a 'stair-cased' approach that creates a pipeline and leads to a steady stream of entrepreneurial talent emerging across the university.

The most striking difference, however, is that the University of Waterloo has no faculty of business which typically is where entrepreneurship education and support is located within universities. Instead, the university has an entrepreneurship centre – the Conrad Business, Entrepreneurship and Technology Centre – that is a university-level centre that supports entrepreneurship across disciplinary boundaries.

Creator-ownership of intellectual property policy

The University of Waterloo has long pursed an intellectual property (IP) policy that states that the IP created in the course of teaching and research activities belongs to the creator. This creator-owns policy is unique in the Canadian tertiary education sector where the standard policy model is that the IP created by academic staff is owned by the university.

This creator-owns policy has got several effects that positively reinforce each other. It encourages researchers to pursue entrepreneurial opportunities by commercialising their discoveries and provides an incentive to

attract leading and entrepreneurial researchers which in combination strengthens the overall research capability and capacity of the university and the impact it generates for its communities.

Overall, the University of Waterloo has gained a reputation as a research-intensive university that – in international rankings - ranks highly in specialised fields such as for example computer science and engineering.

Industry and community connections

The University of Waterloo is embedded in a large and diverse network that goes beyond national borders and provides valuable resources for its entrepreneurial talent. According to Armitage (2015), the University of Waterloo is the 'nucleus' of the ecosystem i.e. the core of a network that connects multiple types of actors such as government, investors, businesses and the community are grouped. The economic impact the university has as described before illustrates how inextricably the university is linked with its local as well as global community.

Summary

The University of Waterloo provides an interesting case study of the impact universities can have on entrepreneurial ecosystems. The key strengths that differentiate the university are its experiential education model, its approach to entrepreneurship that spans disciplinary boundaries, its creator-owns intellectual property policy that encourages commercialisation of research and its strong industry and community connections. As a result, the University of Waterloo is increasingly recognised as one of the most innovative universities in the world.

Sources: Armitage (2015), Compass (2015) and McLaughlin (2015)

Conclusions and implications

As outlined in this chapter, the role of universities as catalysts within entrepreneurial ecosystems is extremely complex. Furthermore, the expectations for universities' contributions to national and international ecosystems is also evolving in response to government changes of policy, regulations and funding. To address each of the key themes, we have drawn upon the relevant literature and provided detailed examples to illustrate the themes in the literature. We have profiled the issues associated with the emergence of entrepreneurship as a field and also considered the historical aspects of commercialisation of innovation by universities.

In the preceding discussion we have shown how the university, as a key national institution, has embraced the field of entrepreneurship as a research and teaching activity, particularly within its business schools. How entrepreneurship should be taught and whether or not it is likely to make any substantial difference to the total stock of successful, high growth firms and job creation, remain open questions. It is clear that most universities in Australia and throughout the world have courses and even research centres, specialising in entrepreneurship. These courses are also generally very popular with students and this role of educating the entrepreneurs of the future is one potential role for universities. However, the value of this education remains unclear and further research is needed to fully assess its impact.

The economic development role of universities is another potentially very important one. This is identified as a key aspect of how the university sector makes its contribution to the NIS and in-turn to the entrepreneurial ecosystem. However, as with the role of educating entrepreneurs, the ability to demonstrate the impact that university research has on economic and job growth is problematic. Although there are many examples of how universities have served as the catalyst for innovation in selected industries, reliable data remains difficult to collect.

In Australia, the relatively low level of university-industry collaboration has been a cause of concern. This has led to changes in how universities in that country are funded for research and how their performance is measured. Such pressure from government policy is a trend found in many other countries. It will no doubt lead to universities seeking to place a greater emphasis on commercialisation and industry engagement activities. However, the nature of such activity is also difficult to manage and is typically dependent on a few individuals within both the industry partners and the universities, who can bridge the divide and forge meaningful alliances.

Implications for further research, policy and practice

- *To measure the social and economic impact of entrepreneurship education* further research is needed that examines the effectiveness of entrepreneurship programmes of different types in short, medium and longer-term horizons.
- *To measure the impact of university commercialisation* further research is needed to show the scale and significance of this nationally, and understand the factors/scenarios which contribute to the highest returns.
- *To improve the quality of entrepreneurship education within the university sector*, governments and their education ministries/departments need to encourage and support experimentation with entrepreneurship programmes, collect evidence and disseminate best practices
- *To increase economic development from innovations*, governments need to recognise the broader range of innovations as defined by the OECD in the Olso Manual.
- *To increase the human capital within the entrepreneurial ecosystem*, universities need to produce graduates with relevant entrepreneurial knowledge and skills. For universities to become 'fountains of youth' for innovation and economic development, cross-disciplinary and experiential learning programs are crucial to foster this entrepreneurial talent. Developing entrepreneurship programs that overcome traditional disciplinary silos, university-level entrepreneurship centres are considered to be an important alternative to traditional approaches where entrepreneurship forms part of the business faculty. Offering a wide range of entrepreneurial support initiatives besides formal educational programs is also important to create a pipeline for entrepreneurial talent. Such entrepreneurial support initiatives should not solely focus on new venture creation, but should consider sparking creative thinking and developing entrepreneurial behaviour across different contexts such as e.g. corporate or not-for-profit.
- *To develop and promote an entrepreneurial culture within the ecosystem*, universities have a role in cultivating an environment that nurtures creativity, innovation and value creation. Allowing staff and student to seize commercial opportunities through intellectual property policies that benefit the creator rather than the university is an important step in this direction.
- *Finally, the role universities play within their entrepreneurial ecosystem depends on the specific context, purpose and maturity of the ecosystem*. Ecosystems are different and there is no one-size-fits-all approach but individual universities have to figure out what their specific role is building on the key strength that differentiates them.

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