

A Study into Fostering Entrepreneurship in Information Communication Technology (ICT)

Geoff D. Skinner

Abstract—The paper details the findings of a recent research project in the realms of Information and Communication Technologies (ICT) and Innovation Management. The major issues considered by the project included: investigation of the possible inherent entrepreneurial nature of ICT; how to foster ICT innovation; and examination of the inherent difficulties currently found within the ICT industry of Australia in regards to supporting the development of innovative and creative ideas. The study was completed over a twelve month period with a focus on Internet technologies and their related innovators. The results of the research, included herein, have provided a number of unique contributions to the field in addition to a set of successful industry perspectives on ICT innovation. In particular how to manage and increase the opportunities for an entrepreneur in Australia to continue economic growth in the ICT sector.

Keywords—Information and Communication Technology, Collaboration, Technological Innovation, Entrepreneurship, Technical Creativity.

I. INTRODUCTION

THE art of entrepreneurship has the potential to ignite creativity and innovation within the ICT industry. With the advent of the internet, increasing popularity of broadband and the introduction of Web 2.0 applications; the information age has become an opportunistic environment for entrepreneurs. The rapid evolution of technology in the last fifty years plays a significant role in our day to day lives. Information and communication technology (ICT) builds and supports the processes of organizations on a competitive global platform. The shift from the physical world to the virtual world is also a noticeable trend as an increasing number of everyday functions and processes are shifting to an electronic realm.

Traditionally, ICT entrepreneurship has been most successful and lucrative in the United States (US). Areas of Asia and Europe – particularly Scandinavia – have exhibited entrepreneurial flair but not to the quality and frequency of the US. There are a few theories proposed as to why this may be the case; including the likes of resources, exposure to venture capitalists, working environments, education standards, market size, risk taking experience and business strategies.

Manuscript received April 30, 2009; Revised version received June 19, 2009.

G. D. Skinner is with the University of Newcastle, Newcastle, NSW 2308 Australia (phone: 02-49854512; e-mail: Geoff.Skinner@Newcastle.edu.au).

Despite the suggestions of inadequacies there is no conclusive evidence as to why successful entrepreneurship cannot happen anywhere else in the world, such as a remote location like Australia.

The idea of combining the traditional business skills and traits of entrepreneurship within information technology innovation practice is a relatively new concept. There are no clear methodologies or templates that aim to foster the process of creativity, innovation and entrepreneurship in the development of ICT. Therefore, the focus of this paper is to detail an intensive ongoing study, to date, that is investigating technology-based entrepreneurship with a focus on the issues found with ICT innovation in Australia. The three major research questions addressed by the study, in addition to their related derived hypothesis are the following:

What constitutes successful ICT entrepreneurship?

H1.1 The traditional characteristics of entrepreneurship and the entrepreneurial traits of an entrepreneur will show to have a positive effect on ICT creativity and innovation.

H1.2 Focusing on the creative aspects of innovation will improve the success of entrepreneurial ventures in the field of information communication technology.

What sparks innovation in ICT?

H2.1 the majorities of innovations in the ICT industry are derived from previous innovations and in most cases will show to be an emulation of a physical-world process, product or practice as a digital-world representation.

H2.2 ICT innovation will be come through to fruition in at least one of the three following ways:

- via an intrinsic or extrinsic motivation;
- through technological evolution;
- personal financial gain and/or entrepreneurial opportunity

Is it possible to improve the frequency and consistency of ICT entrepreneurship in a positive manner?

H3.1 Formalizing the act of creativity and innovation in the development of new ideas and technologies will foster the quality and quantity of ICT entrepreneurship

H3.2 Incorporating an entrepreneurial attitude in the approach and creation of new ICT ideas will improve the process, frequency and consistency of ICT innovation

The remainder of the paper is used to detail the work and results of the research. A best effort have been made to

encompass a vast body of results and research in this paper. Therefore, brief background and related works are detailed in section 2, sections 3 through 6 discuss the components of the project, while section 7 provides the research results and conjectures on what can be done to foster ICT entrepreneurship in Australia to help economic growth. A conclusion and discussion of our future work is provided in Section 8, which is followed by a list of references.

II. BACKGROUND AND RELATED WORK

The ICT evolution is heavily linked with the core concepts of creativity which enables new technologies to emerge. Gupta [1] introduced the idea of creative knowledge networks that have the capacity to “unfold tremendous creative energy of our society by helping people dream and converting these dreams into reality by networking with other individuals and institutions.” Likewise, the importance of collaboration, for our focus digital or virtual collaboration, is identified as being a valued commodity for successful innovation [2]. The authors of [2] examine the i-Land environment which is an interactive landscape for creativity and innovation. The literature identifies the i-Land application environment and educational setting as a prime example of ICT creativity and the fostering of creativity to support ICT development. Essentially, the i-Land innovation has shown that creativity is an important part of ICT development and that the evolution and implementation of ICT also has an equally significant impact on the creative aspects of information organization and in producing new innovative processes and ideas.

The literature [3] describes Internet entrepreneurship as a concept that uses a global network in order to capture the potentially worldwide distributed nature of innovation processes involving knowledge-intensive products in the modern economy. The phenomenon involves social and economic components and not just technology as IT, computers and the Internet. Furthermore, it states that the definition of “Internet entrepreneurship” has five main attributes:

1. That multiple persons are distributed organizationally and/or geographically but can still interact in real time to create novelty;
2. That one person can be both user and developer but s/he does not necessarily combine both roles;
3. That copying and distributing information may be costless or may be costly, depending on the situation;
4. That distributed persons contribute to innovation through the investment of their resources (time and effort – without necessarily being ‘paid’ for their labor);
5. The instantaneous worldwide distribution of software and communication over the internet, or World Wide Web enables an identifiably different process of knowledge creation from organization-based innovation.

Internet entrepreneurship exists as a modern phenomenon that functions as a new means of innovating and has shown to

have a positive impact on the economy as it has led to a system of improvements with regard to the evolution of ICT. Open source software (OSS) has had an impact on traditional R&D processes and strategies of firms and must be understood as an early stage of innovation with strong converges toward commercialization [3]. It has been [4] identified that those who combine skills and creativity in Internet site creation, business know-how, access to finance and knowledge are successful ICT and Internet entrepreneurs and that the frequency of this act is still relatively rare worldwide.

There is overwhelming support that the era of the entrepreneur is coming of age and the literature [5] reveals that entrepreneurial opportunities in ICT are becoming more and more prominent as technology evolves. The technological challenges of today’s evolving ICT/business environment can be pre-determined by conditions that shape social change; It has been [6] proposed that technology and organization co-evolve, and that this process is characterized by periods of social construction and periods of technological determinism. Empowering people and corporations to develop entrepreneurship has greater success when supported by correctly using together computing resources and existing knowledge. Further, access to architectural tools for business and business knowledge and understanding of the opportunities arising out of new ICT are two essential conditions for entrepreneurship development [4].

According to Preston (2001), students studying at the Massachusetts Institution of Technology (MIT) create roughly two new inventions every day. “MIT’s Technology Licensing Office files four patents a week, licenses hundreds of inventions to industry each year, and creates ten to twenty new start-ups a year around these inventions” (Preston: 2001). Chen (2007) suggests that the advent of the Internet has been a positive but “disruptive force” to the world’s economies. For example, the arrival of wireless communications has revolutionized the telecommunications industry with access and adoption rates growing exponentially. In reference to the last 50 years of technological advancement, ICT innovation goes hand in hand with the rate of its evolution. The Internet has redefined the boundaries of technological advancement and innovation and with it created levels of uncertainty that provide opportunities for natural innovators in every market of every industry.

Innovation in the ICT industry is evolving and formal ways of fostering technological advancement at all levels of operations are still in its early stages. Preston [7] suggests that success in innovation should be rewarded as positive reinforcement fosters future innovations and suppresses the stigma of failure. This is the major difference between successful innovation in the US and any other part of the world. Gupta [1] proposes the idea of knowledge networks in a bid to “connect grassroots innovators” which aims to help generate a “market for ideas which may network innovators, investors and entrepreneurs”. Gupta [1] goes on to suggest that through the use of modern ICT devices such as “real time

connectivity through data bases and multimedia technology across language and cultural boundaries may increase societal capacity to spur, spawn, stimulate and sustain grassroots innovations". On the other hand, Bernstein, Klein & Malone [8] put forward that "online repository of knowledge" and the use of ICT to achieve this can greatly improve the effects of innovations and increase its frequency for future innovative endeavors.

III. INVESTIGATING TEN PROMINENT ICT INNOVATIONS

A major component of the research involved the investigation and analysis of ten influential and widely-recognized innovations of the ICT industry. Each concept,

product or venture was profiled by describing how the idea came about, what made the idea unique and how the innovation became so successful. The review incorporates the definition and use of a success metric which aims to classify the origins of ICT innovation. The review contributed to knowledge on ICT entrepreneurship and particular trends that contribute to successful ICT innovation and creative idea generation. The objective of the investigation was an attempt to answer some of the following questions: What is a successful IT innovation?; How did the creators first come up with the idea?; and How did they then market and transform that idea into reality?

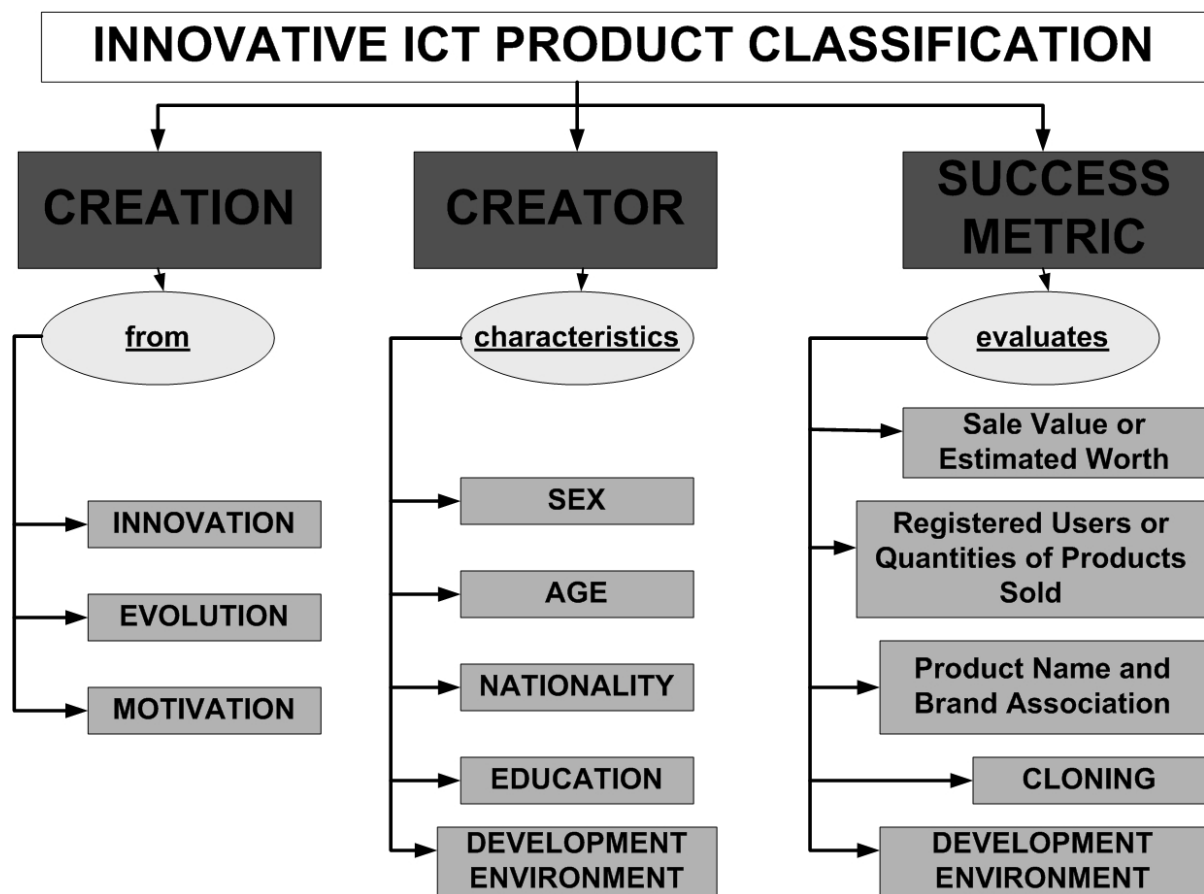


Fig. 1 Classification scheme for characterizing Innovative products

The following ten ICT 'products' were chosen for analysis: MySpace [9], YouTube [10], eBay [11], PayPal [12], Skype [13], Hotmail [14], Second Life [15], Apple [16], Expedia [17] and Facebook [18]. All of these ICT products have a prominent and successful standing being used by millions of entities every day. For many, these innovations make life easier, contribute to economic growth, provide entertainment and connect a globally diverse user entity base. Each of the products in their own right has delivered something unique in addition to representing successful examples of creativity,

innovation and entrepreneurship in the ICT sector.

Our study aimed to examine common success traits of ICT innovation by studying what the product is, how it is unique and how it became successful. In addition, to provide important knowledge to the analysis the creators or founders of each product was also investigated. This included their background, experience and other personal characteristics. From these we developed a number of categories to use in a classification scheme (Fig. 1) and formulate a metric of success.

The analysis showed that the majority of ICT innovations

and entrepreneurial internet ventures are started either through the natural evolution of technology, the intrinsic or extrinsic motivation of the creator, or a form of cloning innovation, where by a previous idea was improved upon. Therefore, the first category in our classification scheme involved grouping an innovation into one of three CREATION categories:

- Innovation – the product or idea was built upon another idea that was similar or improvements were made as an extension to an original concept. The product is still unique and different but may serve the same purpose as the copied idea.
- Evolution – an idea or product that is an act of innovation where the idea came about and evolved via the natural advancement in technology. Opportunities and new ideas are made possible through the advent of new technology.
- Motivation – a drive that comes from within the entrepreneur themselves. It can be evident in different forms such as the opportunity of personal financial gain, or the fulfillment of a personal need in which one recognizes as an opportunity in the market.

The next category was the CREATOR category and contains sub-categories relating to demographical and personal information of each product creator or creators. The sub-categories for classification are the following:

- Sex – the sex of the creator(s). This is an important demographic due to the fact that the IT industry has traditionally been a male dominated industry. Do males still dominate this industry?
- Age – the age of the creator(s) when the product was launched and at the time of its success. This is an important characteristic because age can relate directly to experience, potential for creativity and risk taking behavior. Is the age of the entrepreneur a determining factor in the success of an IT innovation?
- Nationality – the birth place, cultural background and upbringing of the creator(s). Does one's nationality or where one was raised have an effect on the success of an entrepreneurial IT innovation?
- Education – the education of the creator(s) – did they have a tertiary education? How did they learn what they needed to learn in order to be successful? Are qualifications important in attaining success?
- Development Environment – where the product was developed. The majority of successful IT innovations have come from the USA, why is this the case? Can products flourish just as well in other parts of the world?

The final category used for classification was what we termed the SUCCESS METRIC. As a product success means different things to different people it is useful to have various classifications for success besides the common net worth, or in some cases the 'sale price'. That is, an ICT innovation and their creator(s) are often seen as being successful based solely on how much they sold their idea for. Our classification scheme argues that net worth is not the only metric of success as our classification framework includes the following categories:

- Sale value or estimated worth – the annual net revenue of the company/product/idea. If sold tomorrow, what would be the net worth or value of the company/product/idea? This determines the success threshold in terms of currency value.
- Registered users or quantities of products sold – the number of registered users or total products sold of the innovation and the time it took to reach that figure – this measures the success of a company/product/idea with regard to popularity, usefulness and competition. At what point did the company/product/idea become successful and how quickly did it get there?
- Product name and brand association – Reputation, recognition and the establishment of the company/product/idea as a "generic term" within common society – has the company/product/idea reached a level of success where the brand is now well known and synonymous with superior quality and customer satisfaction? This measures the longevity and sustained success of the company/product/idea with regard to industry standards and customer loyalty.
- Cloning – the re-creation of a company/product/idea by a competitor – has the company/product/idea been copied or is it a copy? The copying of an original concept signifies success in terms of a contribution to technological advancement or a pioneering change in the industry.
- Globalization and localization – the widespread use and acknowledgement of the company/product/idea within its chosen industry. The use of global/national domains with local customized content signifies widespread success.

IV. SUCCESS AND ENTREPRENEURS

Another phase of the study involved the analysis of successful innovators and entrepreneurs within the ICT sector. Within this phase two specific approaches were taken. The first was a case study of perhaps the most publicized and recognized technology entrepreneur and innovator, Mark Cuban. The second component involved a professional questionnaire completed by six high profile Australian ICT entrepreneurs. The six professionals that participated in research included: Martin Wells founder of Tangler [19], Cameron Reilly founder of The Podcast Network [20], Chris Deere founder of Hunterlink [21] and Ipera Communications [22], Robert Buck founder of Diamond IT [23], Matt Freedman founder of Redback Solutions [24], and Lloyd Davies co-founder of Liveware Solutions [25].

A case study has the benefits of detailing what may or may not have worked in the past and determining whether it is applicable as a benchmark and guidance for those wishing to emulate its success. Mark Cuban currently is a benchmark in ICT innovation with a string of success's both by his amassed personal fortune and the fact many of his most successful innovations either fulfilled one or a number of our success metrics. For example, he sold his first company MircoSolutions Inc for US \$30 million, followed by the sale of Broadcast.com for US \$5.7 billion. Further, registered users

for Broadcast.com were in their millions and Cuban's latest project, HDNet, is received in 66 million US households. Besides being described as having a natural entrepreneurial nature, Cubans is the epitome of problem-based learning as his philosophy is to say yes to basically any challenge that set before him. The results we draw from this case study also indicate that a formal education in computing is not required for success. Rather, the ability to identify an opportunity and take advantage of it is of more importance. As our study aimed to show, the ICT sector continues to provide many such windows of opportunity due to its rapidly evolutionary nature.

As our research was primarily aimed at fostering better technology-based entrepreneurial behavior and managing innovation in Australia, it was imperative that successful Australian entrepreneurs were able to contribute to our work. Their input added another professional dimension to our research to ensure that first hand practical or real-world knowledge was also reflected in our results. Therefore, the six ICT professionals responded to a total of ten primary questions, with a number of sub-questions among the ten primaries. The questions have been provided below and the results of the survey and our conjectures are discussed in Section 6. The following questions were asked of each of the six key Australian ICT innovative professionals:

1. Do you consider yourself an IT expert with naturally creative and innovative instincts; or an entrepreneur who has noticed the potential in the IT industry?
2. As an IT professional are you profit driven? Idea/technological advancement driven? Or a combination of both?
3. What makes an idea a good idea in the IT industry?
4. What was your main idea and how did it come about?
5. Did you spot a gap in the industry and solve the problem on purpose or did you stumble upon the idea by mistake?
 - a. Are there many good ideas out there that just haven't got off the ground yet?
 - b. If so, why do you think this is the case?
6. Why has your venture been so successful? Why has your venture been so successful?
 - a. What were your major obstacles?
 - b. What are your strengths and weaknesses?
7. What is your philosophy regarding creativity and innovation in the IT/business industry?
 - a. What sparks innovation in IT?
8. How did you get started in IT?
9. What is your educational background? Did you graduate from university with an IT or business degree or something similar?
10. Does the structured learning environment of secondary and tertiary education suppress entrepreneurial flair in the IT industry?
 - a. If so, how does this affect the creative and innovative characteristics of a future IT professional?

V. CURRENT ICT SUPPORT AND THE NEXT GENERATION

The next component of the research was to identify ICT strategies and applications that facilitate creativity and innovation in ICT entrepreneurship. Firstly, brainstorming is shown to be a fundamental collaboration technique that facilitates the collection and generation of new ideas that enriches the act of creativity. Mind mapping is identified as a form of brainstorming that displays and organizes information and ideas in a formal and concise manner. The art of mind mapping links ideas via the diagrammatic representation of a core concept and their related attributes. This activity is shown to be beneficial in assisting creativity as a physical world process. More importantly, the evolution of ICT and the increasing need for efficiency has led to the equivalent formation of physical world processes in the virtual world.

Two examples of virtual world emulations analyzed during the research included The Personal Brain [26] and SOUP [27] applications. The Personal Brain is an application used to mimic the process of mind mapping in an electronic format. It is a software program that organizes files and creates relationships to improve the accessibility and management of information. The SOUP application has characteristics of an anonymous peer review digital suggestion box for creative ideas. The application formalizes the process of creative idea evaluation in order to foster and reward innovation in a collaborative environment.

Another major contribution of the research was a student survey based around their perceptions of the influence of tertiary education on innovation and entrepreneurship. The sample set for the survey was a mix of undergraduate and graduate students across a number of campus locations at a tertiary educational institution in Australia. Close to 200 students participated in the survey with each student answering ten multiple choice questions. Statistical analysis was performed on the results to discover any potential trends emerging relating to the impact of entrepreneurship on the ICT industry and the current IT tertiary curriculum. The purpose of the student survey was to determine the current perspectives of students studying at a tertiary institution regarding the role and impact entrepreneurship, creativity and innovation has on IT.

The student survey consisted of ten multiple choice questions. Each multiple choice question contained options ranging from (A) to (G). Participants selected the most correct answer from their point of view. It was a prerequisite to answers all questions on the survey, as failure to do so voided the respondent's participation. Three out of the ten multiple choice questions in the survey had "other" as an option with a corresponding space for a written comment. The option of "other" was only selected and filled out when the answers provided were not sufficient or more detail was required. There were no right or wrong answers as the perceptions and opinions of the participants were of the utmost importance.

A total of 125 students participated in the survey. All participants were enrolled in an IT degree or computing

related course at the University of Newcastle. Participation was entirely optional and the survey itself was first passed by the ethics board before the submission, collection and analysis of surveys commenced. As mentioned earlier in the methodology, students from the Callaghan, Ourimbah and Singapore campuses formed the sample set.

Students completed the survey in one of two formats; either a paper based hard copy survey or an online version. The paper based hardcopy surveys were submitted as optional participation and completed after the student's lectures and/or tutorials of their relevant IT courses. The online version was made available to students in case a student missed the day of tutorials and lectures when the hardcopy version was made available. The online version of the survey was also used as a mode of convenience for students attending tutorials and lectures at locations other than Callaghan; such as the Ourimbah and Singapore campuses. This allowed for a greater spread and number of participants thus enriching the sample set size. It was also a way of reaching willing participants in a less upfront and invasive manner, here the student could complete the survey in their own time and in a less pressurized environment.

A brief summary of the major statistics and findings for each question from the survey are as follows:

1. 40% of students agree that the current academic structure of university education has a detrimental effect on creativity, innovation and entrepreneurship within IT.
 - a. 38% of students are unsure whether or not the current academic structure has a detrimental effect on creativity, innovation and entrepreneurship within IT.
2. Over 90% (93%) of students believe that creativity and innovation is either very important or essential to the success and evolution of the IT industry.
 - a. 51% - very important
 - b. 42% - essential
3. 54% of students agree that entrepreneurship and other business skills should be incorporated into the IT degree.
 - a. 79% of students either agree or strongly agree – 25% strongly agree, 54% agree
4. 40% of students agree that there is a lack of freedom to express one's own creativity within the current subjects being studied as part of the IT degree.
 - a. 33% of students are neutral.
5. 46% of students believe that entrepreneurship and other business related skills are "very important" to their IT career.
 - a. 28% of students are not sure
6. 23% of students who took the survey are currently doing the information technologies applications major
 - a. 22% - business information systems
 - b. 21% - information technology
7. 48% of students believe their key motivation for creating something new in the IT industry and fulfilling that idea would be for financial gain
 - a. 28% - advancement in IT technology
8. 39% of students use the internet greater than 30 hours a week (on a weekly basis)
 - a. 28% - 10-20 hrs
 - b. 25% - 20-30 hrs
9. 69% of students were first attracted to the IT industry as their chosen career path for their enjoyment and interest in IT
 - a. 14% - opportunities in the job market
 - b. 8% - financial reward of the industry AND other
10. 34% of students believe that the hardest obstacle to overcome in order to achieve intended success from an entrepreneurial IT idea would be time
 - a. 30% - resources
 - b. 21% - money

VI. GETTING RESULTS FOR FOSTERING AUSTRALIAN ENTREPRENEURS

As previously mentioned the major objectives of the research project was to attempt to determine what makes a successful ICT entrepreneur and how can the ICT sector foster innovation. A parallel objective was to focus the results on deriving achievable outcomes to apply to the Australian ICT industry. These objectives were reflected in the three primary research questions formulated for the research. While some of the results have been mixed there are a number of positive outcomes that can make positive contributions to more effectively managing technology-based entrepreneurial activities in Australia and abroad. The remainder of this section, in the limited space provided, details the more prominent results and important contributions of the research.

The investigations of ten 'successful' ICT innovations lead to the following deductions termed 'success factors':

- There is a noticeable trend toward "social networking".
- The properties of Web 2.0 have a significant impact on the direction of new ICT ventures.
- The most successful ICT innovations and ideas are global competitors on a worldwide ubiquitous platform.
- The life cycle of an entrepreneurial venture is significantly compressed with an ICT innovation . It is important to note that even though the windows of opportunities are smaller, the rapid evolutionary growth of the ICT industry induces greater frequencies of these opportunities.
- The idea of linking, communicating and networking are major contributors to a successful ICT innovation.
- Although one person – usually the founder – may initiate the novel idea of a successful venture, it is rare that the venture is entirely successful without the help of others. It is crucial for any entrepreneurial venture to have a supportive and organized network throughout its life cycle, especially in the start-up phase and phases of growth.

The results of the professional questionnaires supported many of the projects 'success factors'. Specifically, Australian innovators recognized the importance of collaboration and support in a comparatively smaller market place like Australia. With a lot less venture capital available it is important that besides being the first person to implement the

idea, that support for the implementation is provided. This is well expressed by Martin Wells when he states that a good idea is only as good as its execution. Therefore, we stress that for Australia to be a technology-base entrepreneurial leader more schemes that provide not only financial support for such ventures but also other resources such as quality staff and knowledge is really needed. The key is Collaboration.

As we expected the results of the student survey were very diverse, with only a strong majority for a single questions but in general a fairly even distribution of responses. In summary around 90% of students felt that Innovation and Entrepreneurship are is either very important or essential for to the success and evolution of the ICT industry. Further, around 55% agreed that entrepreneurship and other business skills should be a foundational part of a computing degree. What we found most interesting is that only 40% of students perceive current academic programs as having a detrimental effect on creativity, innovation and entrepreneurship within ICT. From this we conclude that to protect Australia's innovative future it is worth investigating the feasibility of integrating entrepreneurial skills into tertiary computing programs.

Our analysis of what the literature describes as successful ICT applications for fostering entrepreneurship and innovation revealed that they again all supported some degrees of collaboration and knowledge sharing. Further, creativity and innovation is more affluent when people are provided an environment supporting creative freedom and are encouraged to think laterally and explore ideas that may or may not be worthwhile. Allowing anonymous peer review of ideas, such as supported by the SOUP application, is a positive element for incorporation into innovation fostering initiatives.

VII. PROCESSING THE RESULTS

The metric of success as defined previously; stated and analyzed five major points in determining the success of an entrepreneurial idea in the ICT industry. The five metrics of success were:

1. Sale value or estimated worth
2. Number of registered user or quantities of products sold
3. Product name and brand association
4. Cloning
5. Globalization and localization

This research has shown that innovation is sparked by the three main influences of positive creativity, necessity and opportunity. The results have specified that necessity sparks innovation. The response to question three of the professional questionnaire shows that a good idea in the ICT industry is one that provides a product or process in order to solve a particular problem. The product or process invariably caters for a significant number of people in which those people are prepared to pay money for. The six respondents came up with the following characteristics that all contribute to the definition of a 'good idea' in the ICT industry:

- Solves a problem
- Creates value to an extent where customers would be willing to pay for it
- Incorporates the use of a combination of the latest and most reliable technology. It is important to note that entrepreneurs find most success in sparking innovation when compared to their technical IT counterparts because they tend to have the ability to come up with ideas without limitation. That is, ideas are driven by imagination in which current or new technology must adapt to or be created. On the other hand, negative innovation can occur when the current technology drives what is possible in terms of new possibilities. The perspectives of the respondents regarding creativity and innovation in the ICT industry and the factors that trigger this behavior can be summarized and attributed to the following reasons:

- "Need" is generally considered the major spark to innovation
- Innovation eventuates through the ability to see problems
- Creativity and innovation is achieved best without limitation – entrepreneurs tend to have this positive mind set
- IT professionals tend to achieve innovation when two or more existing ideas are put together in a different way to assist or create a new application or process
- Creativity and innovation is more affluent when the environment where people have creative freedom and are encouraged to think laterally and explore ideas that may or may not be worthwhile
- Creativity and innovation occurs best in a collaborative environment – industry alliances and partnerships facilitate success.

The results throughout the study have shown that there are certain ways to improve the frequency and consistency of ICT entrepreneurship in a positive manner. The most prominent example of improving entrepreneurial behavior is the case study on the 3M Corporation in chapter eight. The company has evolved with the changing times and with over 100 years of experience 3M have managed to sustain their innovative standard. The turnover in innovation at 3M was shown to be a significant attribute to their sustained success. The rule of thumb in the company is that managers of each department are challenged to successfully introduce thirty percent of their product innovations within a four year period. Each business unit within 3M is given incentives to accomplish the thirty percent of revenues coming from the innovations of the last four years. This is a prime example of how entrepreneurship can be improved upon in a positive manner. The results have shown that a positive attitude toward creativity and innovation enhances entrepreneurship and its related endeavors. An optimistic perspective is a fundamental ingredient to a successful entrepreneurial approach. The optimist sees improvement and knowledge in every possibility. On the other hand, it can be said that the pessimist is naturally afraid of change, a disruption of the status quo or the prospect of something new.

The major findings of the research covered many areas of

the topics in question. Entrepreneurship was found to be an interesting phenomenon especially when examined within the ICT industry. Three clear cut questions were asked of the study and two related hypotheses were made addressing each of the three questions. It was found that creativity, innovation and entrepreneurship are intrinsically linked. Further the key findings of the research to date are the following:

- The USA is the ideal environment for successful ICT entrepreneurship. Many successful entrepreneurs either were born in the USA or grew up in the USA, and were also educated in the USA with a tertiary education. Additionally there was evidence that supported the reason for this was that the USA has been shown to be an opportunistic market and also the largest market for ICT products and innovations. However, there is no concrete reason why new innovations and products of an ICT nature cannot flourish just as well in other parts of the world. It is clear that opportunity is an important characteristic in the overall success of ICT entrepreneurial ventures.

1) Positivity

- The entrepreneur and the innovator share common basic characteristics such as positive creativity.
- Creativity was found to be innately positive and is a required exercise throughout the entire life cycle of a successful entrepreneurial venture
- Many IT professionals are self and industry taught – education is only part of the equation. A formal education is a valued part of an entrepreneur's career but there are definitely other facets such as commercial experience, sales experience etc that can have an equal if not greater influence
- Natural flair will shine through in the market. The gifted will always break free from conformity
- Universities focus on educating the masses – however, identifying the gifted at an early stage could increase the frequency of such people making large contributions to the world of innovation in ICT.

2) Promotion of creativity – it can be deduced that the promotion or restriction creativity can prove to be the difference between success and failure of innovation.

- Fostering creativity in a positive manner in order to achieve continual innovation.
- 40% of students agreed that the current academic structure of university education has had a detrimental effect on creativity, innovation and entrepreneurship within IT
- over 90% (93%) of students in question two also believed that creativity and innovation was either very important or essential to the success and evolution of the IT industry
- It was also intriguing to note from the results that the idea of mind-mapping has been prevalent for centuries and that the concept was found to have intrinsic links to the fundamental art of learning, brainstorming, memory, visual thinking, and problem solving. The

above mentioned characteristics have the capacity in one way or another to form the key derivatives for creativity

3) Empowers potential entrepreneurs and innovators to explore what is possible in an uninhibited manner

4) This unique philosophy and approach to creativity and innovation is evidently entrepreneurial in nature. That is, in order to survive one must adapt or initiate change to increase profit and move technology forward.

5) Whether or not one started as an IT person within the industry or came into the industry with an idea as an entrepreneur/business person outside the IT industry; there is good cause to suggest that success can be attained just as easily. This shows that differing backgrounds is not a determining factor of success in the IT industry.

6) IT innovation is brought about either by:

- Motivation – intrinsic/extrinsic
- Evolution – advancement in technology
- Opportunity – personal/financial gain and/or entrepreneurial opportunity

7) Positive creativity, necessity and opportunity spark innovation

8) Social networking is a lucrative ICT entrepreneurial environment

It is important to note that the catalyst for change is re-creation and innovation and the catalyst for re-creation and innovation is change.

VIII. CONCLUSION AND FUTURE WORK

This research has explored the intricacies of ICT entrepreneurship. The study identified the importance and potential of entrepreneurial activity in the ICT industry and devised a unique classification framework shown in Fig. 1. Factors for the successful fostering of technology based entrepreneurship in Australia include collaboration, recognition of compressed life cycles, sound idea execution, recognition of Web 2.0 potential, and due to the critical nature of Australians, anonymous peer review. To support this we plan on enhancing our SOUP application to increase innovation management functionality. Further, we found that the next generation of entrepreneurs feel somewhat limited by the bounds and rigidity of tertiary education but recognize the importance of creativity.

It was recognized throughout the study that limitations for this type of research were going to be inevitable. A number of limitations were prevalent especially in the early stages of data gathering and analysis. Firstly, considering the online nature and scarcity of resources, the majority of evidence in the literature and technology review was internet based. That is, web pages, websites and online articles. The idea of ICT entrepreneurship was also deemed a fairly new topic with little to no papers. A number of books and journal articles were found pertaining to the topic of interest however; they were either out dated or too old for the purpose of the study. The hard copy sources of information were also found to be limited. This included books, journals, and other paper based

articles. These limitations were taken into consideration when determining the objectives and goals of the research. The scope was also affected.

Time and ambiguity were two other major limitations in the research. The nature of the study was very broad in scope with many possibilities. The creative aspects of innovation have shown to have an effect on the success of entrepreneurial ventures in the ICT industry. The degree of this positive affect is quite complex to measure and not within the scope of this study. The study only signifies the beginning for a number of topics that were addressed in formalizing creativity or acts of innovation and entrepreneurship. Our future work aims to continue exploration in this field in increasing detail. Related areas of interest we plan to explore further are the works done by WSEAS authors in current journals [28, 29, 30].

REFERENCES

- [1] A. K. Gupta, "Community Information Services: A Proposal for creating Knowledge Networks for Creativity," in Proceedings of Conference on Information Today and Tomorrow, Central Leather Research Institute, Chennai, September 1998.
- [2] Streitz, Geibler, Holmer, Konomi, Muller-Tomfelde, Reischel, Rexroth, Seitz & Steinmetz, "i-LAND: an interactive landscape for creativity and innovation," in Proceedings of the SIGCHI conference on Human factors in computing systems, Pittsburgh, Pennsylvania, United States, 1999, pp. 120 - 127.
- [3] M. McKelvey, "Internet Entrepreneurship: Linux and the Dynamics of open Source Software," CRIC The University of Manchester & UMIST CRIC, Discussion Paper no. 44, Centre for Research on Innovation and Competition, The University of Manchester, 2001.
- [4] S. L. See, "Corporate entrepreneurship: exploiting technologies for innovation discovery and breakthrough," in Proceedings of Engineering Management Conference IEMC 2004, vol. 2, October 2004 pp. 699 – 702.
- [5] Q. Ma and Y. Wang, "Entrepreneurship on Website," in Proceedings of 2006 IEEE International Conference on Management of Innovation and Technology, vol. 1, June 2006, pp. 86 – 90.
- [6] P. Groenewegen and Y. Taminiau, "The strength of social embeddedness: societal and cultural activism, as conditions for early Internet entrepreneurs in Amsterdam," in Proceedings of Engineering Management Conference IEMC 2003, Nov. 2003 pp. 494 – 498.
- [7] Preston, J. T. (2001), Success Factors in Technology-Based Entrepreneurship, Massachusetts Institute of Technology, MIT Entrepreneurship Centre, Originally a Transcript of a Lecture Delivered in Tokyo in 1997, Updated August 2001.
- [8] Bernstein, A, Klein, M and Malone, T. W (1999), The Process Recombinator: A Tool For Generating New Business Process Ideas.
- [9] MySpace, <http://www.youtube.com/>.
- [10] YouTube, <http://www.youtube.com/>.
- [11] eBay, <http://www.ebay.com/>.
- [12] PayPal, <http://www.paypal.com/>.
- [13] Skype, <http://www.skype.com/>.
- [14] Hotmail, <http://www.hotmail.com/>.
- [15] Second Life, <http://www.secondlife.com/>.
- [16] Apple Inc., <http://www.apple.com/>.
- [17] Expedia, <http://www.expedia.com/>.
- [18] Facebook, <http://www.facebook.com/>.
- [19] Tangler, <http://www.tangler.com/>.
- [20] The Podcast Network, <http://www.thepodcastnetwork.com/>.
- [21] Hunterlink (now PacNet), <http://www.pacific.net.au/>.
- [22] Ipera Communications, <http://www.iperacom.au/>.
- [23] Diamond IT, <http://www.diamondit.com.au/about/profile.aspx>.
- [24] Redback Solutions, <http://www.rb.com.au/>.
- [25] Liveware Solutions, <http://www.liveware.com.au/>.
- [26] The Brain, Personal Brain 4.0, <http://www.thebrain.com/#-50>.
- [27] C-E Solutions, SOUP, <http://www.c-esolutions.com.au/soup.html>.
- [28] G. Leskovar-Spacapan & M. Bastic, "The Relationships Between Organizational Innovation Capability and its Determinants - The Case of Transition Economy," WSEAS TRANSACTIONS on BUSINESS and ECONOMICS, Issue 5, Volume 3, May 2006.
- [29] W. Wu, Q. Chen, B. Yu and H. He, "Effects of Management Innovation on Telecommunication Industry System," WSEAS TRANSACTIONS on SYSTEMS, Issue 5, Volume 7, May 2008.
- [30] M. Botarelli, P. Taticchi, R. Revetria, & F. TonellAn, "Agent Based Tool to Support Tactical Dialogues in Industrial Enterprise Networks: Model and Experimental Campaign," WSEAS TRANSACTIONS on BUSINESS and ECONOMICS, Issue 7, Volume 5, July 2008.