Entrepreneurship Education in Non-Business Schools
Best practice for Australian contexts of knowledge and innovation communities

Chris Collet
ALTC Teaching Fellow
Support for this Fellowship was provided by the Australian Learning and Teaching Council Ltd., which is an initiative of the Australian Government. The views expressed in this report do not necessarily reflect the views of the Australian Learning and Teaching Council or the Australian Government.

This work is published under the terms of the Creative Commons Attribution-Noncommercial-ShareAlike 3.0 Australia Licence. Under this Licence you are free to copy, distribute, display and perform the work and to make derivative works.

**Attribution:** You must attribute the work to the original authors and include the following statement: Support for the original work was provided by the Australian Learning and Teaching Council Ltd, an initiative of the Australian Government Department of Education, Employment and Workplace Relations.

**Noncommercial:** You may not use this work for commercial purposes.

**Share Alike:** If you alter, transform, or build on this work, you may distribute the resulting work only under a licence identical to this one.

For any reuse or distribution, you must make clear to others the licence terms of this work. Any of these conditions can be waived if you obtain permission from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-sa/3.0/au/> or send a letter to:

Creative Commons
543 Howard Street, 5th Floor
San Francisco California 94105
USA.

**Requests and inquiries** concerning these rights should be addressed to:

Office for Learning and Teaching
GPO Box 9880 9880 Location code N255EL10
Sydney NSW 2001
Australia

Telephone: 02 6240 0625
Facsimile: 02 6267 4499

Or to learningandteaching@deewr.gov.au

2011

ISBN
978-0-642-78204-5 [PRINT]
978-0-642-78205-2 [PDF]
978-0-642-78206-9 [RTF]
# Table of Contents

Definitions ................................................................................................................................. 2
About the Author ......................................................................................................................... 2
Acknowledgements ..................................................................................................................... 2
Executive Summary ..................................................................................................................... 3
Introduction ................................................................................................................................. 4
   The Research – Industry Nexus .......................................................................................... 4
   Why does Australia need entrepreneurship education? ...................................................... 5
   Why this Fellowship? .............................................................................................................. 7
Program Aims and Approaches ................................................................................................. 7
   Aims ....................................................................................................................................... 7
      Approach to Activities ....................................................................................................... 8
         Aim 1: Skills for Innovation Commercialisation .............................................................. 8
         Aim 2: Best Practice Exemplars of Entrepreneurship Education ................................... 10
         Aim 3: Resource Development for Entrepreneurship Education .................................. 12
Skills for Innovation Commercialisation .................................................................................. 13
   Respondent characteristics ................................................................................................. 14
   Credentialism ......................................................................................................................... 14
   Graduate Skills ..................................................................................................................... 17
A Model ..................................................................................................................................... 20
Vignettes of Best Practice ......................................................................................................... 23
   Masters by Research ........................................................................................................... 24
   The TEC Program – North Carolina State University ......................................................... 26
   Center for Student Innovation – Rochester Institute of Technology ................................. 28
   E*ntrepreneurship at Rensselaer – Rensselaer Polytechnic Institute ................................. 30
   IDEA – Northeastern University .......................................................................................... 32
   Innovation Space – Arizona State University ..................................................................... 34
   Stockholm School of Entrepreneurship ............................................................................. 36
   Maison de l’Entrepreneuriat – Université de Grenoble ....................................................... 39
   Center für Innovation and Entrepreneurship – Karlsruhe Institute of Technology ............ 40
   Charity Entrepreneurship – Dublin Institute of Technology .............................................. 41
   The Hothouse – Dublin Institute of Technology .................................................................. 43
Fellowship Outcomes @ QUT ................................................................................................. 44
   The QUT Innovation Space ................................................................................................. 46
      History ............................................................................................................................... 46
      The QIS Explained (Advertising material) ...................................................................... 47
      Current QIS Activities ..................................................................................................... 49
   The Q_Hatchery ................................................................................................................. 51
      The Q_Hatchery Explained (Advertising material) ........................................................... 51
      Current (proto-) Q_Hatchery Status ................................................................................. 53
University-Wide Competitions ............................................................................................... 55
Reflections on a Journey by ALTC Teaching Fellowship ......................................................... 57
A Final Word .............................................................................................................................. 62
Appendix 1 – Survey of Industry ............................................................................................ 63
Appendix 2 – International Links ............................................................................................ 65
Appendix 3 – RPI E*ship Exemplars Points System ............................................................... 75
Appendix 4 – Reference Works Cited ..................................................................................... 78
Definitions

The terms 'unit', 'subject' and 'course' have different meanings in different international contexts. Throughout this report, the term 'subject' is used to describe a self-contained block of teaching (aka 'unit' at some institutions), usually of one semester length, whereas a 'course' is used to describe the whole program of study that leads to award of a degree or diploma. In Australia, undergraduate courses or degrees normally comprise six semesters spanning three years with each semester composed of four 'subjects'.

About the Author

Chris has spent over 30 years researching the molecular biology of organisms as divergent as microalgae, bananas, marsupials, birds, fish and fruit fly. During his years as a research scientist, Chris saw many innovative discoveries progress no further than the laboratory bench. In keeping with his disruptive innovation approach to science research, Chris developed an entrepreneurship education program in biotechnology that targeted graduates to the commercialisation and technology transfer sector. The degree created a new career pathway into the technology commercialisation infrastructure such that graduates of the Bachelor of Biotechnology Innovation successfully compete against PhDs with MBAs for jobs. In recognition of his teaching leadership, Chris has received two university and three national teaching awards and a prestigious Teaching Fellowship from the Australian Teaching and Learning Council.

Acknowledgements

I will always be grateful to the Australian Learning and Teaching Council for providing me with opportunities to learn and to experiment with curriculum that have enabled me to embark on a journey; one which has yet to arrive at its destination.

Siobhan Lenihan requires a special mention for her encouragement, guidance and infinite patience.

To my wife, Trudi, for the long periods away from home.
Executive Summary

In the current era of global economic instability, business and industry have already identified a widening gap between graduate skills and employability. An important element of this is the lack of entrepreneurial skills in graduates. This Teaching Fellowship investigated two sides of a story about entrepreneurial skills and their teaching. Senior players in the innovation commercialisation industry, a high profile entrepreneurial sector, were surveyed to gauge their needs and experiences of graduates they employ. International contexts of entrepreneurship education were investigated to explore how their teaching programs impart the skills of entrepreneurship. Such knowledge is an essential for the design of education programs that can deliver the entrepreneurial skills deemed important by industry for future sustainability.

Two programs of entrepreneurship education are being implemented at QUT that draw on the best practice exemplars investigated during this Fellowship. The QUT Innovation Space (QIS) focuses on capturing the innovation and creativity of students, staff and others. The QIS is a physical and virtual meeting and networking space; a connected community enhancing the engagement of participants. The Q_Hatchery is still embryonic; but it is intended to be an innovation community that brings together nascent entrepreneurial businesses to collaborate, train and support each other. There is a niche between concept product and business incubator where an experiential learning environment for otherwise isolated ‘garage-at-home’ businesses could improve success rates. The QIS and the Q_Hatchery serve as living research laboratories to trial the concepts emerging from the skills survey.

The survey of skills requirements of the innovation commercialisation industry has produced a large and high quality data set still being explored. Work experience as an employability factor has already emerged as an industry requirement that provides employee maturity. Exploratory factor analysis of the skills topics surveyed has led to a process-based conceptual model for teaching and learning higher-order entrepreneurial skills. Two foundational skills domains (Knowledge, Awareness) are proposed as prerequisites which allow individuals with a suite of early stage entrepreneurial and behavioural skills (Pre-leadership) to further leverage their careers into a leadership role in industry with development of skills around higher order elements of entrepreneurship, management in new business ventures and progressing winning technologies to market. The next stage of the analysis is to test the proposed model through structured equation modelling.

Another factor that emerged quickly from the survey analysis broadens the generic concept of team skills currently voiced in Australian policy documents discussing the employability agenda. While there was recognition of the role of sharing, creating and using knowledge in a team-based interdisciplinary context, the adoption and adaptation of behaviours and attitudes of other team members of different disciplinary backgrounds (interprofessionalism) featured as an issue. Most undergraduates are taught and undertake teamwork in silos and, thus, seldom experience a true real-world interdisciplinary environment.

Enhancing the entrepreneurial capacity of Australian industry is essential for the economic health of the country and can only be achieved by addressing the lack of entrepreneurial skills in graduates from the higher education system. This Fellowship has attempted to address this deficiency by identifying the skills requirements and providing frameworks for their teaching.
Introduction

The Research – Industry Nexus

While innovation creates intellectual capital (IP), it is the entrepreneurial process that drives the commercialisation of innovation to the global marketplace. Globally, the funding of innovation has focused predominantly on research, pure and applied; with little attention paid to the commercialisation of research outcomes. Outside of the USA, a major criticism of funding of research-industry partnerships recognises that the competing tensions of academic versus industry imperatives often see the commercialisation potential of the nexus never fully realised.

Importantly, in Australia and elsewhere, the approaches and processes of commercialisation has itself been bereft of innovation in the relationship between research institutes and industry partners seeking to bring new discoveries to market.

In the USA, the relationship between industry and research is close and overlapping. The blurring of academic and research boundaries is unique to this entrepreneurial culture where the sheer volume of research and the investment mentality regarding new ventures foster the “cluster” approach to creating, sharing and commercialising innovation.

In the Australian innovation ecology, research – industry partnerships are usually a linear relationship and technology transfer offices traditionally sit between the industry partner and the research institute. The latter are usually understaffed, not highly resourced and conservative in nature and approach. Education, in this linear context, has traditionally been seen as funding for higher degree research students.

Prior to the Lisbon Accord of 2002, the model of industry – research partnerships was the same in the European Union (EU) as that in the Australian landscape. The European Commission (EC) now recognises education as a third component to the industry – research partnership and

---

defines a knowledge and innovation community (KIC) as a triple helix of interactions between these three co-dependencies2. Calls for an increased education component of industry – research partnerships were interpreted within the EU Framework Program 7, the major funding scheme for innovation, as the training of higher degree research students and included support schemes intended to increase mobility between member States.

In response to the continuing record of poor transition of innovation to marketplace, education in the KIC has been redefined in recent years to encompass a major role for entrepreneurship education. Consequently, the European Institute of Innovation and Technology (EIT) was established to focus on improving the innovation to enterprise pipeline. The language that features in EIT documentation is business-centred rather than discovery-focused. The EIT aims to fund entrepreneurship education programs in higher education institutes as a pathway to developing an entrepreneurial culture in the EC and securing an appropriately entrepreneurially attuned and skilled workforce. The explicit aim of this targeted reconceptualisation of the role of education is to accelerate innovations through the pipeline of commercialisation. The funding of KICs by the EIT also heralds one other significant shift recognising that distributed research – industry linkages and activities are not as commercially successful as those that are co-localised in a community.

Why does Australia need entrepreneurship education?

The benefits of curricula that boost national entrepreneurial capacity and impart enterprising skills have been noted in the academic literature, policy documents of governments' worldwide and reports from high-level think tanks (Organisation of Economic Cooperation and Development3, the World Economic Forum4 and the National Academy of Sciences (USA)5). The need for entrepreneurship education is considered a given in this material. Over the last decade, there has been substantial debate in the literature that the traditional didactic approach to teaching entrepreneurship in business schools is disconnected from the process of innovation

---

The argument proceeds that traditional business degrees do not provide the skill sets required to transform complex technological innovation into viable commercial products. A 2008 report on best practice published by the EC notes the real challenge is to develop fully integrated entrepreneurship education programs outside of business schools. It is also becoming apparent that the divide between the content of educational training programs and the emerging practices of taking innovation to enterprise is increasing as a consequence of the rapid evolution of industry. While this may have been an issue restricted to the new industries (such as digital media), it is now apparent more generally across business, commerce, and the manufacturing industry. In the 2011 policy document Skills for Prosperity, Skills Australia recognised the widening gap between the industry requirements around employability and industry-readiness, and the training of graduates. The policy document espouses the need for industry to be involved in the training process citing as a reason the rapid evolution of business, commercial, and industrial practices in the marketplace. The traditional training providers, industry argues, are losing touch with the latest developments in business, commerce, and manufacturing. Nor are the processes of up-skilling the training providers adequate. Although Skills Australia was referring specifically to the TAFE sector, the same adage applies, perhaps doubly so, to the Australian university sector with its ageing workforce, transition from non-professional degrees and focus on research as the primary measure of prestige. Concepts where training and learning is ‘just-in-time’, ‘360-degree’, ‘action-oriented’ and within ‘connected communities’ involving the ‘learner-as-teacher’ are emerging as the future paradigms of teaching in everyday industries now considered as fast-evolving.

In 1994, two doyens of entrepreneurship education, Karl Gartner and William Vesper, argued the heart of entrepreneurship involves action, and that learning-by-doing is the most important enabling tool in entrepreneurship education. Similarly, successful entrepreneurs often learn by doing (action-oriented) and as required (or just-in-time), learning only what is required from those in the know and giving feedback (or 360-degree), and are characterised by developing extensive interlaced networks of high value individuals (connected communities). Most successful entrepreneurs move on to mentor budding entrepreneurs (learner-as-teacher).

It would seem that we are witnessing a collision between the age-old problems of delivering efficacious and successful entrepreneurship education programs and the new-age issue of delivering applicable and relevant general skills training in rapidly evolving industries. This convergence is not surprising as industry recognises the skills underlying entrepreneurship (i.e., the enterprising skills of risk-taking, opportunity recognition, action-orientation, drive to succeed) as important for future business sustainability through innovation that is both systemic and disruptive.

---


Why this Fellowship?

The innovation and entrepreneurial skills that underpin the innovation commercialisation sector highlight the emerging skills requirements of Australian industry. This ALTC Teaching Fellowship looks to investigate entrepreneurial or enterprising skills in the Australian innovation commercialisation industry and how these skills are taught in international contexts of entrepreneurship education. This knowledge is essential for the driving the design of education programs in the Australian higher education sector that will deliver the entrepreneurial skills required for the employability of graduates and the future vitality of Australian industry.

Program Aims and Approaches

This ALTC Fellowship has sought to listen to and assess both sides of a story about innovation commercialisation skills. From those at the heart of the Australian innovation commercialisation industry in order to gauge their needs, their expectations and their experiences with the graduates they employ. The other side of the story explores the point of view of those who develop innovative teaching and learning programs globally that target the skills of entrepreneurship.

The goal of the Fellowship is to enhance the understanding and appreciation of skills requirements of the innovation commercialisation sector and to begin to develop programs of entrepreneurship education (or education in enterprising behaviours and skills) in the Australian higher education sector that impart the requisite skills. The end purpose is to incorporate the findings into education programs at tertiary level that:

- Provide avenues for students to learn the required skill sets;
- Improve the employability of graduates; and
- Increase the entrepreneurial capacity of Australian business.

Aims

This ALTC Fellowship encompassed three specific aims that determined the approach to activities (below):

1. Determine the desirable skill sets for employability in the Australian innovation commercialisation sector;
2. Examine and distil best practice procedures from targeted international contexts, and
3. Develop resources to enable best practice exemplars of education in innovation and entrepreneurship to be embedded in the Australian higher education curriculum.
Approach to Activities

Aim 1: Skills for Innovation Commercialisation

Stated Aim: Determine the desirable skill sets for employability in the innovation commercialisation sector.

Considered Approach: A survey of Australian innovation commercialisation organisations was undertaken to examine the skills requirements of the organisation and the perceived skills deficiencies in recently employed graduates.

Derivation of Questionnaire

An early restriction was placed on survey coverage. Innovation commercialisation is a complex pipeline process that begins at one end of the spectrum with ideation, creativity and innovation and finishes at the other end with a product in the marketplace. Ideation, creativity and innovation are not phenomena irrevocably linked to entrepreneurship; ideation, creativity and innovation can occur in isolation while the entrepreneurship often feeds off them. It is entrepreneurship that occupies the pipeline between extremes and thus this survey is not concerned with innovation itself but the skills needed to commercialise the innovation.

All commercialisation pipelines require technical, generic and enterprising skills; the survey aimed to evaluate the importance of the particular skill set requirements in the industry and the apparent skills gap between the level required by industry requirements and that evident in graduates entering the industry. A guiding principle of the questionnaire design was flexibility to permit administration to both the core commercialisation industry as well as support industries such as venture capital firms, start-up companies, new venture divisions of large firms, government agencies, legal firms and research organisations.

Iterative rounds of searches of the extant literature and internet across a wide breadth of disciplines were used to derive a list of core skills that covered the three recognised domains of technical, generic and enterprising (or entrepreneurial) skills. Web-based sources of skills lists included the generic and specific competences (e.g., business, sciences) of the EU Tuning Project. The graduate capabilities list of QUT, which is essentially no different to that of most universities, was also partitioned into individual skill traits and included in the core skills list. Particular facets of the skill itself, its application and the degree of overlap with other skills confound phrasing of the topics/questions around appropriateness of skills in the workplace. Certain skills can be addressed easily. The core entrepreneurial skills of risk taking, opportunity recognition and drive for success can be considered from a one-dimensional standpoint. On the other hand, the generic reference to team skills, which appears in the list of desired graduate capabilities of every tertiary institute on the globe, is more complex a trait when measuring success of graduates in an innovation commercialisation context. Particular attributes of team skills are of importance in driving a concept through product development. From a simple
viewpoint, all team members must have an awareness of roles and responsibilities whatever the team composition. On the other hand, the term working collaboratively has different implications in teams of like-minded and like-tasked individuals versus multidisciplinary teams where knowledge, skills and behaviours must be shared. In the latter case, the application of team skills also addresses interdisciplinarity and interprofessionalism. In terms of application, the manifestation of, or the requirement for, the skill spans a spectrum through various levels of knowledge (awareness, competency, deep), to the synthesis of knowledge (equivocal/unequivocal; understanding/appreciation) and the ability to apply that knowledge synthesis to familiar and unfamiliar situations.

Approximately 35 core skills were analysed through facilitated interpretative discourse that considered the various elements of overlapping intent of broad scope coverage and the myriad multidimensional facets that each implied in the innovation commercialisation context. Approximately 200 skill topics were derived centred on the manifestation of, or the requirement for, elements of the core skill. Subsequent rounds of facilitated discourse undertook reiterative differential categorisation, prioritisation and construct validation to realise 61 topics.

The final survey comprised 74 primary questions or topics grouped into eight categories (see Appendix 1). The first category consisted of seven questions that addressed demographics of the respondent’s organisation. The second category (credentialism) comprised six questions that sought to ascertain the credentials of the respondent and recently employed personnel, and to ascertain the utility of the respondent’s credentials in the decision-making processes of the organisation. The latter topic emerged as an issue when looking at barriers to graduate entry into the commercialisation infrastructure made evident to the Fellow as part of the outcomes associated with QUT’s Bachelor of Biotechnology Innovation.

The third category comprised the remaining 61 primary topics that addressed a particular graduate skill (including behaviour or attitude) or its application, with each topic included two questions:

- How important (IMP) are each of the following skills to your organisation?
- How evident (EVD) are each of these skills in the graduates you employ?

Topics within the six categories assessing graduate skill levels were distributed as follows:

- Entrepreneurial skills (15),
- Generic skills (11),
- Knowledge (4),
- Information management (6),
- Individual performance (5),
- Practice-focused skills (9) (disciplinary, interdisciplinarity and interprofessionalism), and
- A miscellaneous collection (11) including stand-alone questions or questions with considerable overlap between other nominated categories.

The questionnaire design included a Likert 5-point scale with no neutral point to avoid courtesy bias on the part of respondents and eliminate ambivalence as a common contributory factor to surveys where questions relate to attitudes or preferences.

Survey Procedure

The names of target organisations, their contact details and appropriate personnel, were collected through internet searches of government and private directories of research, development and commercialisation organisations and through searches using phrases such as ‘technology transfer’, ‘research commercialisation’, ‘technology commercialisation’, ‘venture capital’, ‘intellectual property’ and variations thereof. For example, government directories provided lists of Cooperative Research Centres, Centres of Excellence, research institutions and technology transfer offices. In the case of large organisations, such as Divisions of CSIRO, universities and research institutes, individual web sites were searched for the appropriate contact point. Including discipline names in text the string (e.g. ‘creative industries’, ‘multimedia’, ‘information technology’, ‘biotechnology’) also extended the search scope. The large number of results returned made this approach inherently difficult to apply and routinely failed to reveal any additional potential survey respondents. By definition, the organisations targeted are adjuncts to knowledge-intensive innovation industries and thus may not be representative of the commercialisation pipeline but rather representative of the innovation commercialisation pipeline.

As the industry in Australia is small, it was decided to undertake the survey by telephone interview to improve response rates. The Institute of Social Science Research (The University of Queensland) conducted telephone interviews during February 2011, and the survey achieved 207 responses from a list of 452 possible respondents (= response rate of 45%).

Analysis of Results

Rather than testing theory, the survey was designed as an exploratory exercise with the aim of building theory. The dataset generated by the survey is large and complex; analysis and interpretation are still being undertaken. Survey data manipulation and statistical analyses utilises the SPSS package of data to process and manipulate the survey data. A stepwise progression methodology is being followed with the data transformation and interpretation as follows: (1) an identification of the items (skills) of importance to the innovation commercialisation industry using Pearson’s chi-squared tests for independence between IMP and EVD, (2) classification of the items into constructs (skill fields) using exploratory factor analysis to search for influencing variables with internal consistency of construct validity examined using Cronbach’s alpha test, and (3) a search for causality using regression analysis and structured equation modelling. As the analysis is exploratory, reiterative rounds of data and outcomes assessment are being undertaken through discourse and reflection, with concomitant refinements to methodological approaches, in progressing through initial stages of examining the large data set.

Aim 2: Best Practice Exemplars of Entrepreneurship Education

Stated Aim: Examine and distil best practice procedures from targeted international contexts.

Considered Approach: Best practice exemplars were identified through literature and internet searches. Australian exemplars were very restricted in number and have not been examined in this survey. The QUT exemplars routinely sit atop the internet search results.
Selection of International Exemplars

Reiterative internet searches were conducted with the search terms: ‘education’, ‘student’, ‘entrepreneurship’, ‘innovation’, ‘creativity’, ‘laboratory’, ‘space’, ‘enterprising skills’, ‘technology commercialisation’ and combinations thereof. Although, education programs in higher education contexts were a primary focus, results indicating entrepreneurship education in other organisation contexts were also screened across the first 100 hits returned for any combination of search terms. The organisation contexts outside of higher education institutes provided mostly reports of programs provided through educational institutes, including higher education, or initiatives of regional development offices of governments and councils.

For the European context, a number of European Commission reports provided a base line for collecting information on various entrepreneurship education programs. The most influential of these reports which informed the case study visits is the March 2008 report from the EC Enterprise and Industry Directorate-General entitled ‘Best procedure project: Entrepreneurship in higher education, especially in non-business studies’\textsuperscript{15}. Across the European Union, the contexts of entrepreneurship programs appeared more diverse in nature and more recent in introduction.

For the USA context, internet search results revealed a more uniform approach to entrepreneurship education programs with two modes of delivery predominant. In the curriculum space, business schools deliver undergraduate and master’s entrepreneurship programs with a strong theoretical content. Each year, \textit{The Princeton Review} publishes a ranking of the entrepreneurship education programs, undergraduate and graduate, based on a review of the offerings of 2000 higher education institutes. The top 25 programs in either category emanate from business schools or colleges. The second mode of delivery or activity often found is the extracurricular business plan competition. Many of these competitions have been in operation for some time (> 10 years). Most were not accompanied by any apparent training process; instead appearing to rely on the innate entrepreneurial ability of the competitors to provide a differentiating factor. Nonetheless, over the last three years, a number of initiatives have been implemented which provide a less ‘cookie-cutter’ approach to instilling entrepreneurial intent in students.

Literature searches were also carried out using the Web of Knowledge database, primarily, Scopus and other databases available through QUT Library. Direct literature searches provided fewer pointers than internet searches to active education programs that could be evaluated for content and context. Where literature searches pointed to programs of interest, such programs had already been found using the reiterative internet search routines.

Several guiding principles were used to inform the selection process. An over-riding factor in selection was the context of the program; learning by doing and action orientation outside of business schools was the initial criterion. Apparent size and scope of the program were influencing factors as well as the advertised outcomes of the program. Other factors were also deemed important. The aim of the Fellowship is to create materials that facilitate introduction of entrepreneurship education in the Australian higher education sector where there is a dearth of such programs. Factors such the apparent ease of program implementation, a diversity of delivery modes, the level of staff involved and university support, sustainability and transferability were also considered.

\textsuperscript{15} European Commission (2008) \textit{Op cit.}
Implicit in the selection process was an assumption that the programs contain a regime designed to deliver training in a suite of ‘entrepreneurial’ skills in an environment of innovation and creativity in higher education.

**Aim 3: Resource Development for Entrepreneurship Education**

*Stated Aim: Develop resources to enable best practice exemplars of education in innovation and entrepreneurship to be embedded in the Australian higher education curriculum.*

Considered Approach: This aspect of the Fellowship aims to bring together the two major study components: industry expectations and higher education curriculum. To provide a resource of examples of programs, the different models of entrepreneurship education programs are being developed into reports that highlight their educational approaches, context, organisational structure, resource requirements and offerings. As there is an overall dearth of entrepreneurship education programs in Australia, this resource should provide a "starting point" for educators interested in following this avenue of teaching and scholarship. The research collected has also been used to develop a number of entrepreneurship education programs that are being implemented at QUT. These programs are serving as the testing grounds for establishing the parameters, conditions and responses to implementing entrepreneurship education programs in the Australian context.
Skills for Innovation Commercialisation

Innovation has long been recognised as a key driver of economic growth and prosperity. Increased global competition over the last twenty years arising from both the emergence of the mega-economies of China and India, and emerging economies in South America, Asia and Africa, has focused the attention of world governments, particularly in developed countries, on the need to revitalise and stimulate economies. Industry and government awareness has been accompanied by increased policy documents and initiatives aimed at stimulating innovation. A deeper understanding of the issues at hand point to the need not only to innovate; but also to commercialise and disseminate those innovations. With a heightened economic imperative focused on innovation, the diverse industry that is innovation commercialisation has become a high profile high technology sector with significant influence, impact and leverage. By definition, and in contrast to the commercialisation process, innovation commercialisation is an industry highly dependent on technical knowledge and skills coupled with a well-developed applied and experiential framework to drive successful outcomes. Consequently, credentialed individuals who build successful careers based on a learning-by-doing approach populate the industry.

Diversity in the industry arises as the commercialisation of innovation is a very context specific process; highly dependent upon the nature of the grounding discipline (or inter-discipline). For example, the technological scope, the long gestation period in research and development (12 – 15 years) and huge financial commitment (upwards of US$1 bn) to bring an innovation such as a novel therapeutic to market contrasts the relatively short timespan (< 18 months) and modest investment (< $300,000) that can accompany a new application for a smartphone. The former requires a larger, highly regulated, compliance-oriented pipeline process involving the contributions of scientific inventors, mathematicians, chemists, technicians, product developers, business people, venture financiers, lawyers, and an increasing number of clinical trials specialists. Each is involved in leveraging their product onto a global marketplace through alliances and partnerships with multinational pharmaceutical companies. In this instance, no one person may manage the commercialisation pipeline from start to finish and the inventor is likely to be divorced (voluntarily or involuntarily) from the process during the early phases of the venture. The inventor of a software application is in a position to manage the product development and commercialisation processes with a small team that can distribute the product globally through a simpler framework relatively free from regulation and compliance issues. Whatever the technological focus of the player, success in the industry is dependent not just on the inherent novelty and utility of the innovation but on the ability to sell the innovation in a market populated with competing technologies or services.

This phase of the study is being undertaken in conjunction with Associate Professor Damian Hine of the UQ Business School. Dr Hine and I designed a survey instrument that could capture the expectations of those in the innovation commercialisation industry and contrast that with the experience they have had with graduates they have employed. The survey was conducted in early 2011, and 207 useable responses were gained from mostly senior managers in organisations dedicated to innovation commercialisation. Application of the statistical analysis is being undertaken by Karen du Plessis, while analysis and interpretation of the survey data, inclusive of reiterative rounds of discourse and reflection, are being undertaken in conjunction
with Associate Professor Hine. This report offers an initial assessment of the data emanating from the survey.

**Respondent characteristics**

ELECTING TO USE A PROFESSIONAL TELEPHONE SURVEY ORGANISATION, THE INSTITUTE OF SOCIAL SCIENCE RESEARCH, RESULTED IN AN EXCELLENT RESPONSE RATE OF 45% PROVIDING A DATA SET OF HIGH QUALITY. THE SURVEY REALISED 207 RESPONSES FROM INDUSTRY PERSONNEL WITH 94.2% OF RESPONDENTS REPRESENTING MANAGEMENT: MIDDLE (25.1%) AND UPPER LEVEL (SENIOR MANAGER: 36.7%; CEO 32.4%). FOUR SECTORS DOMINATED THE INDUSTRY GROUPS MAKING UP 88% OF THE RESPONDENTS: HEALTH AND COMMUNITY SERVICES (20%), PROPERTY AND BUSINESS SERVICES (20%), AGRICULTURE, FORESTRY AND FISHING (22%) AND A MISCELLANEOUS GROUP (VARIOUS) (26%). MINING, MANUFACTURING, GOVERNMENT ADMINISTRATION AND DEFENCE, UTILITIES AND COMMUNICATION SERVICES WERE ALL AT OR BELOW 4%. THE SECTOR REPRESENTATION REFLECTS THE NON-RANDOM SAMPLING APPROACH TO TARGET SELECTION WITH A FOCUS ON THOSE ORGANISATIONS WHOSE BRIEF IT IS TO COMMERCIALISE INNOVATIONS. THERE ARE SOME ACCEPTED LIMITATIONS TO THIS TECHNIQUE; NAMELY THE PROBLEM OF OVERLOOKING TYPES OF ORGANISATIONS, ESPECIALLY SMALL-TO-MEDIUM ENTERPRISES. THE MAJORITY (70%) OF INDUSTRY ORGANISATIONS WERE UNDER 40 YEARS OF AGE WITH 55% LESS THAN 20 YEARS OLD AND OVER HALF OF THE ORGANISATIONS EMPLOYED UP TO 100 EMPLOYEES AND ALMOST ALL HAD LESS THAN 2000 EMPLOYEES. AS ONE WOULD EXPECT, THE GEOGRAPHIC FOCUS OF THE ORGANISATIONS WAS PRIMORDIALLY INTERNATIONAL (49.8%) OR NATIONAL (39.6%) WHILE THOSE WITH A REGIONAL (8.2%) OR LOCAL (2.4%) FOCUS WERE IN A DISTINCT MINORITY.

**Credentialism**

THE SURVEY RESPONDENTS REPRESENT A HIGHLY CREDENTIALED POPULATION OF INDIVIDUALS: 42% HAD A HIGHEST QUALIFICATION OF A PHD, 23.5% HAD A MASTER’S DEGREE AND 34% GRADUATED WITH A BACHELOR’S DEGREE (INCLUDING HONOURS).

OF THE EMPLOYEES HIRED BY THE ORGANISATIONS IN THE LAST THREE YEARS, THE MAJORITY (83.8%) OF EMPLOYEES WERE RECENT GRADUATES (37.3%) OR HAD GRADUATED LESS THAN A YEAR BEFOREHAND (14.1%) OR WERE PREVIOUSLY EMPLOYED GRADUATES (32.4%). NON-GRADUATES ACCOUNTED FOR 16.2% OF RECENT EMPLOYEES. AS NOTED ABOVE, HIGHLY CREDENTIALED INDIVIDUALS POPULATE THE INNOVATION COMMERCIALISATION INDUSTRY. A LARGE PERCENTAGE OF GRADUATES EMPLOYED HAD THE HIGHER-LEVEL QUALIFICATIONS OF MASTER’S DEGREE (12.9%) OR PHD (31.6) AND ALMOST 42% OF EMPLOYED GRADUATES HAVE AT LEAST A BACHELOR’S DEGREE. THE HIGH PROPORTION OF GRADUATES WITH POST-BACHELOR’S DEGREES (44.5%) SUPPORTS THE NOTION OF AN INDUSTRY REQUIREMENT FOR ADVANCED KNOWLEDGE AND SKILLS BASE.

![Figure 4 – Per cent qualifications of employees in the innovation commercialisation industry.](image-url)

*Degree abbreviations: Bach = bachelor; PhD = Doctor of Philosophy; MBA = Master of Business Administration.*
When hiring graduates, industry respondents placed more weight on the importance of technical knowledge (56%) than that of generic skills (e.g. communication, team work) at 44%. Nonetheless, the distribution suggests that both technical knowledge/skills and a command of the soft skills are considered important by management in determining the employability of graduates in the innovation commercialisation context. The high demand for soft skills reflects the nature of the innovation commercialisation industry where the success of players, and hence their employer organisation, is dependent on cultivating relationships to licence or sell the innovation to larger players in their sector, to form alliances with partner organisations and in securing both R&D and distribution networks in a landscape of heavily competing technologies.

Although the commercialisation industry values the qualifications of the credentialed graduate (56%), work experience is recognised as an important component of employability at 44%. Work experience provides a contextualisation and relevance factor that is not otherwise achieved in a degree course setting; i.e. recent graduates are not usually industry-ready despite the fact that many programs have introduced some form of internship or industry placement in recent years. Managers see that work experience provides employee maturity, honing awareness of the commercial imperative. In this regard, the high demand for a level of work experience is reflected in the gap analysis on the scaled questions (see below), which highlights the perception that graduates may be equipped theoretically for the workforce but lack an experiential base that affects workplace decisions and activities impacting on business success. Employers regard this ‘blooding’ of new employees in the real world imperative as requisite training and the importance placed on experience is further reflected in the responses to the question relating to the decision-making processes. What the observed response distribution may also highlight are additional, possibly combinatorial, attitudinal factors such as: (1) unwillingness on the part of this particular industry to engage in the early training experience of the recent graduate, and (2) a failure of university courses to adequately develop industry-ready graduates for employability in this sector. This may also be a hangover of an Australian industrial landscape in which traditionally commercial entities focus on production and distribution and leave the innovation to “others” such as universities, CSIRO, hospitals, other government agencies and backyard inventors.

From the Fellow’s perspective, this demand for work experience as a component of graduate employability may also underscore the success witnessed in the graduate outcomes of the QUT Bachelor of Biotechnology Innovation when compared with graduates of the business – biotechnology double degree. The former comprises a substantive (one entire semester) industry-based business development project around initial concept ideas which serves as work-related experience whereas the latter lacks any directed high level work experience.

---

The value of the experiential framework alters over time and takes a prominent role in the decision-making processes of management in an innovation commercialisation context. Although a highly credentialed population, the qualifications of the respondents are not the most significant contributing factor in decision-making activities (at only 27%); rather work-acquired experience provides the most important component of business success (73%). This suggests that businesses decisions are informed predominantly by previous experiences: successes and failures and the learning that occurs as a result of these experiences.

These results highlight an interesting dichotomy between the relative contributions of higher-level technical qualifications and work-acquired experience in plotting a commercialisation pathway for an innovation. Evidence suggests the value of in-depth technical knowledge is supplanted quickly as disciplines evolve and merge, and the importance of understanding the complex technical aspects that are emphasised in higher degree qualifications is of little relevance. Thus, in innovation commercialisation, there appears to be a requirement for a threshold qualification as distinct from its actual use.

Collet (2012) highlights the opposing attitudes that exist in the biotechnology industry regarding the employment suitability of graduates of a blended undergraduate degree that targets the bio-innovation commercialisation infrastructure. The employer target market of biotechnology commercialisation is dynamic and high profile where players bring together components of the commercialisation pipeline process. Players are usually highly credentialed with a PhD and an MBA. Industry sector success is dependent on selling the innovation; usually amongst competing technologies. A minority in the biotechnology industry maintain that the course does not satisfy industry requirements citing the lack of depth in the technical discipline and an understanding of the scientific process that can only come from a PhD degree. This recurring message delivered at networking events impacts negatively on student attitudes and arises from a misunderstanding of course intent, which is to create business development associates whereas industry elements regard graduates as potential business development managers. Other biotechnology industry players argue that the ‘must have PhD’ mentality is a reflection on the credentialed pathway that the individual player took to arrive in the sector. Senior players in the sector argue that the most valuable tools in the decision-making process are work experience and the ability to learn the relevant disciplinary knowledge quickly. As innovations derive from interdisciplinary areas, the emphasis shifts from an in-depth knowledge of one area to an ability to learn and synthesise knowledge from an array of different sources (a desired graduate capability!).

Prior to this survey, anecdotal evidence collected by the Fellow suggested that the debate over qualifications versus experience was specific to the biotechnology commercialisation sector and some other science disciplines, such as chemistry and physics. Furthermore, the evidence suggested that such attitudes were not apparent in the technology-focused disciplines of engineering and information technology; nor were they apparent in the creative industries. First pass analysis of the data obtained in this study suggests that the must-have attitude regarding credentials may be more widespread amongst professional fields and industry sectors. Certainly, this dichotomy between requirement for a higher credential versus its

applicability in ongoing business actions both needs to be explored in a survey that targets a broader array of industries and contexts and represents a worthy future investigation.

**Graduate Skills**

At the simplest level, the survey sought to ascertain the perceived importance (IMP) of graduate skills in the innovation commercialisation industry from the viewpoint of the employer and to also contrast the perception that the employer group has of the skills level evident (EVD) in graduate employees. However, these variables are not necessarily independent. From the viewpoint of the respondent, the relative importance of any one skill in business activity is evaluated in comparison to a suite of other skills. The respondent is explicitly aware of this process of the survey. In questionnaires of this nature, it is not unusual for respondents to rate the importance of a variable highly as well as rate their own levels of attainment higher than they perceive as evident in others. While an overall ranking reveals broad trends in the IMP response (see Appendix 1) pointing to skills perceived to be of higher importance than others, the high standard deviation values make simplistic analysis meaningless. For each of the 61 questions, the IMP<sub>mean</sub> response was higher than the EVD<sub>mean</sub> (average means: IMP = 3.6: EVD = 2.78). The results overwhelmingly suggest a substantial gap exists between the skills considered essential for industry activity/success and those evident in recent graduates.

In reviewing graduate skills levels, the respondent is not engaged in a comparative ranking of the skills in graduates; the person is explicitly providing a value judgement about a perceived distance measure (deficiency) that implicitly provides an independent measure of the importance of the skill in the respondent’s activities. For this reason, it is the distance between the means of IMP and EVD that provides meaningful measures of skills importance (i.e., IMP<sub>mean</sub> minus EVD<sub>mean</sub> as a variable in itself).

It is important to reiterate that the design of the survey was both to explore industry perception and to further build on pre-existing theory; therefore, an integral part of the stepwise progression methodology is reiterative discourse and reflection regarding the meanings of the derived constructs and then deriving appropriate next steps in data analysis and construct classification and definition.

A Pearson chi-squared analysis was applied to test for independence between the IMP<sub>mean</sub> and EVD<sub>mean</sub> variable for each question. Of the 61 comparisons, only four showed no significant measure of independence (ability to recognise an opportunity, ability to negotiate, effective written communication skills, ability to apply knowledge in practice). These four item variables were discarded from further analyses. Two comparisons were significant at the p<0.01 level (ability to adapt to new situations (p = 0.004) and ability to adopt one’s skills and knowledge to fit with other professionals (p = 0.001)) while the remaining 55 IMP:EVD comparisons were significant at the p<0.001 level).

The next step in the analytical design was to classify the responses using exploratory factor analysis (EFA) to statistically classify the variables (factors) into constructs according to their similarity so that the hypothetical constructs that represent skill fields are revealed. A new variable was created for analysis based on IMP<sub>mean</sub> minus EVD<sub>mean</sub> and EFA undertaken on the new variable. The rotated component matrix resolved 11 constructs (see below). Interpretation of the table does not require any statistical knowledge. The factors on the right are those that have loaded together, creating a construct, which is named after consideration of the factors. Understanding of each construct simply requires consideration of the constituent factors in toto.
<table>
<thead>
<tr>
<th>Skill Field Construct &amp; Abbreviation</th>
<th>Cronbach Alpha</th>
<th>Variable Names &amp; Items</th>
</tr>
</thead>
</table>
| #1 Entrepreneurial Leadership (EL)   | 0.912          | Willingness to take risks  
|                                      |                | Ability to gain management support for a new enterprise  
|                                      |                | Ability to marshal resources for a new enterprise  
|                                      |                | Ability to identify key people in a venture  
|                                      |                | Ability to influence team behaviour to promote positive team outcomes  
|                                      |                | Ability to lead a new venture  
|                                      |                | Ability to form an effective team  
|                                      |                | Ability to inspire others  
|                                      |                | Knowledge of administrative systems  
|                                      |                | Ability to plan business ventures  
|                                      |                | Ability to mentor  
| #2 Transforming Information (TI)      | 0.896          | Ability to accurately document information from different sources  
|                                      |                | Ability to accurately report information  
|                                      |                | Ability to evaluate information and data  
|                                      |                | Ability to synthesise information and data  
|                                      |                | Ability to critically question  
|                                      |                | Ability to communicate effectively with discipline specialists  
|                                      |                | Ability to share new knowledge with others  
| #3 Technical Leadership (TL)         | 0.822          | Basic general knowledge in technical area  
|                                      |                | Ability to understand essential concepts relating to the specific discipline  
|                                      |                | Deep knowledge of a specific discipline  
|                                      |                | Ability to apply disciplinary knowledge to the solution of problems of a familiar nature  
|                                      |                | Ability to apply disciplinary knowledge to the solution of problems of an unfamiliar nature  
|                                      |                | Ability to manage a project  
| #4 Functional Business Knowledge (FBK)| 0.839          | Knowledge of accounting  
|                                      |                | Knowledge of financial systems  
|                                      |                | Knowledge of marketing  
|                                      |                | Knowledge of general principles of law relating to business  
| #5 Interprofessional Collaboration (IC)| 0.834        | Ability to work collaboratively with other professions  
|                                      |                | Ability to adapt one’s own skills and knowledge to fit with other professionals  
|                                      |                | Ability to work in an interdisciplinary team  
|                                      |                | Ability to communicate effectively with non-experts  
|                                      |                | Appreciation of the client’s perspective  
| #6 Tolerance (T)                     | 0.676          | Appreciation of cultural diversity  
|                                      |                | Ability to behave in a non-judgmental manner  
| #7 Entrepreneurial Antecedence (EA)  | 0.802          | Drive to succeed  
|                                      |                | Effective oral communication skills  
|                                      |                | Ability to acquire new knowledge  
|                                      |                | Ability to assimilate new external knowledge with existing knowledge  
|                                      |                | Ability to create new knowledge  
|                                      |                | Ability to retrieve information from different sources  
| #8 Pick & Progress (P&P)             | 0.839          | Knowledge of commercialisation pathways  
|                                      |                | Understanding of new product/service development processes  
|                                      |                | Understanding of technology valuation  
|                                      |                | Understand emerging technology and its potential impact  
| #9 Independence (I)                  | 0.682          | Ability to adapt to new situations  
|                                      |                | Ability to work autonomously  
|                                      |                | Ability to work effectively in uncertain environments  
| #10 Lifelong Learning (LL)           | 0.828          | Responsibility for continuing professional learning  
|                                      |                | Initiative for continuing professional learning  
| #11 Reflection (R)                   | 0.785          | Ability to reflect on own performance  
|                                      |                | Ability to respond positively to feedback  

*Table 1 – Constructs resolved using exploratory factor analysis to assess relationships between 57 skills topics of the survey data set and their internal validity estimate (Cronbach alpha).*
The internal consistency of construct validity was determined using Cronbach’s alpha test; for each of the construct tests the high values returned (>0.7; above the acceptable level of cut-off) indicate high levels of internal validity with two exceptions (Tolerance and Independence) just below 0.7 that, otherwise, make intuitive sense. The Cronbach alphas were very high when compared with other studies and against the rule of thumb, giving enhanced confidence in the high quality of the data and its validity.

Three constructs contained only two items: Tolerance, Reflection and Lifelong Learning. Nonetheless, these constructs were not discarded from the following discussion as the Cronbach alphas were above (LL: 0.828; R: 0.785) or close to 0.7 (T: 0.676) indicating relatively high internal validity. Furthermore, the items are well defined and, intuitively, should cluster. Two variables failed to connect with other variables: M6 – ability to interpret team dynamics and M7 – awareness of roles and responsibilities of team members.

Overall, cross loading of item variables in the rotated component matrix was very low, meaning the factors correlated very highly within their construct but not across multiple constructs; however, several items are worthy of examination and consideration:

- Item E5 (drive to succeed) loads with Entrepreneurial Antecedence (0.432) but also loads with Independence (0.421).
- Item G5 (knowledge of administrative systems) loads strongly with Entrepreneurial Leadership (0.616) rather than Functional Business Knowledge (0.410) where one would intuitively expect – although it does denote systems knowledge rather than knowledge in one specific management field, essential to an entrepreneurial manager.
- Item I1 (retrieve information from different sources) loads with Entrepreneurial Antecedence (0.506) and also with Transforming Information (0.477) and while essential as the first step in information management, the skill is also an important initial component of recognising, creating and developing new knowledge.
- The ability to mentor (item IP5) loads with Entrepreneurial Leadership (0.518) but also with Technical Leadership (0.501); the skill is important in leadership activity.
- The ability to manage a project (item M1) loads with Technical Leadership (0.440) but also with Entrepreneurial Leadership (0.423), as entrepreneurship requires effective project management to bring initiatives to fruition.

The following skill field constructs emerged through reflection and discourse.

Entrepreneurial Leadership recognises a coalescence of actions, attitudes and personalities that are necessary to progress new ventures. In an organisational sense, and distinct from the lone jack-of-all-trades entrepreneur, knowledge of administrative skills would play an important role in achieving positive outcomes. The cross-loading of item M1 (managing a project) extends the concept of leading a venture. The factors that constitute this construct offer an excellent profile of an entrepreneur.

Transforming Information recognises a suite of attributes that encompass a pathway beginning with information retrieval, include the transformation of information into knowledge and provides for imparting that information to others. One would intuitively, consider item I1 – retrieve information from different sources – in this category.

The term Technical Leadership is used to describe a skills construct that encompasses high-level discipline-specific knowledge and its application in a project context. In this regard, the cross-loading of item IP5 – the ability to mentor – is an extension of the leadership role of a technical expert.
Interprofessional Collaboration recognises a suite of skills that coalesce around active collaboration and communication in multidisciplinary team environments that may extend beyond the organisation. It should be noted that items M6 (interpreting team dynamics) and M7 (team roles and responsibilities) are two elements of teamwork did not connect with this construct.

Entrepreneurial Antecedence is so-called as this construct of skills features as a prerequisite to Entrepreneurial Leadership. Each of the skills – ability to draw widely on information, new knowledge development and application, drive to succeed, and persuasiveness (effective oral communication skills) – feeds into those corralled under leading an entrepreneurial venture. These are traits in common with a lone jack-of-all-trades entrepreneur.

Several constructs are entirely intuitive. Items E3 (adapt to new situations), E7 (work autonomously) and E8 (work in uncertain environments) represent a suite of skills that embody the attributes of Independence. Pick and Progress comprises a suite of skills that recognises the process of picking a potentially winning technology and progressing the technology through to a product. Similarly, the content of the three constructs Tolerance, Lifelong Learning and Reflection are entirely intuitive.

A Model

The next steps in the stepwise progression methodology are to derive meta-constructs that can link the skill field constructs into a higher order structure that investigates the causality of the observed phenomenon. At the simplest level, regression analysis will be used to examine relationships between constructs that can then be used to provide hypotheses and conceptual meta-constructs that can be tested. However, we intend to undertake structural equation modelling, as this form of regression testing is more robust, with the constructs having been already defined in the exploratory analysis.

Based on the derived skills field constructs, a conceptual

Figure 7 – Conceptual model of relationship between constructs and meta-constructs derived from the exploratory factor analysis.
meta-construct already presents itself as an experiential pathway to entrepreneurial leadership (above).

Four domains are apparent (left): Knowledge, Awareness, Pre-Leadership and Leadership come together as a process-based approach. Knowledge and Awareness sit as foundational domains; skills that are essential in entrepreneurs but are also evident in other professions. The next step in the process serves as a Pre-Leadership domain combining a broad set of skills fields (Entrepreneurial Antecedence, Interprofessional Collaboration, Independence) that leverages entry of the individual into an early entrepreneurial career.

The model already presents several features and defines essential elements of relevance to curriculum design, entrepreneurship education and preparing graduates for the workforce (employability).

The role of interprofessional skills in leveraging foundational skills has largely been unrecognised in the literature with respect to the employability of graduates, in general, and specifically in careers in the innovation commercialisation infrastructure. This study highlights Interprofessional Collaboration an area worthy of further examination in the interplay of interdisciplinary teams and how these characteristics may be enshrined in the graduate capabilities list of higher education institutes.

The combined suite of leverage-oriented skills serves as a precursor for a higher order application of entrepreneurial skills, or Leadership, in a framework heavily weighted with experiential learning. The meta-construct is defined around the term leadership as higher order elements of entrepreneurship and management in new venture environments are combined with picking winners to progress to the marketplace.

Experiential learning, witnessed overtly as Pick & Progress, features highly as a contributing factor to career success and thus to leadership in the industry. Clearly evident from the survey questions is also the demand for work experience in employing graduates. The importance of experience as an employability factor (employee maturity), and its ongoing impact in undertaking business actions, further highlights the importance of work experiences in the undergraduate curriculum through industry placements and internships. Such experiences would be incorporated as part of the higher order application of our model.

The model has a wider applicability beyond the innovation commercialisation sector. In many respects, the first two layers of the model, foundation and leverage, fulfil the employability
agenda articulated by the OECD\textsuperscript{18} that calls for entrepreneurial skills and enterprising behaviours to be included as essential elements of higher education curriculum to improve graduate career prospects and industry-readiness. The students themselves have expressed these sentiments in recognition of the skills needed in attaining and retaining employment\textsuperscript{19}. If the intention is to instil an entrepreneurial mindset in science, technology and engineering graduates, then the underlying elements and framework of our model need to be incorporated across of all technically focused degrees.

We will seek to operationalise the model using structural equation modelling as the next stage of development. Importantly, the model is also intuitively sound, and supported by very strong statistical significance in all tests to date. As a result, we are very confident that the survey was well designed and administered and that ensuing survey results are strong, giving us confidence to both progress with the study, and to offer strong recommendations in the near future.


Vignettes of Best Practice

The Fellowship also aimed to investigate different models of entrepreneurship education from the perspective of how skills perceived in the literature as important for innovation, entrepreneurship and commercialisation are taught in programs globally. The following vignettes outline some of the different models of entrepreneurship education investigated. The list of examples is not exhaustive of those visited; diversity of models being the overriding determinant in choice for this report. Other examples investigated will be reported elsewhere. The models extend beyond the focus of purely commercialisation of technology innovation and cover the broader context of skills delivery and entrepreneurial attributes. The Fellowship outcomes provide a landscape of models that can be adopted and adapted to the Australian higher education landscape.

Most of the best practice exemplars were not established with a defined set of skills, competencies and knowledge to be taught, and then a curriculum subsequently developed. Many exemplars were established as awareness-raising exercises and evolved a framework of activities that included introductory topics that cover basic business skills (business planning, venture finance, marketing, intellectual property law) and case studies of, and by, entrepreneurs that serve to inspire. Many exemplars were established with the intent of creating new ventures. These programs follow a formulaic model that is outcomes-focused to achieve new businesses. Entrepreneurial skills are not taught *per se*, however they are inherent in the learning-by-doing approach.

Site visits highlighted that the gulf between the entrepreneurship education theoreticians and the practitioners is wide and deep. Few of the practitioners teaching (hosting?) the programs were also involved in theoretical development of entrepreneurship education pedagogy. The agenda driving the theoreticians is academic papers and reputation amongst peers and colleagues. As a generalisation, the theoretician teaches predominantly into theory-based courses in business schools. The practitioners teaching the programs were, by and large, business people or business-oriented technology-based academics focused on awareness raising, learning by doing, new innovation contexts, industry and business support, spin out companies and regional economic development. Most practitioners openly admitted that, overall, the activities they undertook in their programs do not easily fit into the university requirements for conducting a subject or course.

It is a truism to say that each entrepreneurship education example investigated exhibited a level of vibrancy inherent in the institute’s program, personnel and students. Each also provided some level of differentiating factor from other institutes and interesting lessons for the development of entrepreneurship education programs could be had from all.

Entrepreneurship education is very much context specific; the context reflects a plethora of factors including the faculty hosting the program, the number of staff involved and their interests, the university resources available (start up funding, space, on-going commitment), the level of external funding, local industry involvement, the degree of high level university support, the interplay of curricular and extracurricular activities, the intellectual property policies of the institute and, to some degree, the geographic location of the institute.
As an example of the specificity of context: consider geographic location. There were clear geographic divides in the primary disciplinary focus of entrepreneurship education activities. For example, as an interesting dichotomy, Scandinavia and Germany focus on technological areas (biotechnology, engineering, ICT) while the countries of the Iberian Peninsula have a broader context and address societal not-for-profit contexts to a greater level than those countries to the north. These differences largely reflect factors such as nature and diversity of regional industry clusters and industry interest in technology transfer from universities. In northern Europe, industry collaborators were heavily involved in establishing and teaching entrepreneurship education programs, whereas, on the Iberian Peninsula, educators lamented the absence of industry collaboration that extends to all levels of industry – university relationships. While the northern EU sees the value in vibrant collaboration across the discovery, development and commercialisation pipeline, Iberian academics claim that industry is not interested in the transfer of indigenous IP.

Many entrepreneurship education programs in United States tertiary institutes follow a similar model of theoretically focused curricula, undergraduate and master’s level, housed in the business school and extracurricular activities encompassing business plan competitions. Over the last few years, some new models have emerged that specifically target undergraduate students and are based on the action-learning approach; Northeastern University, Rochester Institute of Technology, Arizona State University and Rensselaer Polytechnic Institute serve as exemplars.

In almost all of the exemplars visited, and certainly amongst those reported here, the initiatives began, and continue, with full support and backing from the highest officer of the institution: President, Vice-Chancellor or Rector.

**Masters by Research**

At many universities in the European Union, entrepreneurship degrees in the scientific and technical disciplines (ie, technology commercialisation) have been implemented as research master’s degrees. The master’s degrees comprise an initial coursework component teaching the fundamentals of business and entrepreneurship (6 or 12 months), a project component that focuses on business development in a technological context (12 or 6 months), and concludes with a final semester of writing an academic thesis.

Intellectual property used as the basis of the business development projects is derived from internal university sources and/or from industry partners. Essentially, the business development project components are taught as a learning-by-doing approach. In most cases, the projects are undertaken as an individual working in conjunction with the academic inventors. Usually a panel of academics and industry serve as mentors for the student cohorts to ensure project progression.

In one particular enlightened example of industry – university collaboration, Novozymes, a biotechnology company headquartered in Lund, Sweden, is providing non-core IP to a master’s course at Danish Technological University. In this program, students develop the IP into potentially sustainable business ventures. Besides helping to build a stronger regional and interdependent industry base, another return to Novozymes is the financial income from supply of materials and consumables to the nascent company once it is launched.
The research masters approach provides an interesting array of conflicting tensions, as the content of the thesis is divorced from the focus of the project. In all bar one example witnessed, the final thesis addresses any business topic (e.g., finance, marketing, management) of choice rather than the techno-entrepreneurship development project undertaken by the student. Examples of this approach occur at the University of Oslo (Truls Erikson) and Norwegian University of Science and Technology (Trondheim; Sigmund Waago). At the Karolinska Institute (Stockholm), the final thesis topic is on the advanced scientific theory that forms the basis of the innovation.

The thesis, by its very nature of being a research thesis, should address advanced theoretical concepts based on the project’s practicum. Since the content of the degree is techno-business development, the thesis should be in the context of advanced science and business theory and also draw on the interdisciplinary context. This is, after all, where the content of the degree sits. As noted above, however, the theses are on topics divorced from the techno-entrepreneurship project component; as a consequence they are more of a literature survey than a body of work that addresses a research premise. Such theses present a number of difficulties. Science-based graduates tend to struggle with the advanced business theory even in a literature survey. The academically light nature of the resultant thesis impacts on the credibility of the master’s techno-entrepreneurship program amongst the more traditional academic staff in the institute; the latter view such “light” programs with distaste. It can be argued that failing to address the disconnect between degree content (action-oriented entrepreneurship) and the thesis (academic output) does not advance the theory of the field of entrepreneurship education research.

For the Master of Research (Entrepreneurship) program at the University of Oslo, the outcomes of the business development project of 12 months are not assessed due to confidentiality issues associated with the IP. There are no guidelines for the project and no stated outcomes. A satisfactory versus unsatisfactory performance ranking is sought from the industry partner. Students are assessed on participation on weekly meetings that discuss approaches to problem-solving and personal growth.

In the context of a master’s degree that focuses on business development, the moniker of “research” is questionable. If the master’s course aims to create business-aware scientists, then the graduate will have to move onto a PhD in any event and the research skills of the graduate are honed in the PhD environment. The target market of such programs is an industry highly interested in the business acumen and the interdisciplinary skill set instilled by an undergraduate science/technical degree coupled with an entrepreneurship master’s degree that is practically focused. At the University of Oslo, a big issue facing the program was that students were not finding value in completing the thesis; instead preferring to forgo the final semester of thesis writing to take up lucrative positions in industry. To industry, the value of the experiential learning outweighs that of the graduate qualifications in the decision-making processes around new technology development.

An alternative to the research master’s degree format is to implement such entrepreneurship education courses that target science graduates such as coursework masters where projects comprise a substantive portion of the degree. The decision to offer a degree badged as “research” versus “coursework” is made on academic grounds by academics; it is not clear that the target market (i.e., industry) would care.
Angus Kingon (now at Brown University) and Stephen Markham established the Technology Entrepreneurship & Commercialisation (TEC) initiative in 1994 with substantial grants from the National Science Foundation and the Kenan Institute for Engineering, Technology and Science. Ted Baker, Steve Barr and Roger Debo have since joined the NCSU College of Management to deliver a two-semester program (one subject per semester) that is integrated with the MBA program. Importantly, the TEC program teams MBA students with graduate science and engineering students with the express purpose of generating spin out companies around intellectual property owned by North Carolina State University and by partner organisations. The emphasis is on high-technology commercialisation.

The philosophy and approaches of the proprietary process-based program are described in detail in the appropriately titled article: Bridging the Valley of Death, a name that encapsulates both the rationale for the initiative’s introduction and the structure of the program. The process (or the TEC Algorithm) provides a roadmap of commercialisation and a framework for strategic decision-making beginning with the ideation process and (hopefully) ending with a viable start-up company.

Each cycle of the TEC program comprises six teams of 4 – 6 students; teams are required to attend a three-hour class one night a week during semester. The class is divided into formal lectures/discussions dealing with the TEC Algorithm for the first half and a team meeting for the second half that includes the team mentors. Teams are mentored by Executives-in-Residence (EiRs) and Commercialisation Analysts. EiRs are business professionals, highly experienced in creating and managing high technology business ventures (i.e. early stage start-ups). The role of EiRs is critical to the team’s eventual success as they provide coaching, direction and leadership to the team. EiRs facilitate team organisation, manage the workloads, undertake dispute resolution, and evaluate performance levels of the team and its individuals (interns) on a weekly basis especially in relation to assigned tasks. Above all else, the EiRs serve as role models in a real-world learning context.

Ultimately, the TEC initiative is a real-world learning-by-doing education program that draws innovation and entrepreneurship together. It is worth reiterating some key points made in conclusion by Barr et al. (2009): for the TEC program to succeed as an educational pedagogy four strong key elements must prevail. The program must be:

- Authentic or real – the emphasised endpoint is a new high technology company,
- Intensive – to enact mastery and self-sufficiency,

---

• Interdisciplinary – the realisation of ignorance of other disciplines provides for an openness in learning, and
• Iterative – iteration provides the framework for harnessing a seemingly chaotic process.

With over 250 graduates of the program attracting in excess of $200 M of venture capital to Research Triangle companies, the TEC team can rightly claim that this is a highly successful program. The TEC program has been adopted and adapted by a considerable number of other universities including Ohio State University, University of Ljubljana (Slovenia), Loughborough University (UK), University of Cape Town (SA), Dublin City University (Eire), a consortium of 12 universities in Portugal and six in South Korea. International educators delivering the TEC Algorithm have an online network that allows sharing of advice and support (www.itecnet.org).
Center for Student Innovation – Rochester Institute of Technology

Person: Jon Schull
Director
Location: Rochester, NY, USA
Web: www.rit.edu/innovationcenter/
Byword: Truly Open & Chaordic

On a campus consisting almost entirely of square, brown-brick buildings, the Center for Student Innovation (CSI) is an anomaly of round glass that houses a truly chaordic21 approach to harnessing undergraduate innovation and creativity. The CSI is the outcome of an insightful incoming President of Rochester Institute of Technology (RIT) who saw the need to harness the entrepreneurial spirit of the institute and commissioned the unusual structure as a drawcard and as a statement. The round building essentially comprises a single large room where students, in teams or singly, can undertake projects; and that is where the distinction is drawn: it is a project space, not a club space.

The CSI opened in 2009. There are no offices in the CSI for Jon and the other staff to occupy. Instead, they inhabit the open space; meeting with or talking to students and working at communal tables using available computers or personal laptops.

Projects can be part of a curriculum requirement or an extracurricular activity of interest to the student. The CSI focuses on the ideation process, attracting curious and like-minded students from across the Faculties and facilitating formation of multidisciplinary teams to progress ideas to products and services.

Students coming to the CSI can enter their idea onto the Innovation Website (an online project database: http://beta.innovation.rit.edu/csi2/main/index) and meet with CSI and faculty staff to focus and formulate the idea into a project. Reiterative meetings address issues such as project planning and timelines, product design, requisite resources (skills, staffing, IT requirements and goods) and appropriate mentors (CSI staff, faculty, alumni, businesses) to progress the project. Potential projects are then documented and submitted to the CSI staff for consideration. Space is allocated within the CSI to conduct the project. Activity on the project is recorded as a blog on the Innovation Website and the CSI staff monitor progress.

Projects that need to develop prototypes use the fairly basic resources of the CSI. The MakerSpace is an area cordoned off by poster-boards that provides a simple mechanical workshop with tools, materials, benches, lockers and some expertise. Fashion design students set up the Textiles Space as a dedicated area. Computational support is also available for student groups developing software applications. The virtual environment also provides links into other faculty-based labs around the campus such as the Rapid Prototyping Lab and College of

---

21 Chaordic: from chaos comes order.
Entrepreneurship Education in Non-Business Schools

Engineering Labs where students can gain specialist expertise and equipment with the help of academic sponsors.

Two weeks of inactivity on a project can lead to a “re-purposing” of the materials and space to other, active projects.

Projects span a diverse array: ranging from new products and services, from social ventures to commercial businesses, and from simple products to complex high technology applications. The CSI offers no formal training programs for the student groups although staff members do teach subjects on ideation in faculty-based curriculum. The focus is on the practical: turning ideas into outcomes.

Since 2007, RIT has also hosted the Albert J Simone Center for Innovation and Entrepreneurship (SCIE) through the College of Business (http://www.rit.edu/research/simonecenter/). In contrast to the chaordic environment of the CSI (above), the Simone Center provides a structured environment for delivering entrepreneurship activities. Offered are educational programs (minors, concentrations and subjects) in entrepreneurship, innovation and commercialisation as well as various entrepreneurial experiences.

The Student Business Development Lab provides student teams the opportunity to progress business concepts towards commercialisation. Entry can be through:

- A credit bearing elective subject (Applied Entrepreneurship),
- Co-op credit in partnership with other academic units,
- Other subjects that focus on product or service development, or
- Independent admission upon application.

The SCIE also hosts a number of competitions (e.g., RIT Business Plan Competition, RIT Shark Tank elevator pitch competition), an Entrepreneurs Conference, a (new) build-your-own-business summer bootcamp, specialist networked communities (e.g., digital entrepreneurship) and a 24/7-immersion program built around a residential community (Global Village).

The SCIE presents a highly integrated and dynamic initiative in entrepreneurship education. One must ask about the relationship between the SCIE and the CSI.
E*ntrepreneurship at Rensselaer – Rensselaer Polytechnic Institute

Person: Robert Chernow,
Vice-Provost for Entrepreneurship
Location: Troy, NY, USA
Web: www.eship.rpi.edu/index.php
Byword: The Power of One

The program at Rensselaer Polytechnic Institute (RPI) provides a clear example of an EE program being entrepreneurial in meeting the challenge and leveraging maximal impact against minimal human resources. The President of RPI charged Rob Chernow, a successful businessman, with enhancing the entrepreneurial culture of staff and students. Rob implemented two approaches to developing curriculum-based initiatives. Grants of up to $10,000 are available for proposals from entrepreneurially inclined academics to incorporate new content into their subjects, or modify the existing content, to make subjects more entrepreneurially focused. For the non-entrepreneurial academic, modules are made available to help teach and highlight entrepreneurial aspects of subjects and topics. Modules comprise recorded Question and Answer sessions about the commercialisation of technologies and interviews of industry entrepreneurs that have been modularised into sound bites for use in lectures.

Rob also coordinates and runs a series of linked extracurricular activities that target the whole RPI student population but are also inclusive of faculty staff and the community:
- New Horizons Speakers Series,
- Elevator Pitch Competition,
- Change the World Challenge,
- Class of ’51 Entrepreneurship Fund.
- E*ship Exemplars Program.

The New Horizon Speakers Series features guest entrepreneurs giving lectures or featuring in panel discussions, sharing their experiences and perspectives on creating their companies. Advertisements for all the events are distributed through the website and via Facebook.

The Elevator Pitch Competition is open to enrolled graduate and undergraduate students to make a pitch in one of three categories about a new business, a social venture or an idea/innovation. Applicants, in teams or individually, have 90 seconds to pitch their idea, and use any form of media they wish, to address four key questions:
1. What is the problem you are trying to solve?
2. How are you solving the problem?
3. Who are you solving it for?
4. How is your solution different from what is already available?

To provide added emphasis (realism?) to make a polished presentation in the time it takes an elevator to complete an average journey, contestants are required to deliver their pitch in a (three-sided) mock-up elevator complete with life size images of Bill Gates, Warren Buffett and
Steve Jobs. Prizes range from $1,500 for the best overall pitch to $500 for the most creative pitch.

The Change the World Challenge has a focus on innovative technological ideas that improve the human condition and could potentially change the world. Twice a year, contestants present their “big ideas” addressing the grand challenges (energy, water, internationalisation, security) to a panel of judges. In this instance, the pitch is in the form of a three-page document (excluding diagrams) addressing the same four core questions as the Elevator Pitch Competition. Ten winners share in an overall prize pool of $10,000. The alumni Class of ’51 also sponsors a competition for early development of entrepreneurial ideas. The format is the same as that for the Change the World Challenge with prizes not exceeding $5,000 in toto.

The most important and ingenious aspect of the extracurricular education landscape at RPI comes from the E*ship Exemplars Program. The Exemplars Program is an entrepreneurs’ club that serves as the glue of all the extracurricular activities by rewarding students for their participation and thus drives the success of the collection of activities. [The pros and cons of a system that provides rewards are not debated here; although it is a hotly debated topic. In this instance, the system works!] For every activity (eg, registration, seminar, new member referral, workshop, project, training module, external internship, new venture) across the different levels of attainment (eg, competition submission, participation, winning), points are awarded. Like a frequent-users club, the level of activity defines the number of points earned. Students who achieve 100 points of activity receive a Certificate of Achievement in Entrepreneurship and a letter of recommendation signed by Rob as Vice-Provost of Entrepreneurship. Appendix 3 provides the full list of activities and the points earned.

Existing RPI student business services and systems are used to administer the program; thereby reducing manpower requirements. Students join the entrepreneurs’ club such as the E*ship Exemplars Program (via Facebook registration), and an identifier is issued that is attached to the RPI student card. Student participation at an event is validated via swiping the card through a reader. Points earned through competition entry are automatically assigned through the virtual lodgement interfaces. In more complex instances of students starting new ventures or undertaking internship programs to gain entrepreneurial experiences, validation of the levels of input/outcomes and points rewarded is undertaken by Rob. Cumulative point tallies can be provided from central services and students can monitor earned points through their Exemplars account.
In 2009, a group of students convinced the university president to support an ambitious program to support the entrepreneurial activities of students, staff and alumni at Northeastern University (NEU) in Boston. The students, with the help and direction of two faculty academics Dan Gregory and Marc Meyer, created the IDEA Venture Accelerator program. IDEA serves to coach new ventures through development of their business idea, connect new ventures with resources and fund ventures with potential. All the activities are extracurricular, staffed and taught by volunteers, and repeated on a semester basis. By using volunteer undergraduates at all stages, IDEA can deliver an extensive program with minimal impost on faculty finances and the time commitment of senior participants from NEU and business.

A Management Team of 12 students runs a highly structured program with a focus on business creation and development; the team is structured as a company with defined roles (eg, CEO, Operations Manager, Communications Officer, etc). Dan Gregory serves to facilitate, monitor and supervise the whole program; to stop the team from falling off the edge of the table to paraphrase Dan’s words. An Advisory Board of faculty and external businesspersons provides strategic advice to the student Management Team. Advisory Board members pay a fee of $25,000 per annum to sit on the Board.

A three-tiered framework called ‘Ready-Set-Go’ is used to deliver the program. All ventures follow a defined roadmap for progression (ie, milestones). The ‘Ready’ phase introduces the ideation process through six bootcamp sessions (three hours every Saturday morning) addressing customer requirements, industries, markets, product development and business models. A student-run entrepreneurship club, separate from the IDEA team, delivers the Ready bootcamp sessions. The ‘Set’ phase takes potential ventures arising from the Ready phase and begins individual coaching exercises to progress concepts and plans. Resource requirements are identified and timelines are established. Of the large number of ventures entering the pipeline less than 20% are expected to reach the final phase within the one year of coaching. The ‘Go’ phase represents concept maturity; teams have been established, products refined and costed, the customer base and market potential defined and the financial projections elaborated. The most senior (experienced) coaches mentor the Go stage ventures. Go stage ventures can apply for a non-refundable grant of $10,000 to take the product to market with

coaching & gap funding

ideation

resource mix

matURITY
funding dependent on the quality of the 10 – 15 page business case (quality of market, quality of solution, business model, impact of milestones and quality of team). Ventures can apply as often as they need.

The support and coaching teams are highly structured as a learning environment.

- Mentors are managed by the Management Team
- Mentors are mainly Executive MBA students
- Mentors coach the Coaches
- Coaches interact with the Talent (disciplinary specific expertise)
- Coaches and Talent advise and support the student ventures

The Coaching Team comprises a Head Coach and a team of ten sub-coaches. The program connects ventures to resources such as faculty and students across the campus willing to provide their expertise (Talent), events, investment forums and trade shows (Nexpo), service providers and mentors.

A negative factor impacting on the program is the lack of physical space and a virtual environment according the Marketing Officer of IDEA, Michael Hans. IDEA has (had?) neither physical or a virtual space allocated. The issue of a virtual space was leading to communication issues as the program grew; although a system was being developed. Individual student ventures were hiring low-cost rental space in downtown locations.

The educational material of the Ready-Set-Go framework was published in 2011 as a textbook: Entrepreneurship: An innovator’s guide to startups and corporate ventures by two Professors of Entrepreneurship at Northeastern University, Marc H Meyer and Fred G Crane. The book serves as a comprehensive and valuable guide for educators wishing to build programs aimed at new venture creation.

---

**Entrepreneurship**
Marc H. Meyer
PhD
Northeastern University

Entrepreneurship: An innovator’s guide to startups and corporate ventures

The Herberger Institute for Design, The Fulton School of Engineering and the Carey School of Business have come together to create the ASU Innovation Space. The ASU Innovation Space is a transdisciplinary education and research laboratory for undergraduates centred on the theme of design-led innovation (or integrated innovation).

The education program is delivered in two consecutive subjects; one per semester across the students' final year. There are seven phases in the program with the first semester focusing on user, societal and environmental needs, market trends, consumer demand and investigating new technologies. External sponsors can bring projects to the program and they also deliver technological expertise where necessary. Entry is limited to 36 students such that nine teams of four students participate in the program. Each team comprises one student from each of Engineering, Business, Industrial Design and Visual Communication. Prospective students submit an online application and the selection is based on GPA and experience in multi-disciplinary and entrepreneurial settings.

Allocation to teams is facilitated through self-awareness exercises (Meyers-Briggs) conducted by a clinical psychologist and exercises where students sell their skills to each other.

The model of innovation that serves as the guide for the students in the program is based on reflection of a reiterative cycle addressing four questions leading to product development:

- What is valuable to users?
  - Products should satisfy user needs and desires.
- What is possible through engineering?
  - Innovative but proven engineering standards should apply.
- What is desirable to business?
  - Products should provide value for business.
- What is good for society and environment?
  - Products should benefit society with minimal impact on the environment.

In generating solutions to recognised problems, student teams are encouraged to apply principles of biomimicry (materials, processes and functions; www.asknature.org) as a methodology for sustainable product innovation. Each team gets a budget subsidy of between $1,200-1,500 to fund their project across the two semesters. Upon completion of the year,
students can apply for a $20,000 grant from the Edson Program and entry into the ASU SkySong Innovation Center at Scottsdale, which provides space and facilities to further progress the venture.

Four full-time faculty members, one from each disciplinary area, plus two teaching assistants, staff the two-semester program; manning the two three-hour classes per week for each subject. This level of manpower represents a significant investment from ASU and the university’s expectations are that the experiment will deliver some level of spin out activity as well as improved industry linkages and graduate outcomes. According to Program Director, Prasad Boradkar, the ASU Innovation Space was a top-down initiative and, apparently, the university will attempt similar frameworks in other innovation contexts if the experiment is successful.

The level of university input and resources has seen ASU enact an approach I have not witnessed elsewhere in undergraduate education. Students in the program sign over intellectual property rights to ASU, even if the idea is student-derived. ASU will licence the technology to the student team if they wish to develop the venture through to a viable firm.
Stockholm School of Entrepreneurship

Person: Nick Kaye  
Executive Director
Location: Stockholm, Sweden  
Web: www.sses.se  
Byword: A Consortium Approach #1

The Stockholm School of Entrepreneurship (SSES) was formally established as a collaborative partnership between three tertiary institutes in 1999: the Royal Institute of Technology, the Stockholm School of Economics and the Karolinska Institute. The three institutes agreed on a common integrated syllabus in 1998 and a donation from the Persson Family Foundation enabled the formation of the SSES a year later. Two other institutes have since joined the consortium: the University College of Arts, Crafts and Design (Konstfack) in 2002 and Stockholm University in 2009. The Rector of each member institute, members of the SSES Board and of the SSES team constitute the Owners’ Group that supports the academic operations of the SSES. A separate Board of Directors provides strategic advice and direction. An endowment from the Persson Family Foundation has meant that the SSES can function as a non-profit association.

The collaboration between the five institutes derives from recognition of three key points:

- Innovation and entrepreneurship are about regional development and thus require a collaborative approach with a regional focus rather than competing for a small industry and funding base,
- Pooling resources also serves as a more cost-effective method of delivery of a diverse and comprehensive suite of educational materials, activities and events, and
- A single entity provides a coordinated, united and focused interface for industry partners in contrast to the otherwise competitive interests of a number of (perhaps self-serving) institutes.

The SSES acts as a School shared between the institutes and is based off-campus in its own headquarters in central Stockholm (on Salmätargatan) within an easy 30 minute commute to each of its partner campuses. The SSES has some 40 academic staff that interact with Competence Centres on each of the five campuses to deliver their materials. The campus Centres feature a team of academics led by a Director.

The SSES curriculum materials comprise:

- Individual subjects,
- Programs (contributions to degrees),
- Activities (workshops, seminars), and
- Events (competitions, networking seminars).

The subjects are focused on applied entrepreneurship (learning-by-doing) in an interdisciplinary context. All subjects carry credit that counts towards attainment of a degree and are offered in the Bachelor of Science and in the Master of Science.
Subjects are divided into three categories:

- **Four core subjects**, each of a semester length, are taken in sequence and provide a structured framework for the new venture creation process:
  - Ideation – creating the business idea and an introduction to entrepreneurship,
  - Planning – developing the business plan,
  - Execution – the business plan is implemented and a company begins with the challenge to make a sale to a customer, and
  - Growth – managing the firm as it grows and is presented with new opportunities.

- **Skills subjects** provide practical refinement of important aspects for business success and supplement the core subjects:
  - Finance for start-ups – introduces basic finance and projections, venture finance and exit strategies, and
  - Negotiations for start-ups – teaches the analysis of negotiations and sales.

- **Context subjects** provide industry or issue-specific insights and so provide a level of specialisation ancillary to the core and skills subjects. Example context subjects include:
  - Design and innovation – strategic design as a means of creating new products and structuring business models,
  - Entrepreneurship and gender – examines the gender specific differences in entrepreneurial experience,
  - Entrepreneurship in developing countries – examines the development challenges for third world countries and the barriers to market entry,
  - From science to business – provides an insight into (hi-tech) biotechnology entrepreneurship, and
  - Social entrepreneurship – challenges students to use the tools of entrepreneurship to solve global and social problems and introduces the non-profit corporate sector.

The SSES helps design and deliver entrepreneurship education materials for programmes offered through member institutes, for example:

- The Karolinska Institute offers a Master in Bioentrepreneurship for graduates of the biosciences or technology, and
- The Royal Institute of Technology offers a Master in Entrepreneurship and Innovation Management.

A new Diploma in Venture Creation (aka White Label) is delivered by the SSES in house by a team led by Course Director, Mikael Samuelsson. As its name suggests, the Diploma focuses on new venture creation. The White Label program comprises the four core subjects (Ideation, Planning, Execution, Growth) fast-tracked over a one-year time frame with intensive coaching, training activities, workshops, events participation and six months tenure in a business incubator. Events include networking sessions, business competitions and bootcamps; international and domestic. There is obvious overlap between the Diploma and other degrees (BSc and MSc) with students enrolled in either of the latter able to undertake the Diploma and gain credit towards their degree.

Skills development is enhanced through series of workshops and bootcamps. Introductions to specific skill sets are provided by one-hour workshops (Toolbox Friday); topics covered include Design Thinking, Business Law, Presentation and Pitching, Networking, Business Model Design, Intellectual Property Protection, and Strategic Sales. Weekend Workshops are devoted to intensive training exercises that extend the ‘taste’ provided in the Toolbox Friday sessions. While the Toolbox Friday sessions are open to a large audience the two-day workshops are limited to small groups of 14 applicants as they are interactive learning-by-doing exercises.
Bootcamps serve to immerse students in particular industries or experiences. Internship-like experiences are available, for example, as a one-month bootcamp that places students in entrepreneurial companies in the San Francisco Bay area. A three-day bootcamp immerses students in the biotechnology industry and takes budding entrepreneurs through establishing a life sciences company. In conjunction with the National Institute of Design in Ahmedabad, a two-week bootcamp takes students to India to explore and discuss future trends and influences (trend-spotting).

The SSES sends teams to domestic, local and international competitions that focus on new ventures such as the Venture Challenge (USA), the European Business Plan of the Year and Idea to Product (global). Local and international visitors to one of the five member schools present seminars, of academic focus, on average every two weeks. These are open to any student and academic of the consortium. Inspirational events are held every few months to provide opportunities for seminars and networking between industry, students and entrepreneurs. The events may be themed: the Good Morning Events focus on future trends, the Start-Up Day events feature new projects and people to follow.
Established in 2002, the Maison de l'Entrepreneuriat at Grenoble represents a consortium comprising Université Joseph Fourier, Université Pierre Mendès-France, Université Stendhal, Institut Polytechnique de Grenoble, Institut d'Études Politiques de Grenoble and Université de Savoie. The first five institutes are founding members of the consortium and also constitute the original Université de Grenoble which was split up in 1970 into separate, focused ‘colleges’. In contrast to the Stockholm example, the founding members of the Grenoble consortium are centrally located in a smaller city (0.5 M versus 2.5 M in Sweden) and thus three underlying reasons for collaboration (focus on regional development, pooled resources and combined front) are further highlighted and reinforced through interaction and involvement at all levels by local entrepreneurs, organisations and authorities.

The overall framework of intent and activities of the Grenoble Entrepreneurship House mirrors that of the Stockholm consortium. The main objectives are to promote entrepreneurship through awareness raising around the benefits of an entrepreneurial career, networking events, basic levels of training, advice and support for students pursuing ideas that could lead to new venture creation, and an annual business plan competition. Credit-bearing subjects are also offered at the three levels of undergraduate, master’s and PhD degrees. The approach to learning is very much action-learning around building businesses; in this instance though, the exercises can be hypothetical. Local academics, organisations and experienced entrepreneurs are heavily involved in presenting interactive ad hoc evening workshops that address specialist issues such as building internet businesses, female entrepreneurship, entrepreneurship and innovation in biotechnology, and acquisitions.

Of significance is that the Maison de l'Entrepreneuriat model has served as the template for the establishment of other Entrepreneurship Houses across France; the first of these being at Lille, Nantes, Aix en Provence (Marseille), Limoges, Poitiers and Clermont-Ferrand. The development of these regional consortia post-2004 was a response from the Ministry of Research with support of the Observatoire des Pratiques Pédagogiques en Entrepreneuriat to the perceived lack of an entrepreneurial culture noted in France’s 1999 innovation policy. As a consequence of the model being replicated across France, the Grenoble group provides training, advice and support to the other Entrepreneurship Houses.

---

23 Maisons de l'Entrepreneuriat have been housed at the following institutions:
Université de Lille Nord de France - www.maison-entrepreneuriat-ndlf.fr/
Université de Nantes - www.entreprendre.univ-nantes.fr/
Université de Provence - gsite.univ-provence.fr/document.php?pagina=5663
Université de Limoges - www.unilim.fr/Maison-Entrepreneuriat?lang=fr
Université de Poitiers - universitescreatives.univ-poitiers.fr/
Université de Clermont - www.clermont-universite.fr/-Entrepreneuriat-etudiant.
Center für Innovation and Entrepreneurship – Karlsruhe Institute of Technology

Person: Tim Lagerpusch
Location: Karlsruhe, Germany
Web: www.cie-kit.de
Byword: From entrepreneurs to entrepreneurs

Two entrepreneurial engineering graduates of Karlsruhe Institute of Technology returned to the city and persuaded the Rector of KIT of the need for a centre on the campus to stimulate entrepreneurial activity and culture in students, graduates, staff and alumni. Post-graduation, Christian Schwarzkopf and Tim Lagerpusch had previously founded a number of companies but decided to turn their talents to helping capture the entrepreneurial activity on the KIT campus through the Centre for Innovation and Entrepreneurship (CIE). Funding for the initiative came from the state government (€200,000) and provided for salaries and the purchase of the small self-contained building in the centre of KIT campus. The latter provides the office base for the two founders and represent the first point of contact for entrepreneurial students.

The ultimate focus of the CIE is new venture creation through facilitation; Tim and Christian serve as the drivers and facilitators of entrepreneurial effort by providing advice, support and connections to others nascent entrepreneurs as well as players along the commercialisation pipeline. Students (“clients”) with potential business concepts visit the CIE and begin their path to an entrepreneurial career. The excellent do-it-yourself handbook of Osterwalder and Pigneur provides the overall template for new venture creation24. Professional expertise is drawn primarily from the Faculty of Economics and Business Engineering and from other Faculties across campus. Activities and outcomes draw heavily on the coaching of the founders and their extensive network of local entrepreneurial talent. The clients of the CIE essentially become members of a club as they learn and in turn teach the next cohort of entrepreneurs.

In contrast to the other models, the CIE does not offer formal subjects or courses in innovation, entrepreneurship or business creation. All activities are essentially ad hoc directed at the immediate needs of the client. In essence, Tim and Christian serve as (free-lance) business consultants with the nominal support of KIT. With short-term funding drawn from government, the long-term tenure of the CIE is dependant to a large degree on successful new venture creation.

Charity Entrepreneurship – Dublin Institute of Technology

Person: Thomas Cooney
Director, Institute of Minority Entrepreneurship

Location: Dublin, Ireland
Web: www.dit.ie
Byword: Social Entrepreneurship for Students

Thomas Cooney has taken an entrepreneurial approach to teaching the fundamentals of running a new venture by replacing the traditional content of an undergraduate elective subject with an exercise in social entrepreneurship that returns value to the community. The students must organise and host an event for charity.

Briefly, students self select into groups of up to three and then must complete a series of tasks over three months culminating in hosting the event; these tasks are as follows:

1. Identify a charity for support
2. Generate an idea for the charity event
3. Secure an appropriate venue
4. Secure event sponsorship
5. Develop and implement a marketing strategy
6. Sell event tickets
7. Organise the event
8. Plan a budget and manage finances
9. Host the event
10. Review event outcomes and operations

Three reasons are cited for providing an entrepreneurship education framework in the context of organising a charity event. The first is that the “practice” rather than a “theory” approach better contextualises entrepreneurial learning. The second is that students are introduced to alternate (non-profit) contexts of entrepreneurship. The third is that Tom witnessed, when he introduced the subject in 2006, what he perceives as a level of selfishness in students as a consequence of a booming Irish economy (the Celtic Tiger). Embedding the learning experience in a social entrepreneurship context builds amongst students an awareness of those members of society less fortunate than themselves.

Didactic lectures and case study analyses are replaced with workshops and activities within a “learning by doing” framework that conceptualises the content of other business subjects. Each week a different practical theme features in the workshop relating to the tasks that must be undertaken; for example Social Entrepreneurship (week 1) and Event Management (week 2).

The culmination of the subject/exercise is that each student must write a reflective report that outlines his or her learning experiences; the reports are framed with a template of questions. It is this report that provides the assessment for the subject. For any variety of reasons, the charity event may not fare well (for example: 24 hours of rain on a golf classic day that closed the course or an entertainer that did not turn up for the event) and the fund raising itself impacted by any number of factors beyond control of the student team. Ultimately, it is the
Entrepreneurship Education in Non-Business Schools

lessons learned from the exercise that shape the student experience and attitudes, and forms the basis of assessment.

Although the exercise is conducted as a team, the reflective report records the experience of the individual student. This precludes the possibility of a group failing the subject as a consequence of the poor performance of one student. Should a student’s report receive a failing grade, then the student is required to re-submit the reflective report before the exams of the following semester.

The student team determines the choice of charity and final choice of charity is usually influenced by an existing family connection to the charity organisation. Initially, Tom had in mind targeting a single charity organisation, however a variety of concerns that include student sensitivities about the charity cause and industry opinions about preferential treatment led to the current approach.

One of the first steps the student team must take is to secure, in writing, a letter from the charity organisation that authorises the event and agrees to event support. Nonetheless, student teams must seed fund the event and there is always the problem that funds raised may not meet the expenditure to conduct the event. As an elective, students self-select to enrol with an advanced knowledge of the intent and approach of the subject; thus levels of engagement are high and teams can become very competitive. The average amount of funds raised is €3,000 per team and the largest sum raised, with the help of paternal influential, is €250,000. It is worth noting that awareness of the subject is widespread amongst the Dublin-based charity organisations but they do not initiate involvement in the subject; rather student teams must engage with the charities.
Like many similar entities in other institutes of higher education, the Hothouse is essentially the technology transfer arm of DIT providing services, training, support and incubation facilities to the staff and post-graduates who have assigned their IP to the institute. The DIT Hothouse also extends their services to undergraduate students; and this is undertaken in several ways.

The staple diet of a business plan competition is sponsored to the tune of €2,500 through external affiliates; the best overall invention receives €1,500, the best staff invention receives €500 and the best undergraduate invention receives €500. In the DIT Inventor Competition, competitors are asked to address three questions relating to:

- What was invented?
- What are the advantages?
- Where will it be used?

Submission is simply by e-mail. A judging panel, comprising IP and commercialisation experts, then evaluates originality, benefits, market potential, feasibility of development and implementation, and feasibility of commercialisation. The point of differentiation from most business plan competitions is that there is no elevator pitch component: thus, the invention is not disclosed. The winners are announced in media releases but the details of the invention remain confidential and thus can still be patented.

Another point of differentiation from many other university-owned technology transfer offices is that DIT Hothouse staff also meet with undergraduate students to provide a free, preliminary, but cursory, evaluation of the potential of student-owned IP. The student can opt to have the DIT Hothouse offer to protect and commercialise the IP but must sign over the rights to the IP to DIT. In return, DIT will undertake all aspects of the commercialisation process and pay a 75% share of any licence royalties to the inventor. Alternately, DIT will take a 15% equity stake in the new venture, post-protection of the IP, should the student inventor elect to proceed along the new company pathway. In exchange, DIT Hothouse provide mentoring, and access to incubation facilities and their network of investors and entrepreneurs.
Fellowship Outcomes @ QUT

Like all universities, QUT features exercises in high-level creativity in many of its undergraduate subjects. For example, the degree programs of the Creative Industries Faculty have subjects that allow an internship program with a creative media company, innovation/creativity and business development topics feature in IT subjects, and the Engineering Faculty have successive units that introduce students to design-led innovation and basic new venture creation. These undergraduate exercises are recognition that graduates for improved job prospects need entrepreneurial skills and also that self-employment is the obligatory career for many graduates in some disciplines.

Unique to QUT is a whole-of-degree approach to innovation and entrepreneurship: the Bachelor of Biotechnology Innovation (now Technology Innovation). The degree instils high-level entrepreneurial skills in graduates who serve in the bio-innovation commercialisation support framework rather than act as innovators/inventors although they are highly inclined to behave in an enterprising fashion. The teaching approaches and outcomes of the biotechnology innovation degree are detailed in two papers: Collet and Wyatt (2005) and Collet (2012).

The following section describes new initiatives implemented at QUT as a consequence of the ALTC Teaching Fellowship. The QUT Innovation Space (QIS) and the Q_Hatchery draw widely on the best practice exemplars. The platforms described below are intended to be complementary to, and progressive of, the existing areas of education in creativity, innovation and entrepreneurship across the university; including the whole-of-degree courses and subjects embed in various degrees. They are experiments in education and training; broad in scope and ambitious in contexts that are being implemented on a transuniversity platform. In building such university-wide extracurricular platforms, the experiments aim to unite, resource and progress the fragmented entrepreneurship activity across courses, in the postgraduate sector and amongst staff.

Implementation of these programs at QUT serves two purposes. General action-oriented entrepreneurship education programs, and technology commercialisation programs specifically, are mostly absent from the Australian higher education institutes. As witnessed by the Fellow in implementing the biotechnology innovation degree and its successor, there are a large number of unknown variables that need to be addressed in implementing programs of such a nature that cannot be gleaned from investigating overseas examples: student response to initiatives and exercises, interaction between curriculum and extracurricular activities, Industry acceptance and engagement, and methods and pathways of integrating such programs into curriculum and the university systems to name just a few. Secondly, the programs will serve as the testing ground of the outcomes from the study into innovation commercialisation skills

While creativity and innovation are traits that lie within many people, the desire to create new ventures may not necessarily follow. Early in the evolution of the QIS it became evident that the intended scope of the project was too broad. The original aim was to address the pipeline

between ideation and new venture development; however this served to dilute focus and efforts. Furthermore, a single entity could not adequately address the continuum between extremes, as training regimes are fundamentally different.

It is also worth noting that the original QIS advisory board comprised industry members representing firms that serviced the innovation commercialisation pipeline (eg, commercialisation consultants, business incubators). From their perspective, the notion of a university-based incubator was viewed as direct competition and, in these tight times, the industry representatives argued strongly that the QIS activities should end with development of a concept product.

There is, I believe, a niche that remains to be filled: between concept product and business incubators. Many innovators and inventors adopt the ‘garage-at-home’ approach to conduct these early-stage business-building activities.

The QIS focus is now on capturing ideas and energy of staff, students, alumni and others. The Q_Hatchery will provide the framework to extend the concept product or service into a new venture. The proposed community training approach outlined below is also recognition that traditional business incubators do not necessarily cater for current and future trends in business development (see arguments below).

A simple evaluation (filter) process has been implemented to transit ideas and concept products or services from the QIS into the residency program that is the Q_Hatchery. Over a series of three meetings with a member of QIS staff, the student entrepreneur has to address questions as follows:

- What is the problem being addressed?
- How does the innovation solve the problem?
- How is the innovation novel?
- What is the competition in the area?
- How will the innovation be developed?
- What resources are needed?
- Impediments to development?
- What is the extent of disclosure?
- What commercial relationships or sponsorships may already be held?

If the student entrepreneur shows commitment and drive, residency in the Q_Hatchery is explored.
The QUT Innovation Space

The QUT Innovation Space (QIS) is a student-focused university-wide platform of education in innovation and entrepreneurship where student innovators and entrepreneurs can learn the skills required to transition intellectual capital to the marketplace. While some students may seek to progress their ideas, other students may seek entrepreneurial skills training to further their careers in industry or government, and thus the emphasis of the QIS is on entrepreneurship training, rather than just new venture creation.

The QIS platform sits in the extracurricular space in its initial formulation, but acknowledges, however, that further development may/will require that activities in the QIS attract credit from various courses of the university.

Over the period of 2011 – 2012, the QIS project aims to create, develop and/or implement the following:

1. A recognisable physical environment where students from all disciplinary areas across the university can interact as cohorts, teams and with mentors to progress innovation into potential products or services;
2. A virtual environment, with a central presence in the university IT framework, to complement the physical and relationship components and provide public access and different levels of secure access for participants to contribute to materials and project discussion forums;
3. A network of relationships with engagement centred on students and drawing upon the mentorship, interests and expertise of business, industry, entrepreneurs, government and academics;
4. A series of small-scale learning modules that teach skills in creativity, environment scoping, product development, market research, competitor analysis, intellectual property management, business planning, networking, communication, and business ethics and etiquette; and
5. A strategic range of activities such as industry seminars, networking, monthly events and competitions (eg, ideas and business planning) that support the mission of the QIS.

History

Seed funding from the Faculty of Science and Technology ($12,000) in May 2010 helped initiate the QIS project and this was followed by an QUT Engagement Innovation Grant that provided ($30,000) further developmental and start-up support. An ALTC Priority Project Grant ($220,000) supports the cost of operations across the two years 2011 – 2012. The QIS operated out of communal office space in the faculty for the first four months of 2011. In May 2011, the QIS moved to 90 m² ‘cool’ space that includes three interconnected rooms behind Artisan’s Café on the Gardens Point campus. The walls are now adorned with whiteboards and blackboard paint. The project funds employ a number of part-time staff (Innovation Facilitators).
The QIS Explained (Advertising material)

What?

The QIS aims to facilitate the successful development of student creativity/innovation into intellectual capital and commercial or social products or services.

Overall the aims of the QUT Innovation Space are two-fold; to:

- encourage entrepreneurial and enterprising approaches, behaviours and attitudes in the next generation of students, and
- facilitate the early stage development of new products, services and enterprises that serve the needs of the community, society and the economy.

A goal is to value-add to the creativity and innovation at QUT and of the Brisbane region. We think of the QIS as a connected community of like-minded individuals; it is an ideas incubator, not a business incubator. Ultimately, the QUT Innovation Space is a teaching space designed to involve students, undergraduate and postgraduate, in the process of entrepreneurship to build the businesses of tomorrow.

The QUT Innovation Space:

- Serves as the networked community and innovation exchange amongst student entrepreneurs and between students, entrepreneurs and industry,
- Provides a student-centred infrastructure to help aspiring student entrepreneurs evaluate their ideas, to impart the elements of success and to provide inspiration, and
- Aims to facilitate a truly trans-disciplinary approach to solving today's problems by bringing together students and mentors from multiple disciplines and industries.

Why?

QUT already encourages high-level creativity in its courses but opportunities for undergraduates to develop that innovation into products are limited. Furthermore, entrepreneurially inclined students are looking for opportunities to network and meet with like-minded individuals. By providing a unique university-wide learning environment, student creativity, innovation and entrepreneurship can be harnessed; potentially into a pipeline of new businesses. Furthermore, there are few low cost avenues for businesses, industry, government or free-lance entrepreneurs to explore the potential of concept ideas as new enterprise ventures; the QIS provides such opportunities. The QUT Innovation Space encourages the emergence of entrepreneurs and new enterprises of tomorrow.

Who?

The QIS welcomes students, staff and associates to visit, drop in and become engaged in the activities that include Lunchbox Seminars (Wednesdays), four2six networking events (Fridays), other student-centred events and workshops or just drop in for a chat with and Innovation Facilitator. You will meet many like-minded people to connect with. If you have an idea, you can arrange to talk to our Engagement Officer to begin the progression and evaluation process. We welcome the involvement of entrepreneurs, business, industry, academic staff, PhD students and
government in transforming intellectual capital into new ventures of commercial and social worth.

**How can the QIS help?**

The QIS provides a meeting space in G309/310 of Gardens Point campus. Innovation Facilitators are there to provide the connections between people and host events, workshops and seminars. The QIS will also serve to advance the ideas and intellectual capital of students (both undergraduate and postgraduate), academic staff, industry, businesses, government and entrepreneurs. The intent is not to be prescriptive but to be engaging, flexible and interactive amongst the stakeholders. Skills development will focus on instilling the entrepreneurial mindset in those students with ideas or those interested in expanding their skill set to improve their career progressions.

**Where the Ideas Can Come From**

The QIS provides a source of capable, innovative, and entrepreneurial Ideas or intellectual capital or property (IP) can be brought to the QIS from any source, including:

- Undergraduate students – under QUT policy, undergraduate students own their IP;
- Academics or postgraduate students – where the IP is owned by QUT or where the IP is generated outside of the QUT research sector;
- Entrepreneurs – looking to develop initial concept ideas into new businesses;
- Businesses or industry representatives –
  - where the IP and the new venture may remain with the industry partner, for example as part of their core business activity;
  - alternately, the industry partner may elect to donate the IP to a new venture, for example where the IP is peripheral to the core business focus, and the new venture may evolve with a linked supply/client relationship to the industry partner;
- Mentors may wish to develop ideas and propositions from any source of open innovation.

**Entry to the QIS**

The QUT Innovation Space is open to any QUT student who:

- Wants to connect with other innovative, creative and entrepreneurial people,
- Is an innovator or entrepreneur with an idea of commercial or social potential who wishes to develop that idea into a product, and/or
- Wishes to become involved in new venture development, to learn entrepreneurship and innovation commercialisation.

Motivation is the key ingredient.

We are looking for students to take their concepts to the marketplace; students who want to make an impact by building sustainable enterprises serving the community and society. You do not necessarily have to have the creative ideas to achieve this goal. Importantly, we are looking for students who understand that pain must precede gain.
Current QIS Activities

The QIS operates as a connected community enhancing engagement of participants. Activities focus capturing the ideas and energy of the users (staff, students, alumni, others – the sparks, weirdos) and maximising the interaction between people.

Activities fall into two categories: open and membership.

Open activities include seminars, bootcamps and targeted events hosted by students where any one can attend. These were designed to provide a promotional face to the QIS. Lunchbox sessions is a series of seminars where internal or external speakers present topics relevant to ideation or business creation. A bootcamp event conducted over two days serves as an introduction to business venture creation. The QIS also manages events for students (or teams of students) that want to host an event that facilitates innovation or entrepreneurship. For example, the QIS organised a ‘geek-session’ hosted by a group of IT students where programmers from around southeast Queensland came to write programs that would address problems of social or business consequence. The event, titled CodeSmash, was attended by 50+ participants including students from three universities (QUT, UQ and Griffith) and representatives from industry.

A membership-style of community engagement was established to create a sense of belonging amongst visitors as the primary goal. A secondary concern was perceived by visitors to the QIS; IP ownership. The approach taken here was to implement a Code of Conduct Agreement that a visitor signs if they wish to participate in other activities. The Code is short and most of the content is focused on community ownership of the QIS; however it also contains two important statements that address IP ownership:

- Members agree to take responsibility for the protection of their ideas and IP – consider a confidentiality agreement, talk to QIS’ in house lawyer, get up-skilled and understand the IP issues relevant to your idea, technology or invention.
- Members agree to prevent disclosure of other members’ ideas – disclosure of someone’s technology can destroy their chance to patent or commercialise. It might be a cool idea, but respect that they have shared it with you in confidence. Put it in the vault.

IP concerns arose for two reasons. First students wanted to be sure that their ideas were safe if disclosed to QIS staff. A natural concern; but, to be honest, few ideas are really of any merit. It was a predatory nature of some student regulars that began to attract QIS staff attention.

Formal membership-based activities consist of the following:
- Creative thinking exercises conducted by an outside consultancy group, Edgeware (see below) who also act as Entrepreneurs-in-Residence.
- Creative thinking to build a business course also offered by Edgeware. The course runs for six days over weekends
- 4.2.6 networking/workshop sessions held on Friday afternoons, 4 – 6 pm, where visitors drop into talk about their ideas and potential applications in a relaxed format. Speakers receive feedback from others as well as get to meet fellow sparks.
• A Services Exchange where users can add to a pinboard a notice of their needs to progress their idea further (“I need…”) as well a notice of what services they can offer others (“I give…”).
• User projects where students use the physical space to progress their ideas further (usually these are IT-based projects).
• Advisory Service where QIS staff provide advice on how to improve, progress or research ideas or concepts in real products and services.

External industry representatives, including business consultancy groups and state government departments, have hosted seminars, workshops and networking events. Other activities conducted in the QIS include hosting external visitors who want to give back to the university. For instance, an IP Lawyer who has been giving regular seminars has elected to conduct his business from the QIS for one day a fortnight so that he can provide free advice to students (students must make an appointment).

The main role of the QIS is, however, providing the physical environment that facilitates the networking independent of the formal activities. It is clear from all visitors that the notion of a dedicated physical space is what attracts them to the QIS.

QIS events and happenings are advertised through:

• The QIS website: www.qutinnovationspace.com
• Facebook: QUT Innovation Space
• Twitter: http://twitter.com/#!/QUTInnovation

At the end of semester 2 2011, records show that approximately 60 people per week are visiting/using the QIS space for the planned activities listed above. In addition, several student groups are holding meetings in the QIS on a regular basis as part of their project work in various subjects.
The Q_Hatchery

The following section describes the Q_Hatchery and its reason for being; it is taken from a proposal. There is obvious room, post-product conceptualisation, for training to play a large part in new venture creation and the success of nascent businesses. This training needs to be outside of the vested interests of for-profit organisations. The Q_Hatchery aims to fit in that niche between concept product and business incubator. This domain is not a closed shop; there are opportunities to bring together the TAFE institutes (Technical and Further Education) with the more theoretical leanings of a university to examine the ideation to marketplace pipeline; to document, research and disseminate formula to improve the success rate of new business formation.

The Q_Hatchery Explained (Advertising material)

Project Aims:

This initiative aims to build the Q_Hatchery: an innovation community that contributes to Queensland’s capacity in the newly emerging industries. The Q_Hatchery concept is a unique 180-degree approach to workforce development that engages new enterprises as learners and also as teachers.

The Q_Hatchery will be a training environment providing a culture of innovation for nascent entrepreneurial businesses (NEBs) arising from the “melting pot” of converging disciplines of information and communication technologies, creative industries, games design, digital service, personalised medicine and health, sustainability and clean technologies.

Key Educational Objectives:

- Train emerging entrepreneurs with the vocational skills essential for business success using a flexible, immersion-style learning by doing approach,
- Build an entrepreneurial, innovative, highly skilled, business-ready workforce,
- Create a dynamic and synergistic “innovation cluster/community” environment of like-minded individuals and NEBs that leverages “self-learning” of new generation approaches to sustainable systemic innovation, unique business models and new pipelines of commercialisation, and ultimately
- Improve the success rate of emerging small-to-medium enterprises (SMEs) in the Queensland business landscape.

Key Research Objectives:

- Explore new pipelines of innovation and invention to enterprise,
- Capture the innovation in building successful non-traditional business models in a volatile world, and
- Explore models of skills delivery and knowledge transfer in a 180-degree learning environment where learners become teachers.
**Project Need:**

Skills education in tertiary institutes fails to \textit{(and cannot)} address the experiential training and knowledge required for NEBs to bridge the 'valley of death' between the 'garage at home' and the self-sufficient small-to-medium enterprise (SME) environment. Given that SMEs account for 90% of the workforce in Australia, new (sector-leading) approaches to providing the requisite skills base and improving the success rate of nascent businesses are essential.

The formation, growth and success of NEBs are mostly driven by a learning-by-doing approach and this represents an adaptive capacity of both the individual NEB and the Q_Hatchery. While the training of tertiary education institutes, TAFE and university, provides the necessary \textit{theoretical} skills for founding and running established businesses, each NEB has context-specific \textit{practical} barriers to self-sufficiency. Furthermore, the business landscape in the emerging industries is evolving at a rapid rate requiring application of new models of business and pipelines of innovation and commercialisation of invention. These new models are not necessarily transparent to the training providers as many are actually invented, trialled and tested by NEBs themselves, in isolation. Dissemination to other NEBs is often via horizontal learning mechanisms and knowledge transfer as peers and co-workers support and mentor each other, rather than through traditional training relationships. One role of the Innovation Facilitator in the Q-Hatchery is to capture the innovation that emerges in business approaches and practices for future vocational training purposes.

Most NEBs are too embryonic to enter business incubators. In any event, the latter usually provide structured, traditional and managed approaches for transition from defined product to market entry and are focused on income generation for their own survival. A high level of chaordic flexibility, nurturing and training is required for nascent businesses to grow to become self-sustaining SMEs. In the isolated and un-supported garage at home environment, NEBs must maintain energy and momentum, search for guidance, training and mentoring, refine their product and business model, and secure a funding base to reach the status of self-sufficiency.

Adopting an 'innovation community/cluster' approach to embryonic NEBs will enhance the pipeline of new SMEs entering the regional business landscape.

One lesson from the QUT Innovation Space experience is that the QUT student population realises a large number of NEBs. Not all can or will be successful; however, the current innovation landscape does not necessarily encourage their success. Traditional business incubators are too prescriptive and rigid; delivering programs tried and tested in old and established industries. As an experimental pre-incubator, drawing on the intrinsic energy and innovative approaches of the participants, the Q_Hatchery can improve that success rate. One avenue for launching and nurturing new commercial initiatives from QUT research programs can also be within the Q_Hatchery. Many of these new commercial entities have the same requirements as those of the NEBs born outside of the research laboratory.

**Training Approaches:**

The teaching landscape is a tailored approach in a benign pre-incubator (ie, hatchery) where education, interaction (networking) and a mutual support network sponsor a positive personal journey leading to company success. Training packages will be fitted to the needs of the
Entrepreneurship Education in Non-Business Schools

individual NEBs and their composite “members”, and will be negotiated for the context-specific requirements for the individual and overall workforce development. Each member of each NEB will be given a value voucher that is consumed within the framework of an engagement contract. The modules will provide a menu of offerings (experiences, short courses, internships, mentoring hours, seminars, master classes) that address requisite vocational skills across a broad range of topics (business, technical, the creative, literacy, professionalism). The approaches to building a connected innovation community are already being developed as within the QUT Innovation Space.

Training modules will address aspects of company success around:

- Creativity and systemic innovation
- Market research,
- Intellectual property,
- Product development and delivery, 
- Commercialisation, 
- Sales and marketing, 
- Organic business models, modelling and planning,
- Company structuring, management, HR and finance, 
- Funding incentives and venture finance, 
- Social, ethical and environmental responsibility,

The Q_Hatchery aims to bring together university, TAFE and private providers as well as capitalise on the evolving horizontal experiential learning framework of an innovation community.

Where to Now?

The project is seeking industry partners and sponsors who want to engage with the Q_Hatchery in improving the success rate of new and different ventures in southeast Queensland.

Current (proto-) Q_Hatchery Status

The practices and processes required for a Q_Hatchery are being trialled alongside the QIS to examine parameters of operations and relationships. Entities with similar intent to the Q_Hatchery exist, or have been attempted and failed, in Brisbane city and its surrounds. The commercial imperative of ensuring their fiscal viability has, to some degree, doomed the pre-incubator model from the outset. The university environment and assuming “a living laboratory” approach in the first instance provides a more benign environment and avenues of funding that may not be open to entities looking to be a commercial success from the outset.

Key to the success and sustainability of the Q-Hatchery is growing reciprocal relationships with potential external stakeholders interested in populating the space. The relationships take many forms. The (flexible) use of space (meeting rooms, training facilities), access to an enthusiastic, dynamic talent pool and high-speed internet are attractive lures. The vested and mutual interest of the stakeholders is necessary to overcome funding limitations in delivering training programs. Some examples follow.
Kevin Gosschalk\textsuperscript{27} (right) provides an example of an entrepreneurial QUT undergraduate who developed a concept product while undertaking a summer school project at university. His product began as a multi-user interactive and physical video game targeted at people with physical disabilities. The potential market extends beyond the latter cohort to the aged and the young. To further develop his product SKAMPA, Kevin has moved into a room next to the QIS so that he can draw on the energy and ideas of the student innovators and entrepreneurs that visit the QIS. With funding from the university and Commercialisation Australia, Kevin now employs a person to help with R&D.

Entrepreneurs-in-residence have a powerful impact on the mindset, behaviours and success rate of budding student entrepreneurs. For Edgeware\textsuperscript{28}, who run the majority of their programs at night or on weekends, access to training and meeting rooms provides a cheaper alternative to hiring space on an \textit{ad hoc} basis. In return, Edgeware provides services such as free training programs and business advice to Q_Hatchery occupants. Graduates of the Edgeware program, which focuses on new venture creation, can also undertake the initial steps needed to get their own businesses off the ground.

Tim Sheehan is a QUT alumni who wandered into the QIS recently after the campus signage caught his eye. Tim talked about his experiences in the USA to one of the QIS “innovation facilitators”. While in working for the Medical University of South Carolina, Tim helped develop some IP around host immune responses to bioimplants. The IP was never progressed by MUSC and the QIS staff encouraged Tim to seek ownership of the IP from MUSC and to lodge a provisional patent. Tim is now housed in the proto-Q_Hatchery developing the small medical device and working towards proof of concept.

\textsuperscript{27} http://www.kgosschalk.com
\textsuperscript{28} http://www.edgeware.com.au/
University-Wide Competitions

An entity such as the QIS also serves as an umbrella for other entrepreneurship activities on campus; either based in curriculum or extracurricular.

Each year Engineers Australia celebrates Engineers Week and designated the theme for 2011 as the “Year of Humanitarian Engineering” to highlight the benefits of engineering to the wider community. The Faculty of Built Environment and Engineering (BEE) at QUT chose the theme of Engineering for Humanity Challenge (E4H) targeted at improving the lifestyles of the disabled. BEE approached the QIS for help with promoting the E4H. The original intent of the E4H was to have the competition targeted solely at the different types of engineering students (mechanical, electrical, design).

With QIS input, the competition was opened to students from Faculties across the university and secured sponsorship exceeding $20,000. Prizes ranged from $5,000 to $1,000 with an additional $5,000 cash and $5,000 in kind available to the winner if they chose to proceed with commercialisation (see next page).

While the Engineering Faculty undertook the major role of project management, organisation and marketing, the QIS provided mentoring and training to the teams in areas of creative thinking, business planning and presentation skills. The QIS network of industry representatives was contacted to elicit sponsorship and these contacts also passed the e-mail onto relevant target contacts in Government agencies and relevant foundations dealing with disabled people. Further, opening the competition up to other Faculties also loosened the purses of other Deans of Faculty.

Following announcement of the challenge, team formation was facilitated through a website (if required) and at training sessions. Teams went through the process of choosing a disability to focus on, talking to persons with the disability to ascertain the real life difficulties and then designing products that could help change lifestyles. Two rounds of submissions from each team were screened; a first cull reduced the teams from 16 to ten. Additional training sessions were undertaken for the ten teams. The judges then reviewed the proposals to arrive at a final five to present to the panel.

The final judging session involved five-minute elevator pitches to an audience of invited guests and academics that were hosted by a national TV presenter. Posters of the teams that made it through the first round cull were placed in library in advance to allow the student population at QUT to vote for a People’s Choice Award.

The success of the 2011 E4H has led to talk of making the E4H Challenge a state-wide, and perhaps a national event in 2012 and beyond.
QUT "Engineering for Humanity Challenge"
Multidisciplinary entrepreneurship challenge open to all QUT disciplines and courses.

Do you have an idea worth $10,000 that can improve people’s lives?

The Challenge

Design an innovative product to allow people with disabilities to be independent and perform daily life activities.

The Prizes

1. 1st Prize - $5,000 cash
2. 2nd Prize - $2,500 cash;
3. 3rd Prize - $1,000 cash; and
4. People’s Choice Prize - $1,000 cash.
5. Humanitarian Engineering Innovation Prize - QUT may (in its absolute discretion) award Team (including the People's Choice Team) $5,000 cash as a contribution towards developing their product + $5,000 for market research of the product provided through the Australian Institute of Commercialisation.

What do you need?

1. Create a multidisciplinary team (see conditions) by 24 August.
2. Come up with an innovative product proposal to assist people with disabilities.
3. Follow the judging criteria guidelines.

From:
Entrepreneurship Education in Non-Business Schools

Reflections on a Journey by ALTC Teaching Fellowship

The innovation commercialisation sector is an industry that, to a large degree, runs ahead of the curve. It is a high profile sector with significant influence on future national economic health. This sector also demands highly qualified graduates replete with technical mastery and imbued with a suite of skills focused on the commercial imperative. The non-technical or non-disciplinary-specific skills have been flagged as behaviours and attitudes often labelled as entrepreneurial or enterprising.

This Teaching Fellowship had three aims: to examine the perceptions of the innovation commercialisation industry regarding graduate skills and employability, to examine how entrepreneurship and enterprising skills are being taught in the global environment and to develop resources to facilitate embedding entrepreneurship education in the fabric of higher education.

Preliminary analyses of the perceptions of the technology commercialisation industry have generated a model for curriculum design that comprises four broad skills domains and is process-based leading from foundation, through leverage to leadership in the industry. The foundational platform includes two skills domains: Knowledge (incorporating the skills field constructs of Technical Leadership, Functional Business Knowledge, Transforming Information) and Awareness (incorporating the constructs of Reflection, Tolerance, Lifelong Learning). The foundation platform is leveraged with a domain of skills that are essential to attain leadership: Pre-leadership, incorporating the skills field constructs of Entrepreneurial Antecedence, Interprofessional Collaboration and Independence. Skills domains that incorporate a combination of high level enterprising skills and management (Entrepreneurial Leadership) with picking and progressing potentially winning technologies to the marketplace (Pick & Progress) define Leadership in the innovation commercialisation industry.

Two issues of relevance to curriculum design highlighted are the importance of work experience as a major employability issue and the elaboration of the Interprofessional Collaboration skills construct as a graduate capability.

In hiring graduates for the innovation commercialisation sector, work experience would appear to be just as important as qualifications. The clear message is that graduates are not considered as industry-ready. Employee maturity derives from work experience enabling the graduate to ‘hit the ground running’ when hired. The current focus building work-integrated learning into the higher education programs is also a reflection of a wider industry concern about the employability of graduates. Internships and placements are compulsory components of professional degrees. Our survey outcomes suggest that these forms of education should be incorporated as part of technical degrees as well. There are solid grounds for such an inclusion: most graduates are destined for industry. Universities have moved from a focus on professional degrees in the late 1800s to focus on higher reasoning processes as a sole

From a personal perspective, the ALTC Teaching Fellowship kick-started a journey that extends well beyond the term of the Fellowship.

I am teaching them to think.... is one academic adage that is often used to disguise an inadequate curriculum.
degree outcome. The change from professional degrees has undoubtedly met the need for higher-level technical skills in graduates destined for an increasingly technologically complex world, but it is has been apparent for some ten years that the gap between the graduate skills base and actual employability is widening. From our perspective, it is the level of the demand (i.e., almost equivalent to importance of qualifications) for the innovation commercialisation industry that is surprising. Whether this is an Australian peculiarity or a global phenomenon could be determined by applying the survey in various international contexts of innovation commercialisation. The graduate employment and destinations from the Master of Research (Entrepreneurship) degrees investigated would suggest the international industry shares the same concerns about the importance of work experience in graduate employability.

A core suite of connected skills emerged from the analysis of industry perceptions that were defined as Interprofessional Collaboration. The list of graduate capabilities displayed by most universities on their websites, including that of QUT, makes a reference to team skills; however, these skills are often defined in simple terms such as collaboration and cooperation. Simple definitions also appear in Government policy documents and discussion papers. For example, in developing the Employability Skills Framework, the Australian Chamber of Commerce and the Business Council of Australia defined teamwork as skills that contribute to productive working relationships and outcomes. The West Review provided a framework of graduate capabilities that listed a generic attribute as the capacity for teamwork. These simple terms can be construed differently in the diversity of higher education contexts. In a recent Background Paper titled Employability skills and attributes framework, teamwork is defined as work effectively with others and the proposed skill areas and elements are listed as follows:

- Knowledge and skills
  - Understand and work with roles and responsibilities
  - Contribute, influence and lead
  - Negotiate and resolve conflict
- Display attitudes that show a willingness to:
  - Recognise other perspectives and express own perspective
  - Reach agreement with others
  - Actively participate in work activities.

The DEEWR list of skills areas and elements best describes a multidisciplinary team environment (i.e., independent contributions with no cross-fertilisation); rather than an interdisciplinary environment (i.e., integration of disciplines). The collection of skills within the Interprofessional Collaboration construct provides for an extended definition of the skills and attitudes contributing to teamwork as it applies to the innovation commercialisation industry.

Interprofessionalism has been defined as an approach to working in teams which emphasises highly collaborative problem solving where different professions learn with, from and about each other to improve outcomes. Considered an important aspect of health care training.

---

since the 1950s, interprofessionalism has only lately been recognised as an educational phenomenon relevant to the biotechnology industry\(^3\). The argument can be made that there is a divide between bringing knowledge to a situation (i.e., multidisciplinarity) and learning from, about and with each other in a team-based environment. Interprofessionalism derives from interdisciplinarity. Interdisciplinarity can be considered as the synthesis and use of knowledge created from different (or multiple) disciplinary contexts. Interprofessionalism can be viewed as the adoption and adaptation of attitudes, competencies and skills from different professional contexts to facilitate positive outcomes. The adoption and adaptation of attitudes and behaviours are required before multidisciplinary exercises can evolve into interdisciplinarity. Biotechnology, as an example of a high technology innovation commercialisation industry, is both interdisciplinary and interprofessional: the science is truly interdisciplinary and the process of commercialisation requires substantial interprofessional practice across science and business\(^3\).  

The **Interprofessional Collaboration** construct contained a suite of specific skills highly relevant to teams including an appreciation of the perspective of others, adapting skills and knowledge to fit with other professions, working in interdisciplinary teams, and communicating with non-experts. In our analyses, questions relating to creating, sharing and assimilating knowledge align with the skill field constructs of *Transforming Information* or *Entrepreneurial Antecedence*. Thus, the perceptions of this array of skills by the innovation commercialisation industry support a divide between interdisciplinarity (knowledge creation and use) and interprofessionalism (altered behaviours).

In addressing the employability of graduates by the innovation commercialisation industry, the impact of our findings on curriculum design is simple to enunciate although difficult to implement. The attitudinal elements of interdisciplinary teamwork need to be developed to allow students to experience and reflect on a diversity of approaches and perspectives used in different disciplines. The difficulty is that as most students learn and interact in discipline silos, the opportunity to undertake interprofessional practice is limited.

A corollary of this proposition is that graduates of double degrees should display a higher level of interprofessional behaviour than graduates of single degrees. The QUT Bachelor of Biotechnology Innovation provides evidence of heightened interprofessionalism in graduates\(^3\). As noted above, the course targets the bio-innovation commercialisation infrastructure and the students undertake parallel pathways of study in business and science. Thus, the graduates have a knowledge focus that is truly interdisciplinary, as befits the target industry. In the post-university professional environment, graduates work with scientists, technologists, lawyers who specialise in patents and contracts, venture capital groups, other companies, and the target market. The graduates are not specialists in the disciplines but are aware of the boundaries of disciplinary knowledge and the inter-relationship of the disciplines. The graduates are aware of the need to use networks and relationships to transcend those discipline boundaries. The skills of the graduates encompass interdisciplinarity (learning, synthesis and application of new

---

\(^3\) Collet C (2012) *Op cit.*
knowledge from multiple disciplines) and interprofessional practice (adopting aspects of professional practice from those disciplines) that can be applied to different pathways of commercialisation in evolving markets.

The dataset collected in the innovation skills survey is very large and the analysis requires an exploratory approach to detect, evaluate and validate underlying themes and their causality. The analysis is at a preliminary stage and yet some clear messages are already emerging about elements needed in curriculum design; especially around interprofessionalism and work experience. Burrowing into subsets of the data is also revealing interesting trends that support the overview given above and further refine the components of the model presented. One striking feature of the dataset is the quality of the responses. The different types of analysis consistently reveal very high statistical support for clustering in exploratory factor analysis. Initial models are apparent and further analysis on these is underway using structured equation models. We are confident that this dataset will continue to yield new insights that will impinge on the design of entrepreneurship education programs, in particular, and will influence the design of curriculum across a broader technological context. While this Fellowship has concentrated on technology commercialisation in assessing skills needs and employability there are obvious implications and application for the broader context of graduate skills and employability.

This Teaching Fellowship also looked at a global context of entrepreneurship education, including education programs that address technology commercialisation, to investigate how entrepreneurship and entrepreneurial programs are developed and structured. Factors that influenced choice of program included the newness (uncovering the pain), the novelty, and potential avenues of sustainability and transferability. It is important to realise that the selection process focused on the non-business school environment and programs that were realising immediate outcomes. Entrepreneurship as a theoretical subject taught in a business school environment may well yield outcomes post-graduation, but these have proved difficult to measure.

Several themes emerged from the Fellowship and the following generalisations can be made.

Most best practice exemplars were not established with a set list of desired entrepreneurial skills to be learned, with activities then designed to deliver the student to a point of skills attainment. Programs are predominantly structured as awareness-raising exercises that follow a set process from ideation through product conception to prototyping. Thus, new venture creation is the predominant focus of most programs. The exercise usually begins with four questions that form a guiding framework for the process: the problem? the solution? the novelty? and the market? The attainment of entrepreneurial skills is implicit in the exercise but not usually an explicit (or quantified component) of the exercise; rather the assumption is made that various enterprising/entrepreneurial skills are most likely attained by the time the student reaches the end of the program.

Of the programs investigated, practitioners ran all. There were no theoreticians of education, and few of entrepreneurship, directing the programs or involved in delivering materials. The practitioners were predominantly academics or business people who saw the need to harness creativity/innovation in the students, and occasionally staff, of the institute. In most instances, the practitioners talked freely of creating new and successful businesses, the innovative ideas, regional development and industry engagement. In many instances, the education initiative was top-down, originating with the rector or president, rather than bottom up. In most instances, there was clear and unequivocal backing, including financial, by chancellery that was also
recognised across the institute. This level of support reflects a high-level awareness of the need for activities of this nature, the role of the institute in promoting regional development and the intangible but substantive reputational return to the institute.

Most of the program educators were unaware of the entrepreneurship education literature. In the EU, most practitioners were unaware of the European Commission's extensive policy documentation and recent funding initiatives in the area. There were clear differences between the level of entrepreneurship education networking activities undertaken in the USA and the EU; the EU practitioners felt isolated in their endeavours. For the EU practitioners, this isolation extended to their isolation from institutional colleagues whereas in the USA, practitioners felt that their colleagues had an appreciation and understanding of their endeavours.

Although case studies have been published on many of the individual programs, none of the programs served as a laboratory for research into entrepreneurship education or, for that matter, research into new venture creation (i.e., entrepreneurship). The gap between educational theory and practice hinted at in the previous paragraph is actually a chasm.

The consortium approaches of the Stockholm School of Entrepreneurship and the Maison de l’Entrepreneuriat are perhaps the most sustainable of the programs investigated. Establishing consortia, with backing from the chancelleries of multiple higher education institutions in a region or city, provides significant advantages over programs concentrated in one institution. The biggest risk to any program based in a single institution is sustainability beyond the small group of individuals, or the one individual, involved; the consortium approach largely obviates this concern. A shared approach allows for cost-effective management and delivery of programs without providing a great impo$t on any one institution. Not only can larger numbers of students be targeted, a more diverse group can be engaged in the same activity adding to the potential for interdisciplinary collaboration. Industry relationships, so often a large part of entrepreneurship education activities, can be managed efficiently and without the inter-institutional competitiveness that disinterests industry. Developing a consortium approach to this type of educational approach makes fundamental sense given that innovation and entrepreneurship are ultimately about regional development.

In the current economic climate, it is unlikely that an Australian higher education institute will fund long-term entrepreneurship education programs to a sustainable level. Strong industry partners and external sponsorship will be essential to building programs; success will be further aided through city- or regional-based alliances between like-minded academics.

The third aim of the Fellowship was to develop resource materials to facilitate the development and embedding of entrepreneurship education in the Australian higher education landscape. I have taken an entrepreneurial approach to this aim by creating the QUT Innovation Space (an ALTC Priority Project) and the Q_Hatchery (in its infancy). These two entities draw on activities and approaches gleaned from the international exemplars. Essentially, I am doing; so that I, and others, can learn. Descriptions of best practice exemplars and advice about facets of skills fields to build into curriculum or extracurricular activities provide one dimension of how to embed an innovation into a highly rigid business environment. By definition, universities are not innovative organisations; they shun risk-taking and return to a well-defined model/structure in times of economic crisis. They are also very large organisations with an almost stultifying adherence to rules, narrowly focused processes, inflexible administrative systems and biased reward structures. These characteristics promote silos – in academia and in the administrative structures and systems. Indeed, after World War II, the President of Harvard University noted
the difficulty of maintaining interdisciplinarity between faculties owing to the administrative and academic structures that encouraged the creep back into silos\textsuperscript{38}.

Entrepreneurship education and the types of programs described in the best practice exemplars represent innovation for the Australian higher education landscape. Barriers to implementation in an Australian higher education context are not necessarily evident from examples of how other global contexts are structured or performing. By implementing the two programs at QUT, I am building research laboratories that permit testing of the concepts that come from the first two aims of the Fellowship. As these living laboratories develop, further insights into the international contexts are becoming evident. Importantly, practical issues are being identified and addressed. These add to the richness of the Fellowship outcomes. The aim is not to provide a dry (academic) account of skills requirements and potential programs that could match the context of the interested academic, but rather provide a rigorous and thorough roadmap for introducing and embedding entrepreneurship education programs in Australian higher education institutes.

A Final Word

We live in an era of generational change, global economic instability, old business creation templates, stagnant and siloed university education systems, and changing global imperatives. In the urban business landscape, new business models are being invented and used on a daily basis; many fail but a few succeed spectacularly (e.g., Google, Facebook, Twitter). Although not all new enterprise successes using innovative business models will be spectacular, the lesson is that, in a volatile world, many will succeed: as small-to-medium enterprises (SMEs). Over 90\% of the Australian workforce is employed by SMEs and, thus, the vitality of this sector is of paramount importance to the economy. The emerging skills requirements of business and industry are evident as a lack of enterprising or entrepreneurial skills.

The two immediate educational outcomes of this ALTC Teaching Fellowship are the implementation of two entrepreneurship education programs that serve as living research laboratories to trial and test the implementation of teaching and learning strategies arising from the study of skills requirements of the innovation commercialisation industry in Australia. The education programs are in themselves innovation contexts in the Australian higher education landscape. Their success will be this Fellow's desideratum of instilling the entrepreneurial mindset in students.

\textsuperscript{38} Christensen CM, Eyring HJ (2011) \textit{The innovative university: Changing the DNA of higher education from the inside out}. Jossey Bass, San Francisco.
Appendix 1 – Survey of Industry

Survey Questionnaire

Skills for Innovation Commercialisation
The project is independent research conducted by the Queensland University of Technology and the University of Queensland for a project funded by the Australian Learning and Teaching Council. The purpose of this project is to determine the skill sets for the commercialisation of innovation. It will be used to develop resources for educators to embed innovation and entrepreneurship education in university-based curricula.

Your participation in this project is voluntary and you can withdraw at any time. The survey will take less than 15 minutes to complete. All comments and responses will be treated confidentially. The names of individual persons are not required in any of the responses unless you elect to volunteer that information.

This questionnaire has met the requirements of QUT’s Research Ethics Committee.

Team member contact details:

**Assoc. Prof. Chris Collet**
Principal Researcher
Faculty of Science & Technology
Queensland University of Technology
Phone: 07 3138 5173
Email: c.collet@qut.edu.au

**Assoc. Prof. Damian Hine**
UQ Business School and Faculty of Science
University of Queensland
Phone: 07 3346 8162
Email: d.hine@business.uq.edu.au
Respondent characteristics

What is the name of your organisation? 

What is your role/job title? 

What is the primary activity of your organisation? 

What is your target product market? 

How long has your organisation been operating? ____________ Years 

How would you describe the geographic focus of your organisation? 
- Local
- Regional
- National
- International

How many staff are directly employed by your organisation? ____________

What tertiary qualifications do you have? (Tick all relevant boxes)
- None
- Bachelors (inc Hons)
- Masters
- PhD
- MBA
- Other

In what area was your undergraduate training? 

Of the staff employed in your organisational area in the last three years, what proportion had the following qualifications?
- Bachelors (inc Hons)
- Masters
- PhD
- MBA
- Other

Rate the relative contribution of qualifications versus experience you consider appropriate when you hire a graduate:
- % Qualifications
- % Experience

Rate the relative contribution of technical knowledge and skills versus soft skills (eg communication, team work) you consider appropriate when you hire a graduate:
- % Knowledge /Technical Skills
- % Generic Skills

In your current position, rate the relative contribution of qualifications versus experience in your decision-making activities:
- % Qualifications
- % Experience
**Survey Questions on Graduate Skills**

Each attribute below to be accompanied by two questions and answered on a 5-point scale:

**How important are each of the following skills to your organisation?**
Scale 1 - 5 1 = Not at all important to 5 = extremely important

**How evident are each of these skills in the graduates you employ?**
Scale 1 - 5 1 = Not at all evident to 5 = extremely evident

**Entrepreneurial (15)**

<table>
<thead>
<tr>
<th>Ability</th>
<th>Not at all</th>
<th>A little</th>
<th>Some -what</th>
<th>Very</th>
<th>Extremely</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ability to recognise an opportunity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important to your organisation?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evident in graduates?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Strong action orientation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important to your organisation?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evident in graduates?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ability to adapt to new situations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important to your organisation?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evident in graduates?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Willingness to take risks</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important to your organisation?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evident in graduates?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Drive to succeed</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important to your organisation?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evident in graduates?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ability to negotiate</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important to your organisation?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evident in graduates?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ability to work autonomously</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important to your organisation?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evident in graduates?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ability to work effectively in uncertain environments</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important to your organisation?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evident in graduates?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ability to gain management support for a new enterprise</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important to your organisation?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evident in graduates?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ability to marshal resources for a new enterprise</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important to your organisation?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evident in graduates?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ability to identify key people in a venture</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important to your organisation?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evident in graduates?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ability to influence team behaviour to promote positive team outcomes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important to your organisation?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evident in graduates?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Ability to lead a new venture
- Important to your organisation?
- Evident in graduates?

### Ability to form an effective team
- Important to your organisation?
- Evident in graduates?

### Ability to inspire others
- Important to your organisation?
- Evident in graduates?

### Generic skills (11)

<table>
<thead>
<tr>
<th>Skill</th>
<th>Important to your organisation?</th>
<th>Evident in graduates?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective written communication skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effective oral communication skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge of accounting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge of financial systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge of administrative systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge of marketing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge of general principles of law relating to business</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge of commercialisation pathways</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understanding of new product/service development processes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understanding of technology valuation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understand emerging technology and its potential impact</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Knowledge acquisition/generation (4)

**Ability to acquire new external knowledge**
- Important to your organisation?
- Evident in graduates?

**Ability to assimilate new external knowledge with existing knowledge**
- Important to your organisation?
- Evident in graduates?

**Ability to create new knowledge**
- Important to your organisation?
- Evident in graduates?

**Ability to share new knowledge with others**
- Important to your organisation?
- Evident in graduates?

Information management skills (6)

**Ability to retrieve information from different sources**
- Important to your organisation?
- Evident in graduates?

**Ability to accurately document information from different sources**
- Important to your organisation?
- Evident in graduates?

**Ability to accurately report information**
- Important to your organisation?
- Evident in graduates?

**Ability to evaluate information and data**
- Important to your organisation?
- Evident in graduates?

**Ability to synthesise information and data**
- Important to your organisation?
- Evident in graduates?

**Ability to critically question**
- Important to your organisation?
- Evident in graduates?

Disciplinarity/interdisciplinarity/interprofessionalism (9)

**Basic general knowledge in technical area**
- Important to your organisation?
- Evident in graduates?

**Ability to understand essential concepts relating to the specific discipline**
- Important to your organisation?
- Evident in graduates?

**Deep knowledge of a specific discipline**
- Important to your organisation?
- Evident in graduates?
### Ability to apply knowledge in practice

<table>
<thead>
<tr>
<th>Important to your organisation?</th>
<th>Evident in graduates?</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

### Ability to apply disciplinary knowledge to the solution of problems of a familiar nature

<table>
<thead>
<tr>
<th>Important to your organisation?</th>
<th>Evident in graduates?</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

### Ability to apply disciplinary knowledge to the solution of problems of an unfamiliar nature

<table>
<thead>
<tr>
<th>Important to your organisation?</th>
<th>Evident in graduates?</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

### Ability to communicate effectively with discipline specialists

<table>
<thead>
<tr>
<th>Important to your organisation?</th>
<th>Evident in graduates?</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

### Ability to work collaboratively with other professions

<table>
<thead>
<tr>
<th>Important to your organisation?</th>
<th>Evident in graduates?</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

### Ability to adapt one’s own skills and knowledge to fit with other professionals

<table>
<thead>
<tr>
<th>Important to your organisation?</th>
<th>Evident in graduates?</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

### Individual performance (5)

#### Responsibility for continuing professional learning

<table>
<thead>
<tr>
<th>Important to your organisation?</th>
<th>Evident in graduates?</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

#### Initiative for continuing professional learning

<table>
<thead>
<tr>
<th>Important to your organisation?</th>
<th>Evident in graduates?</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

#### Ability to respond positively to feedback

<table>
<thead>
<tr>
<th>Important to your organisation?</th>
<th>Evident in graduates?</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

#### Ability to reflect on own performance

<table>
<thead>
<tr>
<th>Important to your organisation?</th>
<th>Evident in graduates?</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

#### Ability to mentor

<table>
<thead>
<tr>
<th>Important to your organisation?</th>
<th>Evident in graduates?</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

### Miscellaneous (11)

#### Ability to manage a project

<table>
<thead>
<tr>
<th>Important to your organisation?</th>
<th>Evident in graduates?</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

#### Ability to plan business ventures

<table>
<thead>
<tr>
<th>Important to your organisation?</th>
<th>Evident in graduates?</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>
Ability to reach a timely independent decision
  Important to your organisation?  
  Evident in graduates?

Ability to build positive customer relations
  Important to your organisation?  
  Evident in graduates?

Ability to work in an interdisciplinary team
  Important to your organisation?  
  Evident in graduates?

Ability to interpret team dynamics
  Important to your organisation?  
  Evident in graduates?

Awareness of the roles and responsibilities of team members
  Important to your organisation?  
  Evident in graduates?

Ability to communicate effectively with non-experts
  Important to your organisation?  
  Evident in graduates?

Appreciation of cultural diversity
  Important to your organisation?  
  Evident in graduates?

Ability to behave in a non judgmental manner
  Important to your organisation?  
  Evident in graduates?

Appreciation of the client’s perspective
  Important to your organisation?  
  Evident in graduates?
### Simplistic Ranking of Skills Importance

<table>
<thead>
<tr>
<th>RANK</th>
<th>Question</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ability to evaluate information and data</td>
<td>4.61</td>
</tr>
<tr>
<td>2</td>
<td>Ability to accurately report information</td>
<td>4.55</td>
</tr>
<tr>
<td>3</td>
<td>Effective written communication skills</td>
<td>4.52</td>
</tr>
<tr>
<td>4</td>
<td>Ability to synthesise information and data</td>
<td>4.51</td>
</tr>
<tr>
<td>5</td>
<td>Ability to retrieve information from different sources</td>
<td>4.48</td>
</tr>
<tr>
<td>6</td>
<td>Ability to critically question</td>
<td>4.47</td>
</tr>
<tr>
<td>7</td>
<td>Effective oral communication skills</td>
<td>4.45</td>
</tr>
<tr>
<td>8</td>
<td>Ability to accurately document information from different sources</td>
<td>4.44</td>
</tr>
<tr>
<td>9</td>
<td>Ability to understand essential concepts relating to the specific discipline</td>
<td>4.41</td>
</tr>
<tr>
<td>10</td>
<td>Drive to succeed</td>
<td>4.4</td>
</tr>
<tr>
<td>11</td>
<td>Ability to assimilate new external knowledge with existing knowledge</td>
<td>4.36</td>
</tr>
<tr>
<td>12</td>
<td>Ability to work collaboratively with other professions</td>
<td>4.36</td>
</tr>
<tr>
<td>13</td>
<td>Ability to apply knowledge in practice</td>
<td>4.35</td>
</tr>
<tr>
<td>14</td>
<td>Ability to acquire new external knowledge</td>
<td>4.32</td>
</tr>
<tr>
<td>15</td>
<td>Ability to communicate effectively with discipline specialists</td>
<td>4.32</td>
</tr>
<tr>
<td>16</td>
<td>Appreciation of the client’s perspective</td>
<td>4.29</td>
</tr>
<tr>
<td>17</td>
<td>Ability to work in an interdisciplinary team</td>
<td>4.25</td>
</tr>
<tr>
<td>18</td>
<td>Ability to respond positively to feedback</td>
<td>4.22</td>
</tr>
<tr>
<td>19</td>
<td>Ability to reflect on own performance</td>
<td>4.2</td>
</tr>
<tr>
<td>20</td>
<td>Ability to share new knowledge with others</td>
<td>4.19</td>
</tr>
<tr>
<td>21</td>
<td>Ability to adapt to new situations</td>
<td>4.17</td>
</tr>
<tr>
<td>22</td>
<td>Ability to apply disciplinary knowledge to the solution of problems of a familiar nature</td>
<td>4.17</td>
</tr>
<tr>
<td>23</td>
<td>Ability to communicate effectively with non-experts</td>
<td>4.16</td>
</tr>
<tr>
<td>24</td>
<td>Strong action orientation</td>
<td>4.12</td>
</tr>
<tr>
<td>25</td>
<td>Basic general knowledge in technical area</td>
<td>4.11</td>
</tr>
<tr>
<td>26</td>
<td>Ability to adapt one’s own skills and knowledge to fit with other professionals</td>
<td>4.09</td>
</tr>
<tr>
<td>27</td>
<td>Responsibility for continuing professional learning</td>
<td>4.07</td>
</tr>
<tr>
<td>28</td>
<td>Ability to apply disciplinary knowledge to the solution of problems of an unfamiliar nature</td>
<td>4.02</td>
</tr>
<tr>
<td>29</td>
<td>Initiative for continuing professional learning</td>
<td>4.01</td>
</tr>
<tr>
<td>30</td>
<td>Ability to create new knowledge</td>
<td>4</td>
</tr>
<tr>
<td>31</td>
<td>Awareness of the roles and responsibilities of team members</td>
<td>4</td>
</tr>
<tr>
<td>32</td>
<td>Ability to behave in a non judgmental manner</td>
<td>3.99</td>
</tr>
<tr>
<td>33</td>
<td>Ability to work autonomously</td>
<td>3.98</td>
</tr>
<tr>
<td>34</td>
<td>Ability to influence team behaviour to promote positive team outcomes</td>
<td>3.98</td>
</tr>
<tr>
<td>35</td>
<td>Ability to manage a project</td>
<td>3.98</td>
</tr>
<tr>
<td>36</td>
<td>Ability to build positive customer relations</td>
<td>3.98</td>
</tr>
<tr>
<td>37</td>
<td>Ability to work effectively in uncertain environments</td>
<td>3.97</td>
</tr>
<tr>
<td>38</td>
<td>Ability to recognise an opportunity</td>
<td>3.95</td>
</tr>
<tr>
<td>39</td>
<td>Ability to reach a timely independent decision</td>
<td>3.86</td>
</tr>
<tr>
<td>40</td>
<td>Appreciation of cultural diversity</td>
<td>3.86</td>
</tr>
<tr>
<td>41</td>
<td>Ability to interpret team dynamics</td>
<td>3.84</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Score</td>
</tr>
<tr>
<td>---</td>
<td>------------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>42</td>
<td>Deep knowledge of a specific discipline</td>
<td>3.83</td>
</tr>
<tr>
<td>43</td>
<td>Ability to form an effective team</td>
<td>3.8</td>
</tr>
<tr>
<td>44</td>
<td>Ability to negotiate</td>
<td>3.73</td>
</tr>
<tr>
<td>45</td>
<td>Ability to inspire others</td>
<td>3.7</td>
</tr>
<tr>
<td>46</td>
<td>Understand emerging technology and its potential impact</td>
<td>3.66</td>
</tr>
<tr>
<td>47</td>
<td>Ability to identify key people in a venture</td>
<td>3.64</td>
</tr>
<tr>
<td>48</td>
<td>Ability to mentor</td>
<td>3.45</td>
</tr>
<tr>
<td>49</td>
<td>Ability to gain management support for a new enterprise</td>
<td>3.4</td>
</tr>
<tr>
<td>50</td>
<td>Ability to marshal resources for a new enterprise</td>
<td>3.36</td>
</tr>
<tr>
<td>51</td>
<td>Willingness to take risks</td>
<td>3.3</td>
</tr>
<tr>
<td>52</td>
<td>Knowledge of commercialisation pathways</td>
<td>3.25</td>
</tr>
<tr>
<td>53</td>
<td>Ability to lead a new venture</td>
<td>3.22</td>
</tr>
<tr>
<td>54</td>
<td>Knowledge of financial systems</td>
<td>3.08</td>
</tr>
<tr>
<td>55</td>
<td>Understanding of technology valuation</td>
<td>3.06</td>
</tr>
<tr>
<td>56</td>
<td>Knowledge of administrative systems</td>
<td>3.03</td>
</tr>
<tr>
<td>57</td>
<td>Understanding of new product/service development processes</td>
<td>2.99</td>
</tr>
<tr>
<td>58</td>
<td>Ability to plan business ventures</td>
<td>2.97</td>
</tr>
<tr>
<td>59</td>
<td>Knowledge of general principles of law relating to business</td>
<td>2.86</td>
</tr>
<tr>
<td>60</td>
<td>Knowledge of marketing</td>
<td>2.82</td>
</tr>
<tr>
<td>61</td>
<td>Knowledge of accounting</td>
<td>2.61</td>
</tr>
</tbody>
</table>
Appendix 2 – International Links

Links to other international contexts not previously featured as vignettes appear in this Section. At the time of writing this report, these investigations had not been written up as vignettes.

United States of America

Bion & Doran Foster Center for Student Innovation
University of Maine, Bangor, MN
Contact: Jesse Moriarity, Coordinator
jesse.moriarity@maine.edu
Web: www2.umaine.edu/innovation/index.html

Norway

NTNU Entrepreneurship Center
Norwegian University of Science and Technology, Trondheim
Contact: Sigmund Waago
sigmund.waago@iot.ntnu.no
Web: www.nec.ntnu.no/e_index.htm

Senter for Entreprenørskap
University of Oslo, Oslo
Contact: Truls Erikson
truls.ekrikson@sfe.uio.no
Web: www.mn.uio.no/sfe/english/

Østfold University College, Fredrikstad
Contact: Gunnar Andersson, Wong Hu
 Gunnar.andersson@hiof.no
 hong.wu@hiof.no

Sweden

Unit for Bioentrepreneurship
Karolinska Institutet, Stockholm
Contact: Lena Hanson
lena.hanson@ki.se
Web: http://ki.se/ki/jsp/polopoly.jsp?d=15463&l=en
Entrepreneurship Education in Non-Business Schools

Creating Entrepreneurs/Entrepreneurship
Lund University, Lund
Contact: Hans Landström
hans.landstrom@fek.lu.se
Web: www.entrepreneur.lu.se/en

Denmark

IDEA Entrepreneurship Centre
University of Southern Denmark, Kolding
Contact: Torben Eli Bager
tob@idea.sdu.dk
Web: www.idea-denmark.dk/en.html

Vaeksthus+
Technical University of Denmark, Lyngby, Copenhagen
Contact: John Heeboll
johe@ipl.dtu.dk
Web: www.vaeksthus.dtu.dk/English.aspx

Oresund Entrepreneurship Academy
Frederiksberg, Copenhagen
Contact: Jakob Stolt, Project Manager
jacob.stolt@oeacademy.org
Web: www.facebook.com/OeresundEntrepreneurshipAcademy

France

Master in Biotechnology Management
Group ESC Toulouse, Toulouse
Contact: Brigitte Gay
b.gay@esc-toulouse.fr

Entrepreneurship Research Centre
EM Lyon Business School, Lyon
Contact: Alain Fayolle
fayolle@em-lyon.com

Germany

UnternehmerTUM
Technical University of Munich
Contact: Oliver Bücken
buecken@unternehmertum.de
Web: www.unternehmertum.de/index.html
Spain

Programa Innova
Universitat Politècnica de Catalunya, Barcelona
Contact: Cristina Areste
cristina.areste@upc.edu
Web: http://pinnova.upc.edu/?set_language=en

Centro de Iniciativas Emprendedoras – CIADE
Universidad Autonoma de Madrid, Madrid
Contact: Isidro De Pablo López
isidro.de.pablo@uam.es
Web: www.ciade.org/

Portugal

Master Programme in Innovation and Technological Entrepreneurship - MIETE
Universidade do Porto, Porto
Contact: João José Pinto Ferreira
jjpferr@gmail.com
Web: http://paginas.fe.up.pt/miete/

Austria

Innovation Lab (StartUp Center)
Institute for Entrepreneurship and Organisational Development, Johannes Kepler University, Linz
Contact: Norbert Kailer
norbert.kailer@jku.at
Web: www.jku.at/iug/content

England

Manchester Enterprise Centre
Manchester Business School, University of Manchester, Manchester
Contact: Lynn Sheppard
lsheppard@manchester.ac.uk
Web: http://mec.portals.mbs.ac.uk/Home.aspx

EnterpriseLab
Nottingham University Business School, Nottingham
Contact: Dan Edge
dan.edge@nottingham.ac.uk
Web: www.nottingham.ac.uk/uniei/student-enterprise/enterpriselab/index.aspx
Appendix 3 – RPI E*ship Exemplars Points System

Copied from: http://www.eship.rpi.edu/exemplars_point_value.php.

Rensselaer students who register as Exemplar members have a unique opportunity to earn points for their participation in Entrepreneurship at Rensselaer events, competitions, lectures and more. By accumulating at least 100 points during their time at Rensselaer, students will become eligible to receive a Certificate of Achievement in Entrepreneurship and a personal letter of recommendation from the Vice Provost of Entrepreneurship.

The table below indicates many of the ways that points can be earned. At most live events, students will be able to simply swipe their Rensselaer ID card with RIN number in a card reader to validate their participation. In competitions, entries submitted by students will automatically record earned points. For other activities, students will be advised on how to ensure points earned are recorded. Each Exemplars member is able to keep track of their earned points through their Exemplars account on the http://www.eship.rpi.edu/exemplars_welcome.php site.

Students who accumulate 100 points will earn an E*ship at Rensselaer Exemplars Certificate of Achievement along with a personal letter of recommendation from the Vice Provost for Entrepreneurship.

At many events, students will be able to validate their participation by swiping their RPI student ID in a card reader. In all cases, students are solely responsible for ensuring their validations are received and accepted by the Office of Entrepreneurship.
<table>
<thead>
<tr>
<th>Activities</th>
<th>Required</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>E*ship Registration</td>
<td>Must register</td>
<td>Register on the Website and your RIN number will be your login ID and you can set your own password. Register by signing up a member of the E*ship Exemplars Facebook group.</td>
</tr>
<tr>
<td>Registration</td>
<td></td>
<td>Membership also requires that you join the Eship@Rensselaer Facebook Group for exclusive access to communications and invitations to special, member-only point-earning events. You must be registered to earn points.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>You must be registered to earn points.</td>
</tr>
<tr>
<td></td>
<td>plus a T-shirt</td>
<td>Your point account will be accessible by only you.</td>
</tr>
<tr>
<td>New Member Referral</td>
<td>1 ea.</td>
<td>You can earn one point for each new member who cites you as a referral on their registration.</td>
</tr>
</tbody>
</table>

### Workshops

Any Exemplar member who participates in at least 7 workshops in an academic year will receive 10 bonus points.

<table>
<thead>
<tr>
<th>Workshop</th>
<th>Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Members Overview</td>
<td>validated at the workshop.</td>
</tr>
<tr>
<td>Case Study Workshop</td>
<td>validated at the workshop.</td>
</tr>
<tr>
<td>Dragons’ Den Video Mini Workshop</td>
<td>validated at the workshop.</td>
</tr>
<tr>
<td>Business Case Workshop I and II</td>
<td>validated at the workshop. Must attend Part I to receive credit for Part II.</td>
</tr>
<tr>
<td>E*ship in the Job Search Workshop</td>
<td>validated at the workshop.</td>
</tr>
</tbody>
</table>

### Events

<table>
<thead>
<tr>
<th>Lectures</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>New Horizons Speaker Series</td>
<td>Participation validated at the workshop. Typically there are 3 hosted each semester</td>
</tr>
<tr>
<td>Special Events</td>
<td>TBD Member-only events will be offered.</td>
</tr>
</tbody>
</table>

### Curriculum

<table>
<thead>
<tr>
<th>Class Projects</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete a course with an E*ship component embedded. Only courses completed since Fall 2010 are eligible.</td>
<td>5 See the full list in Course Finder on eship.rpi.edu. A faculty member must validate your participation.</td>
</tr>
<tr>
<td>Class Project or research project</td>
<td>10 Must include an E*ship component and be pre-approved by the Vice Provost of Entrepreneurship with validation by a faculty member.</td>
</tr>
</tbody>
</table>

### Idea Competitions (Members must participate in each competition at least once.)

<table>
<thead>
<tr>
<th>Competition</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Change the World Challenge</td>
<td>Points are earned by individual entries or by each team entry member.</td>
</tr>
<tr>
<td>Change the World Challenge Pre-entry information session</td>
<td>Participation validated at the workshop.</td>
</tr>
<tr>
<td>Entry</td>
<td>Points will be automatically applied to your account for entries that meet the Submission Criteria.</td>
</tr>
<tr>
<td>Win</td>
<td></td>
</tr>
<tr>
<td>Class of ’51 Competition</td>
<td>Points are earned by individual entries or by each team entry member.</td>
</tr>
<tr>
<td>Class of ’51 Idea Competition Pre-entry information session</td>
<td>Participation validated at the workshop.</td>
</tr>
</tbody>
</table>
### Entrepreneur Education in Non-Business Schools

#### Entry 5 Points will be automatically applied to your account for entries that meet the Submission Criteria.

#### Elevator Pitch Competition
Points are earned by individual entries or by each team entry member.

#### Pre-Entry Workshop Attendance
Points will be validated at the workshop.

#### Entry 5 Points will be automatically applied to your account for entries that meet the Submission Criteria.

#### Finalist 5 Points will be automatically applied to your account for entries that meet the Submission Criteria.

#### Win 10

#### RPI Business Plan Competition 5 You must submit evidence of your entry.

#### Win 10

#### Outside B - Plan Competition 5 You must submit evidence of your entry.

#### Win 10 You must submit evidence of your win.

### Skills Development

<table>
<thead>
<tr>
<th>Activity</th>
<th>Points</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete E*ship Self-Survey 4</td>
<td></td>
<td>Complete on the E*ship Website.</td>
</tr>
<tr>
<td>Complete E*ship Traits Evaluation 4</td>
<td></td>
<td>Points are earned for completing your own Evaluation online and for up to 3 evaluations completed by peers, faculty, mentors or employers you can invite to evaluate. Members will be able to re-do self-evaluations and invited evaluations every two years.</td>
</tr>
<tr>
<td>Complete a Traits Module 3 ea.</td>
<td></td>
<td>eMail (to <a href="mailto:chernr@rpi.edu">chernr@rpi.edu</a>) a summary of your impressions of the module (on the E*ship Website) to earn points.</td>
</tr>
<tr>
<td>Complete an E*ship Case Study 4 ea.</td>
<td></td>
<td>Submit your answers to the case questions “listed” online at the E*ship Website. eMail your answers to the questions to <a href="mailto:chernr@rpi.edu">chernr@rpi.edu</a>.</td>
</tr>
<tr>
<td>Write an E*ship Case Study 15</td>
<td></td>
<td>Subject and outline must be approved in advance - case must follow the established E*ship format.</td>
</tr>
</tbody>
</table>

### Experiences

<table>
<thead>
<tr>
<th>Activity</th>
<th>Points</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrepreneurial Internship Includes co-ops with entrepreneurial experiences.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approved in advance 10 Must be approved by the Vice Provost. A report must be received from the employer.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mentoring Approved in advance 10 Must be approved by the Vice Provost. A report must be received from the mentor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Venturing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start a Venture 10 Using the E*ship business case format, submit your case to the Vice Provost.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approved Business Case 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>License with OTC 25 Validation is required from the OTC.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secure a provisional patent 15 A copy of the patent must be provided to the Vice Provost.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severino Center 25 Must provide validation from SCTE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attend an SCTE workshop 6  Must provide validation from SCTE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attend an SIG event 4 Must provide validation from SCTE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other activities TBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student venture participation TBD Up to 5 points will be earned for participating in a student venture based on a report from the venture leader based on your contributions.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---
**Appendix 4 – Reference Works Cited**


Christensen CM, Eyring HJ (2011) *The innovative university: Changing the DNA of higher education from the inside out*. Jossey Bass, San Francisco.


**Other Works of Worthy of Interest**


