This is the authors’ final peer reviewed (post print) version of the item published as:


Available from Deakin Research Online:

http://hdl.handle.net/10536/DRO/DU:30029644

Reproduced with the kind permissions of the copyright owner.

Copyright: 2010, Inderscience Publishers
Collaboration with Entrepreneurship Education Programs: Building Spinout Capacity at University

Peter W. Moroz and Kevin Hindle
Swinburne University of Technology, Australian Graduate School of Entrepreneurship, Cnr Wakefield and Williams Streets, Hawthorn Victoria, 3122 Australia. Email: pwmoroz@swin.edu.au and khindle@swin.edu.au.

Abstract: As the University Spin Out (USO) has become a highly desirable outcome for commercialization efforts, the development of entrepreneurial capacity within the university system becomes increasingly more important. We hypothesize that entrepreneurship education (EE) programs ceterus paribus may play a role in developing this capacity. This paper examines the attitudes and perceptions of academics who are directly involved in the field of EE programs with four research goals in mind: 1) to determine whether or not there are perceived advantages to collaboration between EE programs and technology transfer departments, 2) identify specific factors that influence these perceptions, (3) query academics as to perceived barriers to collaboration, and (4) to identify whether collaborations already exist and categorize them. Our findings suggest that significant advantages from collaboration between these two functions are perceived and that indirect linkages are believed to be more important than direct linkages.

Keywords: Entrepreneurship education, technology transfer, university spin outs, innovation, entrepreneurship, university collaboration, entrepreneurial capacity, learning.

Biographical Notes: Peter Moroz is a doctoral candidate at the Australian Graduate School of Entrepreneurship, Swinburne University of Technology in Melbourne, Australia. Peter’s research interests include new venture creation in challenged environments, Indigenous entrepreneurship and social entrepreneurship.

Kevin Hindle is Professor of Entrepreneurship at the Australian Graduate School of Entrepreneurship, Swinburne University of Technology, Melbourne, Australia. He is a researcher, educator, management consultant and private equity investor. As a researcher, Kevin Hindle has authored over eighty publications including more than fifty peer-reviewed papers in a range of respected international journals and conference proceedings.

Robert B. Anderson is a Professor with the Faculty of Business Administration of the University of Regina. Bob is the editor of the Journal of Small Business and Entrepreneurship, the regional editor for Canada for the International Journal of Entrepreneurship and Small Business, an associate editor of the Journal of Aboriginal Economic Development, an associate editor of the Journal of Asia Entrepreneurship and Sustainability and a founding editor of the Journal of Enterprising Communities.

1 Introduction

Several studies point to the sizeable impact that university commercialization activities have on regional and national economies (Saxenian 1994; Reamer, et al. 2003; Audretsch and Phillips 2007). Although a diverse range of commercialization activities and
outcomes exist\(^1\), the activity of new venture creation is perhaps the most widely recognized and accepted indicator of success (AUTM 2007; HEFCE 2007; EU Commission; Read 2005). Thus a large body of the extant research in this area is focused on the university spin out (USO) as an important and desired outcome of the research commercialization process (Djokovic and Souitaris 2008).

This recent association of commercialization with new technology venture creation has generated a new term: the ‘entrepreneurial university’ (Rothaermel et al., 2007; O’Shea et al., 2007). Universities that are recognized as moving towards an ‘entrepreneurial paradigm’, such as MIT, Stanford and Cambridge, are highly influential role models. The study of these universities provide evidence to the many benefits that may be construed from successfully converting intellectual property (IP) derived from research programs into tangible financial benefits for the university (in terms of licensing and equity revenues from spin out companies) and the local community in terms of high paying jobs/wealth creation (Etzkowitz 2002; Etzkowitz 2007).

Researchers who explore the complex variables and processes that stimulate the proliferation and success of the USO are embracing the growing literature on entrepreneurship to help understand this phenomenon and identify its antecedents (Shane 2005). Approaching the evolutionary problems of universities from the perspective of the field of entrepreneurship may provide insight that is extremely valuable to understanding and developing the processes required for meeting the overall challenge to innovate faced by universities (Drucker 1985). For instance, knowledge spillover is theorized to be responsible for technological diffusion, as it is understood that latent entrepreneurial activity surfaces wherever opportunities abound (Audretsch 2004; Romer 1990). But the context specific barriers unique to research universities that stand between new knowledge creation and new knowledge exploitation must be fully identified and understood before effective implementation of the commercialization mandate is fully

---

\(^1\) The authors recognize that the prominence of university spin out formation as both a key revenue generator and stimulus for regional economic development is debatable. As this argument draws away from the main thrust of the research, the issue has been regarded as beyond the scope of this paper.
engaged (Hindle 2002). Entrepreneurship theory may better help to map and explain these relationships.

Understanding what makes universities behave entrepreneurially as institutions is thus a broad focus of this paper. More specifically, we seek to explore entrepreneurship at university as a function of the capacity of individuals within the system to foster and or engage in entrepreneurial behavior that results in USOs. Entrepreneurship education (EE) programs are recognized as a growing phenomenon within the academic system that parallels the historical movement of modern universities toward commercialization of their knowledge assets. These EE programs, often delivered via a diverse range of models, typically emphasize the promotion of entrepreneurial behavior and entrepreneurial capacity building (the ability to ‘do’) both internal and external to the university environment. The relationship between the creation of USOs and university based EE programs is thus argued to be a relevant area of study.

We posit that the effective and comprehensive functioning of EE programs across the universities many dimensions is a key component for achieving an entrepreneurial paradigm that fosters USO creation and success\(^2\). The activity of opportunity identification, evaluation and exploitation, especially in challenging environments such as the academic institution, offer a wealth of information on the process of entrepreneurship on both a micro and macro foundational level (Shane and Venkataraman 2000; Low 2001; Uczbarasan 2001; Steyaert 2007). The emergence of the USO as a prime strategy for commercialization of new knowledge and the resulting obligation to build capacity around this activity provides an excellent area for entrepreneurship researchers to generate theory both specifically (within the area of entrepreneurial universities) and generally (the main body of entrepreneurship research).

The purpose of this research is to narrowly focus on the entrepreneurial capacity building dimension of the commercialization process. We intend to discover whether or not collaborations exist between EE and USO commercialization functions, determine their

\(^2\) A concise understanding of the functional dimensions of the university is provided later in this paper.
nature, and identify whether or not they are perceived as important to the USO process. We employ the perspectives of embedded entrepreneurship faculty to generate data through a non-random delivered survey tool. Therefore, the study reported in this paper takes a look at the problems, challenges and potential opportunities inherent to university knowledge transfer and USO’s from the perspective of academics involved in the teaching, research and program development of academic entrepreneurship programs. Through this study, we intend to delve deeper into the entrepreneurial elements of university commercialization from a new and perhaps different viewpoint. In doing so, we challenge the traditional models currently being used and lay the groundwork for the investigation of new ways of innovative thinking around the question at hand: “how do we increase the potential for university derived IP to be commercialized in order to realize the maximum benefits to both the university and society as a whole?”

Our paper is structured as follows. We begin by presenting an overview of several predicate perspectives, define key terms and provide an adequate contextual foundation for the study. Next, a conceptual platform for this study is offered by defining and linking three interrelated and important dimensions of the commercialization process: new knowledge creation, entrepreneurship and innovation. Research based antecedents of successful commercialization processes are introduced that highlight entrepreneurial capacity building as a significant factor. This will set up a conceptual argument as to how collaborations between commercialization functions and EE functions at university may support USO creation and success. Three hypotheses are offered. Next, the methodology used in the paper is explored and the results presented. Analysis of the results is provided in the discussion section. Limitations and paths to future research are discussed with a brief conclusion to the findings of the paper offered.

2 Understanding the Entrepreneurial University

The challenges that accompany an ‘entrepreneurial paradigm’ shift in thinking require a complete re-assessment of the traditional organizational goals long held by research universities (Etzkowitz et al., 2000). No longer is knowledge creation and its unfettered
dissemination the exclusive mandate of academia (Clark 1998). Universities are compelled to embrace an onrushing market head on, as a voracious global economy hungry for new technology demands both greater levels of research output, and rapid commercialization of the fruits of this effort (Kessler and Chakrabarti 1996; Markman et al. 2005; Shane 2004). Long standing as a neutral scholarly observer upon the economic whirlwinds of history, the modern university has become deeply embroiled within the vortex of innovation and creative destruction (Schumpeter 1934; Thursby and Thursby 2002). In order to survive, the modern university is evolving as an institution. Clark (2004) believes that this can only be accomplished through creating, among other things, new entrepreneurial pathways.

What is crucial to this transformation is the reconcilement of the traditional mandates of the university within an interpretive scheme that is inclusive of regional economic realities and sensitive to institutional heterogeneity (Schilling 1998; Thursby et al. 2001). Each institution is unique in terms of the culture and resources available for enacting change. For many schools and colleges within the university system, fostering an environment that is friendly to entrepreneurship, innovation and commercialization is often difficult (Di Gregorio and Shane 2003). Cultures must be broken down and slowly altered in order to accommodate a new socially integrated role in regional development. The educational requirements and transitional tools necessary for this massive up taking will require both time and money (Shane 2005). Most importantly, leadership must be cultivated internally, and kindled wherever it emerges. One area where this leadership is currently emerging is through the establishment of entrepreneurship centers and programs at university across the world (Vesper and Gartner 1997; Finkle et al. 2006; NAEC 2004; Menzies 2002).

2.1 Entrepreneurship education programs

Entrepreneurship research and the application of EE programming may be important in determining what skills, experience and behavioral cues are necessary to help bridge the
gaps that exist between the codified knowledge of the research world, and the tacit knowledge important to navigating commercial markets (Yencken 2002; O’Shea et al. 2005). An extensive body of literature detailing both the ability and efficacy of “teaching” entrepreneurship as a discipline (Gartner, 1994; McMullen, 1998; Kuratko, 1993; Kolvereid, 1997, Menzies, 2002; etc.) provides ample argument for its heightened role in closing this gap. The human resource skills necessary for launching USO’s as well as creating the environment where USO’s are an expected outcome of research trajectories must be either imported or facilitated (Franklin et al. 2001). Entrepreneurship programs may have a role to play in the internal facilitation of building entrepreneurial capacity and fostering new USO’s.

One might argue that the dividing line between protecting the right of researchers to perform basic “social good” research and enabling researchers to develop research that can be readily commercialized may be more easily negotiated through the establishment of proper social cues and training for those who are interested, rather than through elaborate incentive systems and infrastructure projects alone. Entrepreneurship research and pedagogy may contribute to the comprehension of the necessary and important network externalities required to be successful within university innovation systems. As well, by simply providing a greater diffusion of entrepreneurial skill sets and through the consequent outcomes of having more and more people practice entrepreneurship and recognizing/reacting to opportunity, the foundation for facilitation may be more easily laid (Minniti 2004).

Building the individual entrepreneurial capacity of faculty scientists, graduate students, engineers and the staff of technology transfer offices is an important process within the evolution of the entrepreneurial university, but huge gaps exist in the literature with respect to how it is facilitated (Van Looy et al. 2004; Kolvereid and Moen 1997; Yencken and Gillin 2002; Markman et al. 2005; Rothaermel et al. 2007). It is posited that entrepreneurship education may significantly increase the propensity of students and faculty to create new ventures and increase success rates, but the empirical evidence is

Several scholars have studied the rise of EE programs over the last 20 years (McMullen and Long, 1987; Vesper and Gartner 1997, Hindle 2002; Menzies 2002, 2004; Kuratko 2005). They have found that the models, objectives, resources, specializations and efficacy of these programs are extremely diverse. A list of the characteristics found in EE programs is presented in table 1.

Table 1. Potential characteristics of entrepreneurship education programs

| E teaching | Provides academic courses in entrepreneurship that range from single courses to entire undergraduate minor, major and graduate/PhD programs |
| E Research | Academic research focused on both theory and applied areas of entrepreneurship |
| E Internal | Promotion of entrepreneurship across campus, faculty and grad student training, business plan competitions, |
| E External | Services and activities for the community such as boot camps, network building, consulting, business plan assistance, mentoring, workshops |
| E Specialized | Emphasis on particular fields such as social entrepreneurship, corporate entrepreneurship, family entrepreneurship, technology entrepreneurship |
| E Location | Specialized institutes, centers or departments that may or may not be tied to a certain school (business, engineering, etc), cross campus, or external to the university but tied indirectly through linkages (boards, individuals, etc) |
| E Resources | Endowments, chairs, and other revenue streams generated to fund the program (most E programs are funded outside of university cost budgets) |
| E Plus Zone | Anything that is innovative, unique or experimental that seeks to differentiate the program from all others. |

An exhaustive discussion on the characteristics, constellations and outcomes of EE programs is beyond the scope of this paper. What is important to note, is that EE programs are still evolving and the objectives varied. Furthermore, the efficacy of these programs are often measured in simplistic terms, such as the number of students who start businesses after graduation, but the actual outcomes have no uniform criteria for assessment that allow for a thorough evaluation of the contributions that these programs make to the university/community (Langford et al. 2006). Hindle (2001) provides a rule of thumb set of criteria that allows one to gauge the breadth and depth of the EE program simply by stating that stand alone courses (such as business plan courses) will not be as
strong as concentrated programs (such as undergraduate minors/majors or graduate programs), and that the more integrated the program is across the various functional departments of a university (combining individuals with different skills sets/fields of expertise together), the better they will be at building individual entrepreneurial capacity.

Lastly, Hindle (2001; 2006) argues that academics that teach entrepreneurship must have a combination of practical and academic skills. Too often, academics from other fields of business management are recruited to fill the leadership roles of chairs in EE programs, leading to programs that are ‘entrepreneurial’ in name only (Kuratko et al., 2005). Entrepreneurship education programs are best lead by scholars that have been trained specifically by academics who have researched and practiced entrepreneurship. As scholars of this nature are rare, this type of individual is often atypical of those academics that run these programs.

There may be other more direct methods of capacity building that help to promote and enable commercialization processes and USOs. Technology entrepreneurship programs are quickly being adopted within top ranked entrepreneurship schools (Kauffman Foundation 2006). Not only do the curricula developed for these programs help in the venture creation process, they also provide experience, networks and skills that are unique to starting high technology USO’s. The mandates of entrepreneurship schools continue to grow and add other services and resources to the mix, such as links to investors, internal startup financing funds, and other support infrastructure such as mentorship (Finkle et al. 2006). In many respects, the priorities and strengths requisite within entrepreneurship programs and centers is highly compatible with the goals of TTO’s: spinning out new ventures. Some overlap does exist as well, especially in the area of infrastructure development and support for new ventures, such as incubators, and professional/business consulting services (Tornatzky et al. 1996; Locket and Wright 2005; Markman et al 2005; Nelson and Byers 2005; Siegel and Phan 2004; Leitch and Harrison 1999). The next section will provide a brief overview of the USO, definitions and a brief taxonomy to better help align the reader with the functions, objectives and potential outcomes of EE programs.
2.2 University spin outs (USO’s)

There are several terms found within the academic and practical literature for describing new ventures created from within a university environment: university spin off companies, university startups, new venture spin offs and university spin outs (USO’s). For this paper, we have adopted the latter and forego the formalities of defining what a USO is, in order to present taxonomy of the different types of USO’s that exist, their characteristics, objectives and how their performance may be evaluated. Hindle and Yencken (2004) present an authoritative overview of the different types of USO’s by linking them to their host organization (in this case, a public research university). There are four:

1. Direct Research Spin-Off (DRSO): company created and owned by (or in part) the university for the purpose of commercializing IP that has emerged from the institution.
2. Technology Transfer Company (TTC): companies set up by a university to exploit tacit knowledge that are more process based than patent based.
3. Indirect Spin-Off Companies (ISO): companies started by current or former faculty or students that do not have a direct IP relationship/legal stake with the university.
4. Spin Ins (SI): companies that are spun out by existing companies to exploit licensed or collaborative research generated by universities.

Another classification of USOs involves the objectives of three general business models:

1. Consultancy Contracting (CC): companies set up to delivers services; either technical or knowledge based in a supportive role of regional R&D activities. These companies are often lifestyle businesses that do not grow rapidly.
2. Product Oriented (PO): companies developed around a product or process that achieves a sustainable growth pattern.
3. Technology Asset Oriented (TA): companies that are developed around a patented technological asset (or platform) that achieve rapid growth and require large and diverse sets of resources.

Lastly, and perhaps most important to this study, is the USO classification based upon the principal originator or team being a member of faculty, or a graduate student. Data pulled from recent Higher Education Fund Committee (HEFCE) reviews finds that the number of USOs started by graduate students has increased steadily from 1999-2006 and that they far outweigh the number of USOs started by faculty over that same period. These figures suggest that entrepreneurship education programs may be best targeted at graduate students working across the hard sciences and engineering schools. This concept is supported by findings from several academic studies investigating this trend (Menzies 2004; Kirby 2004).

The focus of this paper encompasses all of the above classifications of the USO as the study reported here is exploratory in nature.

2.3 The four functional dimensions of the entrepreneurial university

As mentioned above, the conceptualization of an entrepreneurial university used in this paper aligns with two functional dimensions: that of teaching/research and contributing to internal and external entrepreneurial capacity building in the form of EE programs, and the process of commercialization that results in the formation of new ventures arising from the generation of new knowledge by university staff/collaborations with industry. Although these two dimensions are important, we do not claim that entrepreneurial universities can be evaluated upon the function of their entrepreneurship education and commercialization programs alone.

Hindle (2009) has developed a model that categorizes the functions of the entrepreneurial university into four overlapping dimensions (see figure 1 below). The model holds that the main objective of the entrepreneurial university it to create a continuous stream of
innovation. As innovation is the successful commercialization of new ideas or inventions, entrepreneurship is simply defined as the engine of this value creating process and is not limited to the formation of new ventures (Shane and Venkataraman 2000). Thus entrepreneurial behavior within the teaching and research dimension may produce valuable socioeconomic outcomes in the forms of new innovative programs and research that impacts upon the socioeconomic well being of the region/nation/world. The possibilities are endless and too diverse in scope to represent here.

Figure 1. Four dimensions of the entrepreneurial university

The organizational management dimension of the entrepreneurial university refers to the administration of the institution. Entrepreneurial behavior engaged within this dimension may produce new revenues streams for the university based on innovative ideas or processes, development of angel/mentorship programs through alumni resources, the development and delivery of new educational programs/services that have commercial
value to the university, or entrepreneurial leadership in envisioning and implementing entrepreneurial change to be highly innovative across a wide spectrum of areas.

As the engine of innovative change is conceptualized as entrepreneurship, this inevitably leads to the question as to whether or not EE programs should be taking a more central role in the shift to an entrepreneurial paradigm; and more specific to this paper, the USO process. It also begs the question as to whether or not technology transfer functions would be better served if integrated administratively with EE programs, specifically if the focus of commercialization efforts is to spin out technology into potential high growth ventures. Until now, the main vehicle for university commercialization efforts has evolved around the technology transfer/industry liaison model (Thursby et al. 2001; AUTM 2005; Evans et al. 1999). The efficacy of this model, like any model, should constantly be evaluated and assessed, especially against shifting goals (Kuhn, 1962/1970). Are there perhaps other models or paradigms that may better serve the university in terms of its ability to more effectively spin out technology produced from academic research? We will explore these questions in greater detail below.

3. Theoretical Construction

This section is intended to provide a general framework for understanding the relationship between entrepreneurship and innovation that is significant to USO commercialization policy specifically and economic value creation in general. In so doing, a definition of entrepreneurial capacity is presented, its relationship to entrepreneurship education programs at university outlined and its importance to the commercialization process argued. Empirical evidence and extant theory from past research on the antecedents that influence the spin out process and impact upon issues regarding performance and success are provided. These factors are then synthesized with the general framework presented and hypotheses for testing are offered.
3.1 Entrepreneurship, innovation and commercialization

There is an obvious linkage between innovation and entrepreneurship (Schumpeter 1934; Drucker 1985). Those universities that develop expertise and support policies to stimulate technology transfer are often ascribed to as “entrepreneurial universities” (Slaughter and Leslie 1997; Rothaermehl et al. 2007). This is a worldwide phenomenon (Wright et al. 2007). Although entrepreneurship is often linked to innovation, how innovation is perceived and defined within the literature is not always clear.

Hindle (2002) categorizes the components of innovation into small I (inventions, ideas and the creation of new knowledge) and big I (the economic value attributed to productive opportunities derived from new knowledge). Entrepreneurial actors transform small I innovation into big I innovation through the commercialization of products or services redeemed from research findings. If entrepreneurial actors (students, faculty researchers, administrative staff, external individuals working privately in industry or publicly through government) retain an ability to conceive of what to do with a productive opportunity, it logically follows that in the absence of entrepreneurial capacity, the potential commercial value to a university of any new knowledge is effectively zero (Hindle 2002). In other words, entrepreneurship is the human ‘action based’ engine of innovation.

With the billions of dollars being injected into public research institutions around the world, perhaps the burning problem to be addressed is the notion of a lack of entrepreneurial capacity within the university system. Entrepreneurial capacity is posited as a necessary catalyst for turning new knowledge into new dollars. Yet in comparison, relatively little investment into entrepreneurial capacity building has been made in contrast to funding for basis and applied research (Menzies 2002; Kuratko 2005; Wright et al. 2007; AUTM 2005).

Hindle provides a seminal definition of entrepreneurial capacity:
“…it is the ability of individual or grouped human actors (entrepreneurial protagonists) to evaluate the economic potential latent in a selected item of new knowledge, and to design ways to transform that potential into realizable economic value for intended stakeholders.” (Hindle 2007: 9)

Although entrepreneurial capacity refers to an individual or team based unit of analysis, the potential capacity gap exists on two overlapping levels: the lack of talented individuals who understand the process of turning invention into enterprise, and the deficiency of organizational structures and environments that are not properly suited to stimulate or facilitate entrepreneurial activity (Ropke 1998). These two levels (the individual and the organizational - or systemic) presented here are extremely broad. For a deeper understanding of university commercialization, an examination of the elements contributing to entrepreneurial capacity that exist within the university system for innovation is required.

3.2 Individual and organizational antecedents of successful USO commercialization

Focusing on the creators of IP, DiGreggerio and Shane (2003) assessed the determinants of USO’s and conclude that the skills and abilities of faculty were significant. Scientists, who are incapable of identifying or exploiting the commercial value of their work, tend to not disclose research findings to technology transfer offices (TTO). As well, the goal of most research being performed within universities is discovery based and not commercially motivated. Even if disclosure is made, the scientist must brave the gauntlet of a potentially daunting peer environment (Bercovitz 2004). Considering that the direct involvement of the scientist throughout the early stages of the spinout process is positively correlated with higher levels of USO commercialization (Zucker et al. 1998; Thursby et al. 2001), institutional disincentives may lower their participation. Issues such as lack of time, recognition, motivation and business sense may also cause scientist to retract from such endeavors. Organizational rigidities, a lack of resources and the complexities of the USO process itself all act as barriers to scientists spinning out technologies (Witt and Zellnar 2004).
Since the commercialization of technology is basically an entrepreneurial process, understanding the nature of IP exploitation demands that scientists and students must act entrepreneurially (Ropke 1998), or at the very least, be familiar with and willing to accept entrepreneurial activities as a norm (Lenoir 2004). In other words, they must be alert to market opportunities related to their research findings.

There are several of technology and new venture creation programs targeted at students and faculty (Kauffman Institute, 2006). In a study performed by Kolvereid and Moen (1997), graduates with an entrepreneurship major were found to be more apt to start new businesses and have stronger entrepreneurial intentions than other graduates. Menzies (2004) found that engineers who had taken entrepreneurship courses had higher propensities to venture and better success rates in starting new businesses. Specifically to technology based spinouts, Yencken (2002) finds that training in entrepreneurship and technology management familiarizes innovators with the processes and requirements for creating and sustaining USO’s. Many examples of technology transfer and technology entrepreneurship programs have thus sprung up around North America and Europe based on this premise with a variety of outcomes (Marshall 2006; Thursby et al. 2001; Binks 2006).

In analyzing the effectiveness of university technology transfer, Siegel and Phan (2004) state that entrepreneurship curricula must be embedded throughout the university to maximize the effectiveness of commercialization efforts. This contention is based on considerable evidence that entrepreneurs with a good education (delivered through academic programs) tend to be more successful than those without (Vesper 1990). As entrepreneurship education is itself a non-linear process, it is more closely aligned with innovation than the linear and often bureaucratic nature of technology transfer (Nelson and Byers 2005). Therefore technology entrepreneurs who have received education, training and experience in entrepreneurship and business will have greater levels of entrepreneurial capacity and generate more new ventures than those who have not.
Hyp1: The existence of entrepreneurship education programs will positively correlate with higher USO creation at university.

Although this may seem to be an obvious hypothesis, the breadth and depth of linkages between entrepreneurship programs and technology transfer functions at university is unknown. Those unfamiliar with technology transfer and entrepreneurship programs in this area may not be as likely to cite this as an important factor out of sheer lack of hands on experience or involvement.

3.3 Processes and routines for improving USO commercialization performance

Lockett and Wright (2005) examine the creation of the USO from a macro foundational level and ask two pertinent questions: 1) what are the most important stocks of resource inputs and 2) what are the most important capabilities and routines? Among other things, business development and experience vested in spin outs teams were more important than the actual number of years that TTO had been in operation at a university. Routines that reinforce existing cultures of innovation through organizational norms, policies and procedures were as important as the actual stocks of IP being generated. Markman (1999) reinforces this theory and extends it by stating that value chains consisting of scientists, TTO’s, university administration and external linkages to investors/industry must be put in place and work in tandem with the proper incentives to encourage spinning out technology through new ventures. Thus an argument for the requirement of entrepreneurial capacity as a stock or resource is plausible, and the identification of entrepreneurial processes operating within the university innovation system a logical indicator of these stocks.

Top levels of university administration must adopt a strategic approach to facilitating entrepreneurial action (Siegal and Phan 2004). Spinning out IP also requires routines where selectivity is practiced, as not all IP is created equally. Innovations will often have divergences in market appeal and growth potential (Powers 2005). Thus the discovery and evaluation elements of entrepreneurial capacity are relevant to the opportunity identification process (Shane and Venkataraman 2000). Some of these strategies may be
aligned with cluster development, incubators, research parks, research chairs and other broad based policies that allow for long-term commitments. An understanding of the time that knowledge innovation takes to bring to a state of profitability, its unpredictability in outcomes and a tolerance for failures (Drucker 1985) frames some of the requirements needed for better USO performance. Universities must also modify policies for the heterogeneity of USO types, sizes and growth rates as referred to above in a previous section.

In deference to the value of EE programs, Franklin (2005) posits that entrepreneurial routines and incentives may not be grown as rapidly as needed within the university through entrepreneurship programs alone. Thus surrogate entrepreneurs may help to provide the necessary capacity to accelerate the growth of commercialization experience. External entrepreneurs can be the catalyst required for bringing USO’s out of nascent stages through the structural coupling of the university and regional resources into entrepreneurial patterns. They can also be an integral part of EE programs that seek to build capacity within the university environment employed as “pracademics”. (McMullen & Gillin 1998). As EE programs and centers are integrally linked to the regional entrepreneurial environment, linkages between this type of capacity and innovation system needs are also plausible (Kuratko 2005). Historical success follows an external environment where entrepreneurial activity is strong and universities cultivate ties with the business world (Blumenthal 1996), also a function of EE programs.

As the commercialization process requires a good degree of organizational coordination, administrative support, and the commitment of resources, entrepreneurship programs would most likely be more beneficial when directly tied into university technology transfer processes involving USOs through programs with features as indicated above.

Hyp2: Direct linkages between entrepreneurship education programs and USO commercialization strategies involving TTO’s will be positively correlated with the creation of USO’s at a university.
This leads to a further hypothesis that states:

*Hyp3: Combining technology transfer functions with entrepreneurship education functions will result in greater numbers of USO’s.*

This hypothesis engages the consideration of paradigm shifts or evolutionary patterns in models that may contribute to the effective transfer of technology through the USO. As the suggested structural model is atypical of current configurations, it may serve as an introduction to be analyzed upon its merits. Roberts (1996) looked at various selectivity and support configurations and concluded that weak entrepreneurial environments (both external and internal to the university) may require more rigid policies to enhance commercialization, while universities with past success, well established social cues and an environment rich with entrepreneurial capabilities and routines may not. Degroof (2004) agrees by stating that direct administrative control and rigid policies promoting entrepreneurial activity around USO efforts is better for underdeveloped environments, supporting the need for direct linkages between EE and TTO, especially when past historic success is not a factor. This is assumed to be the prevailing environment in many universities evolving into an entrepreneurial paradigm and USO proliferation.

Not all examinations of direct organizational control as a factor for USO creation are in agreement. Moray (2005) warns that increasing top down control on the venture process may discourage efforts to spin out technology. Regarding the specific collaboration of EE programs and TTOs, the differences between the two activities and their institutional constellations may limit the amount of direct interface between them (Nelson and Byers 2005).

All in all, the complexities involved with USO’s are grand in their totality. This paper does not attempt to delve deep into the various factors and their relationships that either positively or negatively impact the proliferation of USO’s within a university setting. We hope to offer insight of the understanding of the phenomenon from the perspective of entrepreneurship academics that may participate in, have relationships with, or
experience in creating collaborative approaches to new venture creation that include USO formation. We believe that analysis and comparison of the attitudes, views and beliefs of this rarely tapped population may offer some interesting discussion to current theoretical posturing on the subject.

4 Methodology

In order to obtain the data presented in this paper, an invitation to participate in a self-administered web survey was emailed to Canadian entrepreneurship academics. The sample frame consisted of all academics and/or entrepreneurship center directors that were actively involved in administration, teaching, or research within or in conjunction to a university. The sample frame represents 95% of all Canadian universities, disregarding regional colleges or affiliates of the main institution. Technical and trade schools were not represented in this sample frame. The sample population consisted of 67 entrepreneurship educators and was drawn from various sources: subscription lists to the Journal of Small Business and Entrepreneurship, an exhaustive internet search through faculty web pages and by the process of asking respondents to refer the survey to colleagues that fit the above sample frame. This last method is well documented in its application and is often referred to as snowballing (Heckathorn 1997).

The first section of the survey asked respondents to identify several institution specific structural issues to help gauge the depth, breadth and focus of EE programs within their schools. This information was gathered by asking a series of partly closed questions that allowed for respondents to choose from a list of coded responses that included a category for “other” responses. Respondents were asked to elaborate on “other” responses through follow up open ended questions in order to allow for a full range of responses to be collected. Information on research funding, research chairs, and endowments was also collected (Finkle et al., 2006).
Part two of the survey involved asking respondents their opinion on issues involving the collaboration of EE programs and TTO’s responsible for USOs. Answers were coded via a closed four point scale (Bradburn et al., 2004) assessing the strength of their agreement or disagreement with several questions. A middle point was left out of the scale in order to better gauge the leanings of the respondents. In order to avoid satisficing, a “don’t know” response was added at the end of each question’s response choices. This technique reflects the respondent’s ability to answer the questions with some authority, and allows them the option to answer based on a closed set of responses. It is likely that some entrepreneurship educators were not familiar with technology transfer and the commercialization aspects of the USO (Kalton et al. 1980).

The final part of the survey was modeled as two part questions to illicit responses on attitudes and perceptions of entrepreneurship academics, independent of whether or not the questions corresponded to their schools. This method was decided upon in order to mitigate the association of responses within an environmental context and to ensure that academic perceptions of what “should be” were not anchored with what actually may be happening within the program or school. Questions were designed to be as specific as possible to help filter the attitudinal characteristics of the responses (Bradburn et al. 2004).

Responses to opinion and attitude questions were measured by using a mean percentage to evaluate the level of the respondent’s agreement on a cumulative basis. The resulting scores were then used to assess the issue addressed in the question on a positive scale. Responses coded as “don’t know” were included in the aggregate percentages.

A second level of analysis involved parametric tests on dummy variables created for structural, resource variables and environmental variables and then compared with attitudinal variables. Pearson bi-variate tests were performed to identify the strength and significance of any pertinent correlations between the coded responses. Due to the reporting system used in the online survey, opinion and attitude questions were ranked in descending order of strength so that “1” was considered a strong positive result. As
“don’t know” responses were coded as “5”, they were assigned as missing variables and dropped from the dataset.

5 Results

Of the sample population of 67 respondents, there was a completion rate of 53% (n=36). The population of Canadian universities according to the Association of Universities and Colleges of Canada (AUCC, 2006) is currently 89. As the survey was designed as a non-probability based purposive study of entrepreneurship academics within Canadian universities, the sample population of 67 consists of those targeted universities that have EE courses or programs of some kind. Of the 89 universities in the AUCC population, 19 were either affiliates of larger institutions or did not have a full representation of programs (art schools, design schools, and liberal arts colleges) and thus did not fit the requirements of the survey population. Thus the survey population of universities within the scope of this study is 70. Using standard sampling error techniques, with a sample error of +/-3%, the sample size drawn ensures a confidence level of 95% (Judd 1981).

Breaking the respondent list down geographically, 19 eastern, 6 maritime, and 9 western universities were represented in this survey. There were two universities that provided dual reports from 4 individuals, for a total of n=36. Of the 36 respondents, 9 were female and 27 were male. Each province had at least one university respondent reporting.

In regards to university infrastructure and programs, the following results were obtained and are tabulated in Table 2. The vast majority of universities delivered EE programming from the business school (97.2%), while engineering schools reported 52.8%, arts schools 16.7% and medical schools 5.6%. The preeminence of the business school in delivering EE programs is typical of most nations and on the whole an obvious statistic. The growth in EE programs being delivered from engineering schools is a growing trend (Menzies 2002), but the absence of EE programming in other schools and colleges is not (Finkle et al. 2006).
Only 8.3% of universities surveyed reported a PhD program in entrepreneurship, while graduate degrees and undergraduate degrees were 13.9% and 27.8%. This signals a supply chain shortage of trained academics within the Canadian system. Combined with the growing demand and undersupply of entrepreneurship academics within the US (Finkle et al. 2006), this statistic offers some critical insight into the state of growth in the field. As well, the limited availability of graduate and undergraduate programs speaks to the developmental stage that EE still exists within. Full-fledged programs offered through undergraduate and graduate degrees that are multi-dimensional in scope, offer experiential learning, social capital building, and a multitude of other pedagogical techniques required of the unique field of EE are theoretically and empirically superior to courses or skills building classes (Hindle 2001; Finkle et al. 2006).

Table 2. University entrepreneurship education infrastructure and programs

<table>
<thead>
<tr>
<th>Variable Type</th>
<th>Frequency n=36</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate degree in EE offered</td>
<td>10</td>
<td>27.8</td>
</tr>
<tr>
<td>Graduate degree in EE offered</td>
<td>5</td>
<td>13.9</td>
</tr>
<tr>
<td>PhD in EE offered</td>
<td>3</td>
<td>8.3</td>
</tr>
<tr>
<td>Business School EE programs/course</td>
<td>35</td>
<td>97.2</td>
</tr>
<tr>
<td>Engineering School EE programs/course</td>
<td>19</td>
<td>52.8</td>
</tr>
<tr>
<td>Arts School EE programs/course</td>
<td>6</td>
<td>16.7</td>
</tr>
<tr>
<td>Medical School programs/course</td>
<td>2</td>
<td>5.6</td>
</tr>
<tr>
<td>Startup Assistance within University</td>
<td>20</td>
<td>55.6</td>
</tr>
<tr>
<td>Entrepreneurship Education Endowment</td>
<td>17</td>
<td>47.2</td>
</tr>
<tr>
<td>Entrepreneurship Research Chairs</td>
<td>5</td>
<td>13.9</td>
</tr>
<tr>
<td>Entrepreneurship Center</td>
<td>20</td>
<td>55.6</td>
</tr>
<tr>
<td>Technology entrepreneurship courses</td>
<td>12</td>
<td>33.3</td>
</tr>
</tbody>
</table>

Analysis of the data finds that over half of the respondents (55.6%) were aware of an EE program existing at the university. Typically, an EE program will provide a teaching, research and an internal/external outreach component, and will be attached directly or indirectly to the university, or through a school or college (Menzies 2002). Although this basic framework provides an idea as to what an EE program does, there is little homogeneity around how it gets done. Budgets, administration, mandates and actual program delivery and curricula can be highly divergent or even unique from center to center, and ranking their efficacy can be difficult (Finkle et al. 2006).
Consequently, the number of research chairs in entrepreneurship (13.9%) and endowments to EE programs (47.2%) are often directly related to the operation and success of EE programs within a university. Once again, the low number of research chairs represented when combined with world data that illustrates a high number of vacancies within university research chairs in entrepreneurship suggests an under capacity within the university system (Vesper 1999). These numbers can also be interpreted in the light of empirical evidence that points out that ranked entrepreneurship centers have three times as many endowed research chairs than non-ranked centers (Finkle et al. 2006).

Findings on technology entrepreneurship courses uncovered 12 universities (33.3%) that focused directly on high tech startups. As the survey did not prompt for further investigation into the level, program depth and history of these courses and programs, the significance of this variable at face value is ambiguous. Nonetheless, due to this variable being a possible nexus point in the examination of linkages between EE programs and USO creation, it is of considerable importance to this study (Blais 1997).

Opinion based and attitude/belief questions were posed to entrepreneurship academics on a series of issues exploring the linkages between USO processes and EE programs. These results are highlighted in Table 3. The first three questions were related to what is happening at the respondent’s university, and how it is happening. Responses were limited to an attitudinal measurement scale of “strongly agree, agree somewhat, disagree somewhat, and strongly disagree”. Questions that elicited an unusually high number of “don’t know” responses are highlighted for analysis.

<table>
<thead>
<tr>
<th>Table 3. Entrepreneurship Academics Survey Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey Questions</td>
</tr>
<tr>
<td>1) There are direct administrative linkages/programs between entrepreneurship faculty/programs and technology transfer officers/staff/program that are focused on commercialization activities (opportunity identification, selectivity, marketing, business plan, financing, startup launch, etc) at this institution.</td>
</tr>
<tr>
<td>2) There are indirect linkages/personal networks/consulting (predicated upon social interaction without formal administrative structures) between entrepreneurship faculty and technology transfer officers/staff that are focused on commercialization activities (opportunity identification, selectivity, marketing, business plan, financing, start up launch, etc) at this institution.</td>
</tr>
</tbody>
</table>
The first two questions attempt to draw from respondents the nature of collaborative activities that are taking place between EE programs and USO processes within the university from the perspective of the entrepreneurship side. Although 58.3% believed that there were direct administrative linkages between the two, there appears to be an overwhelming opinion that indirect and less formal processes are far greater contributors to USO success. This supports the theory that latent entrepreneurship arises in an environment that is rich in IP (opportunity) and that these networks exist as local group norms outside of formal administrative structures (Siegel and Phan 2004).

Balancing the above with question three, (whether students and or faculty have participated in USO’s), once again, 58.3% were aware of or believed that this activity took place within their university. As the respondents who answered, “don’t know” were unusually high, further analysis is necessary to understand the fully complexity of the responses. It is possible that informal networks that exist as posited by the responses in question 2 (indirect linkages) highlight asymmetric information issues that are concomitant with these activities. There may also be disconnects between activities that are carried out within the purview of university commercialization processes, indicating a bureaucratically stove piped relationship. Lastly, the prevalence of USO’s within some universities is highly rare. Administrative mandates within the university may be more in line with licensing technology than spinning it out (AUTM 2005).
The remaining seven questions administered in the survey strove to capture the attitudes and perceptions of entrepreneurship academics with relation to EE programs and USO creation. Fully 86.1% of respondents agreed, or strongly agreed with question four: “there are advantages to collaboration between the two processes”. Of interest, there were no “strongly disagree” responses instigated by this question. Evidence from this paper thus corroborates a large body of literature that acknowledges the significance of EE program to the USO process (Shane 2004; Etzkowitz 2001; Boni and Emerson 2005; Siegel and Phan 2004; Audretsch 2004).

University top administration is referred to in question five with only 36.1% of respondents indicating that they believed it was not as important as EE programs in the proliferation of USO’s. This result may be limited in its explanatory power as the question is written as to bias entrepreneurship academics. Siegel and Phan (2004) believe that the highest levels of university administration must direct the strategic processes that impact upon the spin out process, while Pries and Guild (2004) require a comprehensive framework around university commercialization activities that reflect a variety of substantial approaches to technology transfer. In contrast, question six pertaining to administrative barriers preventing collaboration reveals that entrepreneurship academics believe or have experienced institutional bureaucracy in a more negative than positive light with respect to linkages between the two functions (47.2%).

A hypothetical paradigm shift is presented in question seven that queries whether or not integration of USO processes with EE programs would lend to a more constructive vehicle for spinning out university research. The positive responses to this question were very low (30.6%) and also resulted in a large “don’t know” category (22.2%). Several assumptions can be made about this outcome. First, although EE and technology transfer programs have overlapping areas of concern, it is possible that the differences between them warrant maintenance of autonomy (Nelson and Byers 2005). Secondly, the large “don’t know” response reflects the reality of the lack of current models that attempt to incorporate the two. As well, there may be a simple aversion from respondents in
considering this question, as well as a lack of depth of knowledge, experience, salience and motivation to analyze the question thoroughly.

Development of student and faculty entrepreneurship programs (question 8) received an overwhelmingly positive response from entrepreneurship academics (83.3%). As graduate students and faculty researchers involved in engineering and science are an empirically significant factor in the USO process, the idea of providing EE in order to propagate greater USO activity within these groups is understandably appealing and in line with other studies (Witt and Zellnar 2005). The debate as to whether or not entrepreneurship can be taught has long been put to rest, and that education can both motivate and contribute to greater success in starting a new venture is a fundamental theory within the field (McMullen and Long 1987; Low 1988; Vesper 1990; Kuratko 2005).

The last two questions are designed to detect deeper foundational connections between the emergence of EE and USOs within the modern university system. Both of these processes are relatively new, sharing a history of evolution that is closely paralleled in their growth and significance (AUTM 2005; Kauffman Center 2001). In question nine, respondents are asked whether or not they agree with the statement that EE and USO support programs are created or evolve independently of each other. Question ten posits the reverse: that these two processes were created or evolved dependent upon the other. Perhaps due to context effects in terms of question order, the second question drew only a meager 5.6% positive response rate while the former evoked a halfway 47.2% for independent evolution. The large “don’t know” response in the latter question of 25% perhaps allows one to intimate some confusion in understanding the question. Undeniably, the results are highly negative to any dependency upon evolutionary pathways between EE and USO support structures.

Multivariate testing was used to help further analyze the data. Dummy variables were created from structural, resource and program information provided by respondents and then compared again ordinal data resulting from expert opinions and attitudes of
entrepreneurship academics. Variables that demonstrated significant correlations on either a 0.05 or 0.01 level are tabulated below. Only those variables that tested significantly are represented.

Table 4. Significant correlations between survey variables

<table>
<thead>
<tr>
<th>Correlations</th>
<th>Indirect EE/TT</th>
<th>Entrepreneurship Program Endowments</th>
<th>Technology Entrepreneurship Courses programs</th>
<th>Student - Faculty participated in USO</th>
<th>Case Studies of USO</th>
<th>Administrative Barriers to Collaboration</th>
<th>EE evolve independent of TTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect EE/TT</td>
<td>X</td>
<td>.372*</td>
<td>.419*</td>
<td>-.395*</td>
<td>-.440*</td>
<td>.371*</td>
<td>.409</td>
</tr>
<tr>
<td>Direct EE/TT</td>
<td>.506**</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Program Level</td>
<td>X</td>
<td>.363*</td>
<td>.413*</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).
X Correlation is insignificant

Of critical interest to this paper is to construct and test variables that may offer some insight into possible linkages between EE programs and the USO process. Therefore, EE programs that specifically focus on technology startups are highly important to this study and provide an obvious starting point for investigation. Pearson tests reveal weak correlations at the 0.05 level between those institutions that have technology entrepreneurship courses/programs and three opinion/attitude responses: 1) Indirect networks for EE and TT programs 2) direct networks for EE and TT programs and 3) higher developed EE programs levels. Correlation between indirect networks and technology entrepreneurship programs suggest that there is a heavy reliance on informal networks over direct administrative linkages, even within formal EE programs focused specifically on high technology venture creation.

The variable “entrepreneurship endowments” signifies the presence of external funding given to a university or school with the mandate of funding and developing EE programs. As resources have been identified in previous studies as a key factor in developing and implementing successful EE programs, schools with endowment money, *ceterus paribus*, should have a significant advantage in resources over those schools that do not (Finkle et al., 2006). Strong correlations with direct and weaker significance for indirect EE and
TT network variables confirm this fact. Endowments are strongly correlated with higher levels of EE programming (PhD and graduate programs). Implications from this result may be that EE programs that are well funded have the resources to catalyze formal collaborative structures with technology transfer components residing within a university. Ensley (2005) has theorized that the university subscribes to aspects of institutional isomorphism, but that formal coercive pressures within an environment can play a role in guiding culture. Extending this theory, it is logical to assume that a strong enough core of EE programming may ultimately create reverse mimetic behaviors that are exported into other areas of the university. Greater amounts of resources available to manage collaboration between the two may thus leverage the creation of formal pathways between USO and EE programs.

The last variable to be examined is the “Indirect EE and TT linkages exist” line within Table 4. The correlations with “administrative barriers to collaboration” and “EE programs evolve independently” could thus be reconciled as ‘barriers do exist’, and that the two functions should be/are mostly independent. Reviewing the rest of the correlates supports this interpretation of the data. Negative results with “USO case studies” and “student faculty participation in USO’s” suggest that these activities do not take place in environments heavily dependent upon indirect linkages. As referred to above previously, “indirect linkages between TTO and EE” can be positively correlated with technology entrepreneurship courses and endowments as well. The resulting significant correlations with the variable “indirect linkages between TT and EE programs” are not a surprising outcome. Further attention to this variable and its empirical implications will be covered in depth in the next section.

6. Discussion

The variable technology entrepreneurship programs correlating weakly with both indirect linkages and direct linkages suggests a considerable amount of discrepancy on the types of collaboration that exist or should be implemented between EE programs and TTO’s responsible for USOs. Conversely, survey results point to an overwhelming
perception of *indirect collaboration*. These results can be interpreted in many ways and could suggest many things: 1) that there are currently not many effective strategies in place that allow for constructive direct linkages between the two functions, 2) the majority of the impact derived from technology entrepreneurship programs are indirectly facilitated outside of direct administrative linkages and are more individually driven, 3) and that student and faculty participation may stem from the indirect application of new knowledge, skills and experience gained through these programs, or in other words, the development of entrepreneurial capacity. As hypothesis one is supported via both empirical components of the study, there may be merit in comparing the efficacies of technology entrepreneurship programs with actual USO outcomes.

There is little support for hypothesis 2, but the significance of direct linkages and resources such as endowments and research chairs (not shown in table) is significantly correlated. As well, endowments are correlated with higher levels of EE programs such as those that deliver PhD’s. These results confirm other studies that state resources are important in building top ranked programs. What is most interesting is that indirect linkages were cited much higher than direct linkages for their significance to potential USO performance. This supports the argument that entrepreneurial capacity currently exists latently within the university system and operates outside of the normal organizational structures. While this may be a negative result, it does provide evidence to the significance of entrepreneurial capacity within the university system, and a corresponding propensity to commercialize.

There is low support for hypothesis three as only 33% of respondents felt that there were significant advantages to be derived from the integration of EE and TTO programs under one roof, although there was a considerable amount of “don’t know” responses. As well, nowhere was this variable significant with others when tested against the other variables. Yet over 86% of respondents viewed collaboration between TTO and EE programs as extremely important to the USO process. Once again, this may signal the effects of a larger contingent of activities that are indirectly attributed to network externalities and the overall growth of entrepreneurial capacity, routines and experience in the USO process.
Those academics that responded strongly to indirect linkages also felt that there were administrative barriers to greater collaboration. It is also shown that correlation exists between indirect linkages and TTO’s and EE programs evolving independent of each other. These results support Nelson and Byers (2005) contribution that these two functions are overlapping, but still differentiated enough to require them to be maintained autonomously. Overall, indirect linkages garnered the second highest positive results in reporting.

6.1 Limitations

There are understandably several limitations to this study. As an examination of entrepreneurship academics attitudes and beliefs towards USO’s, it does not offer much in way of tangible evidence on performance or outcomes. Although a high percentage of Canadian universities responded to the survey with full geographic coverage, the low N of the respondents involved must be considered into the results of the parametric testing and weaken the explanatory power of the data. The findings are also highly exploratory, confined to the salience and experience of respondents who may have limited knowledge with technology transfer and reflects the individual prior knowledge, direct experience and skills of the participants. Yet there is no background information on the respondents provided to demonstrate any experiential or educational capacity to answer the questions without error bias. As the study did not have the resources to provide full backgrounds, the nature of the work and positions they held must stand for their capacity to analyze and interpret the questions in a competent and salience based manner.

What this study does provide is an interesting perspective from the viewpoint of a group of stakeholders that are in many respects, generally involved in the overarching issues of entrepreneurial pathway building within modern universities. Thus the findings provided in this paper, although weakly supported, do pose interesting avenues for new research. That the findings align positively with control variables, as well as resonate highly with the findings of other studies that have surveyed EE programs and USO processes, we believe that they do have value and are empirically justifiable. It must be noted that a sample of Canadian entrepreneurship academics and universities is comparatively small.
in relation to studies performed in other larger nations and that the reliance upon parametric methods for justification of this paper’s findings was coupled with stronger non-parametric findings.

6.2 Implications and future research

There are several implications that can be drawn from this research. The first is that the existence of technology entrepreneurship courses at university may explain some of the variance in USO performance between universities. These programs need to be reviewed in a more comprehensive manner in order to better understand and test the many factors that are relevant to this construct. Are the courses experiential? Do they offer mentorship, access to networks or financial resources? What are the structures of these programs and what are the linkages between other dimensions (both internal and external to the university)? Perhaps most critically, what are the measurable outcomes from these programs? Further studies that link a well documented accounting of breadth, depth and focus and support of EE programs with USO creation may be beneficial to the research field. Also, determining whether EE programs increase the propensity for students, staff and/or surrogate entrepreneurs to spin out patented research and whether or not they influence the survival rate, growth, and type of spin outs formed is a further area of research that requires attention.

Secondly, the conceptual and empirical findings of this research support the individual and team based existence of entrepreneurial capacity to be a significant factor in the university commercialization process. Further investigation of indirect linkages between USO activities and EE programs may prove fruitful in uncovering some of the informal entrepreneurial processes that exist within the university innovation system (Murray 2004). Identification of entrepreneurial processes in as many variant forms and their outcomes as possible within a university context may provide a rich dataset from which to begin constructing patterns and building theory using a variety of variance and narrative based approaches to understanding process within the university context for enterprise and commercialization facilitation (Gartner, 1985; Steyaert 2004; Van de Ven et al. 2004). As well, the lack of convincing support for direct collaboration between
technology transfer and EE programs may very well be a sign of an emerging or untested model that deviates from the norm. The advantages to be realized from these two university functional areas working together must be investigated, barriers identified, and empirical testing of their relationship and outcomes considered. With the huge injections of funds being poured into university research systems around the world, it is imperative that the link between new knowledge creation, entrepreneurial capacity and innovation be further explored and the ways in which task specific tools and the programs, routines and collaborations for facilitating spin out formation be thoroughly examined. Entrepreneurship education programs and centers for outreach and collaboration with business are a fairly new phenomenon. Commercialization functions involving industry liaison or technology transfer units are the dominant regime of today, but the potential for change and the development of new pathways for using these programs to collaborate with or lead commercialization functions at university are not yet fully explored and offer many intriguing possibilities.

7 Conclusion

We argue that it is imperative to consider the linkages between EE and USO creation from many different perspectives. Entrepreneurial theory has a great deal to offer universities in transition seeking to become more innovative. As the USO becomes an increasingly important piece of the commercialization process, those individuals with understanding and expertise in both applied research and entrepreneurial process will gain increasing value. Although the findings of this study offer a provocative direction for researchers to embark upon, more evidence must be collected that supports the conceptual significance of entrepreneurship education as a mediating variable for entrepreneurial capacity building, and that through their expert and strategic operation, impact upon both the USO process; as well as the greater overarching challenge of creating entrepreneurial universities that are better positioned to handle the demands of the knowledge economy. The question then focuses less on the “why” and more on the “how” of creating collaborative models for commercializing all types of knowledge assets produced across the full spectrum of functional dimensions of the university,
whether it is through a USO process or through other innovative processes that creates socioeconomic value through identifiable, effective and measurable pathways.

References


AUCC website: [http://www.aucc.ca/](http://www.aucc.ca/)


Lenoir, Timothy, Nathan Rosenberg, Henry Rowen, Christophe Lécuyer, Jeannette Colyvas, and Brent Goldfarb. “ Inventing the Entrepreneurial University: Stanford

http://siepr.stanford.edu/programs/SST_Seminars/Lenoir.pdf


