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Editorial Preface

This is the first issue of volume first of The Innovative Studies: International Journal (ISIJ). The Journal is published bi-monthly, with papers being peer reviewed to high international standards. The International Journal of Innovative Studies is not limited to a specific aspect of innovation but it is devoted to the publication of high quality papers on all division of computer security in general. ISIJ intends to disseminate knowledge in the various disciplines of the computer security field from theoretical, practical and analytical research to physical implications and theoretical or quantitative discussion intended for academic and industrial progress. In order to position ISIJ as one of the good journal on Innovative Studies, a group of highly valuable scholars are serving on the editorial board. The International Editorial Board ensures that significant developments in computer security from around the world are reflected in the Journal. Some important topics covers by journal are Case Studies and Change Management, Innovation in SME and R&D Management, Technology Strategy and Planning
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submitting quality manuscripts for review and encouraging your colleagues to submit quality manuscripts for review. One of the great benefits we can provide to our prospective authors is the mentoring nature of our review process. ISIJ provides authors with high quality, helpful reviews that are shaped to assist authors in improving their manuscripts.

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The I-CAN Tool and Managing Information and Communication Technology (ICT) Innovation in Australia

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Abstract

Australia, while being a large and eager consumer of innovative and cutting edge Information and Communication Technologies (ICT), continues to struggle to remain a leader in Technological Innovation. This paper has two main contributions to address certain aspects of this complex issue. The first being the current findings of an ongoing research project on Innovation Management in the Australian Information and Communication Technologies (ICT) sector. The major issues being considered by the project include: 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 second major contribution is details of the I.-C.A.N. (Innovation by Collaborative Anonymous Networking) software application tool created and evolving in our research group. I-CAN, besides having a positive reinforcement acronym, is aimed at facilitating productive collaborative innovation in an Australian workplace. Such a work environment is frequently subjected to cultural influences such as the 'tall poppy syndrome' and 'negative' or 'unconstructive' peer-pressure. There influences are frequently seen as inhibitors to employee participation, entrepreneurship and innovation.

Keywords: Innovation Management, Knowledge Management, Information Privacy and Security.

1. 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 number of theories proposed as to why this may be the case; including the likes of resource availability, exposure to venture capitalists, working environments, education standards, market size, risk taking experience and

business strategies. Despite suggestions of the lack of the above elements retards innovation, there is no conclusive evidence as to why successful entrepreneurship and innovation cannot happen anywhere else in the world, such as a 'geographically 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. Our research group has not been able to find any clear methodologies or templates that specifically aim to foster the process of creativity, innovation and entrepreneurship in the ICT realm. Therefore, the topic of this paper is twofold. First, is to detail to date an ongoing study that is investigating Information and Communication Technology (ICT) innovation. The main focus is placed on the issues found within Australia due to it being directly relevant to the research group's geographical location. The work has three major research questions, in addition to their related derived hypothesis, formulated to be addressed by the study. They are the following:

1) What constitutes successful ICT entrepreneurship?

Hypothesis 1.1: The traditional characteristics of entrepreneurship and the entrepreneurial traits of an entrepreneur will show to have a positive effect on ICT creativity and innovation.

Hypothesis 1.2: Focusing on the creative aspects of innovation will improve the success of entrepreneurial ventures in the field of information communication technology.

2) What sparks innovation in ICT?

Hypothesis 2.1: 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.

Hypothesis 2.2: ICT innovation will be come through to fruition in at least one of the following three ways:

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

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

Hypothesis 3.1: Formalizing the act of creativity and innovation in the development of new ideas and technologies will foster the quality and quantity of ICT entrepreneurship

Hypothesis 3.2: Incorporating an entrepreneurial attitude in the approach and creation of new ICT ideas will improve the process, frequency and consistency of ICT innovation

The second topic of this paper is detailing the I-CAN software application tool we have developed and continue to evolve in our research center. Our ongoing literature review and peer discussions has found little in the way of a software networking and collaboration application that fosters innovation while also being well suited for the Australian cultural working environment. The I-CAN, Innovation by Collaborative Anonymous Networking, tool has evolved from one of our earlier professionally tested applications called SOUP [1]. SOUP's motivation and inspiration came by identifying factors that facilitate innovation from the available literature and our own research endeavors. That is, it was found innovation is more effective through collaboration [2,3,4], good knowledge management [5,6], and specifically in the ICT sector an employee having access to their enterprises internal knowledge base [7,8,9]. Further, as the tool was specifically aimed at Australian enterprises and work environments we were aware that we need to take into consideration the cultural influences on innovation. From experience and supported by the literature the design and operation of the tool needed cater for the issues of the 'tall poppy syndrome' (TPS) [10,11] and extensive peer pressure [12] prevalent in Australian organizations.

As technological innovation has been identified as a research priority for Australian academics, considerable efforts are underway in this field. A number of initiatives have recognized that ICT and other science related disciplines are particularly subject to TPS [12]. New Zealand shares many things in common with Australia, including a cultural affliction for TPS. A recent study [13]

highlighted the problem entrepreneurs face in New Zealand with TPS and discussed methods to avoid it and its implications. All of the points were extremely valid for the Australian environment, and therefore our I-CAN tool has been designed to accommodate and manage this cultural nuisance to ensure innovation is not suppressed. Therefore, we felt our research could make a unique and useful contribution to this body of work by providing an ICT application for use in ICT innovation. In developing the software application many of the issues and possible solutions proposed in [14] have been taken into consideration. The key elements of I-CAN include its incorporation of collaboration and networking, knowledge management, and the ability for participants to remain anonymous if so desired to avoid being subjected to TPL and negative peer pressure. Full details of the I-CAN application tool are provided later in this paper.

The remainder of the paper is used to detail the work and results of the research to date. A best effort has been made to encompass a vast body of results and research in this paper in a limited space. Therefore, brief background and related works are detailed in the next section with discussion of the components of the project following after. Proceeding sections provide the research results and conjectures on what can be done to foster and manage ICT innovation in Australia along with details of the i-CAN tool. A conclusion and discussion of our ongoing and future work is provided to summarize the paper, which is followed by a list of references.

2. BACKGROUND AND RELATED WORK

The ICT evolution is heavily linked with the core concepts of creativity which enables new technologies to emerge. Gupta [15] 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 [16]. The authors of [16] 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 [17] 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. It must be understood as an early

stage of innovation with strong convergence toward commercialization [17]. It has been [18] 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 [19] 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 [20] 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 [18, 19].

According to Preston [20], 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" [20]. Some authors [21] suggest 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 [20] 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 [15] 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 [15] 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". Further, Bernstein, Klein & Malone [22] 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.

The idea of an online repository of knowledge and this author's previous work on virtual collaborative environments [23,24] and digital ecosystem's [25,26] was the background motivation and foundation upon which the development of the initial SOUP [1], and now evolved I-CAN, software applications were formulated. Collaborative environments have been shown to provide an ideal digital platform for knowledge sharing and distribution [27], shared workspaces, and, from a potential innovation perspective, virtual brainstorming. Further, digital collaborative environments due to their very nature are ideal for collaboration between diverse geographically located [28], and therefore possibly culturally diverse, users. The author's extensive work on data security and information privacy in digital collaborative environments [29,30] provided a sound knowledge base for assuring the availability of anonymous and pseudo-anonymous interaction within a collaboration. In addition, the data collected and distributed in the collaborative environment is likewise protected by stringent security and privacy controls [31]. As a result, the author and associated research group were in a very good position to develop a tool and operating environment that facilitated user (employee) input and access to innovative ideas while having the ability to remain anonymous. As mentioned, the incorporation of a user's ability to

remain anonymous was a defining and critical feature of any such tool developed for Australian enterprises and organizations. That is, anonymity was one method of alleviating employee hesitation and non-participation due to the possibility of being subjected to negative peer pressure and the tall poppy syndrome [12] if they were identifiable.

3. ANALYSIS OF LEADING ICT INNOVATIONS AND ENTREPRENEURS

An important component of our research to date 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?

The following ten ICT 'products' were chosen for analysis: MySpace [32], YouTube [33], eBay [34], PayPal [35], Skype [36], Hotmail [37], Second Life [38], Apple [39], Expedia [40] and Facebook [41]. 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 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 ICT 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 or similar purpose as the root 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.

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 one of 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 [42], Cameron Reilly founder of The Podcast Network [43], Chris Deere founder of Hunterlink [44] and Ipera Communications [45], Robert Buck founder of Diamond IT [46], Matt Freedman founder of Redback Solutions [47], and Lloyd Davies co-founder of Liveware Solutions [48].

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 one of Cuban's recent projects, HDNet, is received in 66 million US households. Besides being described as having a natural entrepreneurial nature, Cuban is the epitome of problem-based learning as his philosophy is to say yes to basically any challenge 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 results of the survey and our conjectures are discussed in a following section.

4. FUTURE INNOVATORS AND ICT FOR FOSTERING ICT INNOVATION

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 [49] and SOUP [1] 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 peer pressured environment.

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

1. 40% of respondents felt that the current academic structure of university education has a detrimental effect on creativity, innovation and entrepreneurship within IT. 38% of students are unsure whether or not the current academic structure has a detrimental effect on creativity, innovation and entrepreneurship within IT.
2. 93% of respondents believe that creativity and innovation is either very important or essential to the success and evolution of the IT industry.
3. 54% of respondents agree that entrepreneurship and other business skills should be incorporated into the IT degree.
4. 40% of respondents 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.
5. 46% of respondents believe that entrepreneurship and other business related skills are "very important" to their IT career.
6. 23% of respondents who took the survey are currently doing the information technologies applications major.
7. 48% of respondents believe their key motivation for creating something new in the IT industry and fulfilling that idea would be for financial gain
8. 39% of respondents use the internet greater than 30 hours a week (on a weekly basis)
9. 69% of respondents were first attracted to the IT industry as their chosen career path for their enjoyment and interest in IT
10. 34% of respondents believe that the hardest obstacle to overcome in order to achieve intended success from an entrepreneurial IT idea would be time.

5. MANAGING AUSTRALIAN INNOVATORS

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

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

- 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 deductions to date. 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, it is equally important 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 remain a technology-base innovation 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 and is an issue we address in our research with the ongoing development and evolution of the I-CAN tool.

As we expected the results of the student survey were very diverse, with only a strong majority for a single question but in general a fairly even distribution of responses. In summary around 90% of students felt that Innovation and Entrepreneurship are 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. Further, tertiary education structures should facilitate more creative thought and expression either through content delivery or assessment items.

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 I-CAN application we have developed and continue to evolve, is a positive element for incorporation into innovation fostering initiatives.

6. INNOVATION BY COLLABORATVE ANONYMOUS NETWORKING (I-CAN)

The Innovation by Collaborative Anonymous Networking (I-CAN) tool is a software application designed and developed for use in digital collaborative networked environments. The parts of its title, Collaborative and Networking, reflect this feature by allowing users to be geographically dispersed but able to interact in a virtual setting. The Innovation element reflects the purpose of the tool, in that it is aimed at fostering and managing innovative ideas generated by collaboration users. The fourth and final element making up its title is a reflection of the tools ability to allow users to interact in an anonymous way with it. Together, it provides the tools acronym title of I-CAN. From a positive motivation and psychological dimension the acronymic title is based on the

'can do attitude' [50] identified as a character trait of successful entrepreneurs and innovators [51]. That is, the I-CAN application name hopefully empowers users to adopt an 'I can do' attitude and therefore actively and positively participate in the innovation fostering environment. As will be explained in this section, the I-CAN tool provides not only a digital repository for innovative ideas, but also a medium for evolving those ideas through peer feedback and interaction.

6.1 The Evolution of I-CAN

The simplest function and therefore easiest method of explaining the I-CAN tool is to consider the traditional suggestion box and translate it's functionally and purpose to the virtual world. With a traditional suggestion box entities are able to write their comments and feedback, normally on sheets of paper, and deposit them in a labeled container. At some time later, possibly predetermined and/or periodically, the contents of the suggestion box are collected and evaluated. Ideally, the comments and feedback on the sheets of paper are constructive and the collector is empowered to take action on the comments and feedback where feasible. This simple concept works very well in a digital environment and most websites offer a simple 'Feedback Form' where users, customers, employees, members, etc are able to perform a similar feedback and comment deposit.

The main difference that is often overlooked, and vital to our own I-CAN application, is that by moving such a physical world Suggestion Box (SB) to a digital environment entities making 'deposits' in the box can remain anonymous. Where as a physical SB could be subjected to passive monitoring leading to possible deduction of which entity made a deposit. For example, if in any given collection period only one deposit was made and the SB was monitored then the collector and other entities could determine who made the deposit. Where as in a virtual setting if designed, constructed, and implemented correctly you can create an Anonymous Suggestion Box (ASB), which can protect the privacy of its user's. The I-CAN application incorporates the anonymity feature with the technical details of its implementation are provided in later in this section. As previously mentioned, the option for a user to remain anonymous alleviates the possibility of a user being subjected to peer pressure, the tall poppy syndrome, and in the worst case punishment or bullying for their deposits. For example, an employee may use the ASB to report bad peer behavior or comment on their supervisor's unfair treatment of them or illegal behavior. As the entity can remain anonymous they can be free from being subjected to potential revenge or retaliatory actions. It should be noted however that the ASB is not designed or meant to be a medium for such a use. The purpose of an ASB is aimed at only collecting positive and constructive suggestions and feedback. That is, ideally in its simplest form, the I-CAN application can act as an ASB for collecting innovative ideas and suggestions.

SOUP [1] was the next evolved phase preceding the I-CAN application. SOUP also represented our first unique and recognized contribution to the field, as the ASB concept was already available in a number of different formats and implementations. SOUP introduced the ability for peer review and feedback on submitted ideas through negative and positive feedback. SOUP has proved successful and is currently being used by a number of institutions in Australia for innovation management and idea generation. The full details of SOUP are beyond the scope of this paper but a brief summary of its key features follows. The SOUP application when running contains a number of 'SOUP bowls' and each bowl normally represents a particular theme, topic, or area of focus. Each enabled (being registered, active, and granted access permission) member entity is provided a fixed amount of 'Nutrient' and 'Poison' each 24 hours. A member entity is not only able to create a new item, being a creative or innovative idea, which is given an initial 'Health' level, but they are also able to feed ideas other than their own with their daily allocated poison or nutrient effecting that idea's health.

The basic functional purpose is that at a predetermined periodic time frame interval the 'cream' of idea's are collected for review. In sticking with the soup analogy the idea is that those ideas receiving the most nutrient will rise to the top like cream in a SOUP as they are the healthiest. Those ideas that have been fed poison will continue to decrease in health until their health reaches 0 and therefore they die off and are removed from the bowl. The most popular ideas

have then been subjected to 'anonymous' peer review while the bulk of ideas submitted have already been filtered out. It is again important to highlight that ideas are submitted in an anonymous format and are not 'attached' to specific entities in any 'visible' way. Fortunately, due to the benefits of PKI [52] remuneration may be offered as a reward and a means of motivating entities to participate and contribute. That is, entities with successful ideas can remain anonymous when the ideas are being subjected to peer-review. They can also prove they 'own' an idea once it has been extracted from the bowl as being identified as an idea and hence they can claim their 'reward'. As mentioned not all operation details are provided in this paper due to both proprietary reasons and space limitations. However, after being tested and used in live production environments a number of useful modifications were identified, motivating the next major evolutionary phase of the software application to its current state called the I-CAN application.

6.2 Technical and Operational Details of I-CAN

I-CAN is a software application designed for use within a digital collaborative environment as a tool for fostering and managing innovation. In short, I-CAN can be used as a tool allowing authorized member entities of a collaboration to create new innovative ideas and also peer-review current innovative ideas deposited by other authorized member entities. Entities are able to interact with I-CAN in one of three modes: Anonymous; Pseudo-Anonymous; and Identifiable. This is possible as Public Key Infrastructure is integrated into the I-CAN application that allows an entity to generate a unique Public-Private Key pair each time a new 'Innovative Idea' (II) is generated by them. The II is 'digitally signed' by one of the keys while the other key of the pair is kept secret by the II entity owner. At anytime the II entity owner can prove their ownership of a particular II by publishing the matching key of the PKI key pair that they have in their possession. Due to the nature of PKI the keys are unique to both an entity and also each individual II created. For example, if an entity creates five II's then they would have a corresponding five Private-Public Key pairs; one for each of the II's created.

I-CAN consists of a number of Innovative Idea Incubator Containers, which are simply termed an I3C within the I-CAN application. Each I3C represents a different subject, or theme, or focus area. For example, the author's research is directed specifically towards fostering and managing ICT innovation in Australia. Therefore, some example hypothetical I3C's may have labels such as Database Innovations, Network Innovations, Social Networking Innovations, and Programming Innovations to represent different sectors within the ICT industry. Each I3C has a lower (waste) and upper (cream) threshold set and moderated by the I-CAN I3C moderator. II's within an I3C are either collected for processing when they are above the 'cream' threshold or discarded when they are below the 'waste' threshold through an automated real-time routine. II's can be archived for cross-referencing and building a knowledge repository for future reference. For example, an II may fall below the discard 'waste' threshold but may have future merit once reviewed through data mining processes at a later date. A newly created II is given an initial health value corresponding to the medium value of the upper and lower thresholds values for the I3C it is placed in. I3C moderators can have the authority to remove malicious or erroneous II's from an I3C. The reason for moderator removal must be documented within the II before it can be removed. This is to ensure a degree of accountability, integrity and hopefully remove potential bias of a moderator when auditing I-CAN operation.

All authorized users of I-CAN are provided a fixed amount of both food and poison which is in set increments and replenished to the set limit every pre-configured time period. That is, the I-CAN administrator can set the time period in which the food and poison are replenished along with the replenishment level. An authorized user can feed or poison any II in any I3C they have access to, except their own. The requirement of only feeding or poisoning other II's required considerable framework configuration and work to ensure that the application preserved the ability for a user to remain anonymous. Therefore, a user needs to login and authenticate with the I-CAN application to ensure they are unable to feed or poison their own II's. To maintain data integrity and privacy, II ownership tags are encrypted with an encryption key known only to the II entity creator. Further, no records are kept of the entity feeding or poisoning any II to ensure no profiling or statistical

analysis can be run to determine who an II belongs to. Only the health of an II is modified and recorded in its data tags when it is either fed or poisoned along with other tags including II creation date, encrypted owner date, and I3C bowl it in active in. Further the date an II is removed from an I3C is also recorded in an II tag, along with the reason for removal. That is, either it went above the 'cream' threshold, below the 'waste' threshold, or was removed by a moderator. As mentioned, if removed by a moderator then the moderator must provide a reason why they have removed that II.

I-CAN is aimed at Australian work environments but can just as easily be used in any virtual collaborative environment. That is, authorized users are free to interact in an identifiable manner if they so choose but we advise that the preferred operating mode is anonymous. The reason being that other factors, besides peer pressure and the tall poppy syndrome may affect the 'health' of an II. For example, if we take the hypothetical case of I-CAN being used in a large organization made up of many different departments. If rewards are given to those departments with the most II's to elevate above the 'cream' threshold then potential completion may effect and bias user feeding habits. However, if all II's remain anonymous then to a greater degree the II's can be free of this potential completion bias. The author does note that regardless of the anonymity measures in place the system may still be subject to bias through external collusion. For example, a group of people may put forth an II in which all members of the colluding group are aware of. All colluding group members can then feed the II until it quickly elevates above the 'cream' threshold. Unfortunately, to date there are no system and design controls that can be put in place to stop this potential fraudulent behavior. Such behavior would be best monitored in the physical world and ensuring where ever possible that the remuneration can only be 'consumed' by an individual. For example, instead of offering a financial reward perhaps an individual may be granted an extra leave day.

As to be expected I-CAN continues to evolve and due to space limitations not all of its technical and operational parameters can be provided in detail in this paper. However, ways in which I-CAN is planned to be improved in the future are provided in a later section, along with the results to date on the success I-CAN has had in it prototype testing phases.

7. REVIEWING RESULTS TO DATE AND CRITICAL DISCUSSION

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 can be sparked by the three main influences: positive creativity; necessity; and opportunity. The results show that necessity sparks innovation, which is in agreement with common sense deduction and analysis. That is, the history of the human race has shown that in most instances when there is a clear need for something many people set about finding a solution for addressing that need. Response's to 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 was highlighted by a case study on the 3M Corporation studied as part of our background literature review for the research. 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 to date cover 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:

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

2) 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

3) Natural flair will shine through in the market. The gifted will always break free from conformity.

4) 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.

5) Promotion of creativity – it can be deduced that the promotion or restriction of 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 student survey respondents felt that the current academic structure of university education and their institution can have a detrimental effect on creativity, innovation and entrepreneurship within their future IT career
- 93% of student survey respondents 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. These characteristics have the capacity in one way or another to form the key derivatives for creativity

6) Empower potential entrepreneurs and innovators to explore what is possible in an uninhibited manner. 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.

7) Whether or not one started as an ICT person within the industry or came into the industry with an idea as an entrepreneur/business person outside the ICT 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 ICT industry.

8) ICT innovation is brought about either by:

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

9) Positive creativity, necessity and opportunity spark innovation

10) Social networking is a lucrative ICT entrepreneurial environment

It is important to note that there seems to be a cyclic co-dependence for fostering ICT innovation. That is, the catalyst for change is re-creation and innovation and the catalyst for re-creation and innovation is change. Realizing and effectively managing this co-dependence and the cyclic incremental nature of the co-dependence seems to be one of the key elements to ICT innovative success in Australia. Some of the other major key elements include effective collaboration, staff support throughout all levels of an organization or enterprise, and particularly in Australia deterring negative peer pressure and effects of the tall poppy syndrome.

The I-CAN software application tool has proved very effective for managing and fostering innovation while integrating a number of the key elements mentioned above. The evaluation of the prototype I-CAN tool in a testing environment showed that it provided a good platform for collaboration, staff participation at all levels, and supporting anonymous interaction. The results of the prototype testing did reveal that another major feature needs to be added to the next prototype version of I-CAN. That is, the test users of the I-CAN prototype nearly all requested the ability to ‘evolve’ or what we are now terming ‘Mutate’ current Innovative Idea’s (II’s). For example, like our literature review and survey confirmed, many new ICT innovations are actually inspired or built upon previous ICT innovations. Therefore, ideally I-CAN should support the ability for an authorized user to ‘mutate’ a current II in a bowl, effectively using and acknowledging the original II as their inspiration for their evolved and hence mutated II. The plan and method to do this modification are discussed in the next section under future work.

From a critical viewpoint the research to date has been a success in that the findings so far have make significant contributions to not only the perspectives of ICT Innovation in Australia but also on a larger global scale. Through our studies we have achieved a number of our initial objectives while also making a few unique findings to add to the current body of knowledge in this field of study. First, and foremost, it was found that while Australia does suffer from the ‘Tall Poppy Syndrome’ there are many available ways of potentially overcoming this Innovative inhibitor. Companies can provide Innovation incentives that allow a contributor to remain anonymous during the cultivation stage. Our I-CAN tool is one unique and useful contribution that we feel is well suited to fostering ICT Innovation in environments subjected to negative peer pressure such

as the 'Tall Poppy Syndrome' found in Australia and in particular male dominated industries like ICT. Secondly, encouraging employees to accept and embrace change helps contribute to innovation. That is, giving employees the opportunity to re-create themselves and their work further helps foster an innovative environment. Providing employees with ways of expressing their creative talents fosters a culture that facilitates innovation particularly in the ICT industry where rapid change is very much an integral part of the technology being used and evolved.

8. CONCLUSION AND FUTURE WORK

This paper has discussed the research and findings to date of an ongoing project investigating ways of managing and fostering ICT innovation, with a specific focus on the Australian sector. The study identified the importance and potential of entrepreneurial activity in the ICT industry and devised a unique classification framework. Some of the key elements for the successful fostering of technology based entrepreneurship and ICT innovation in Australia include: collaboration; recognition of compressed life cycles; sound idea execution; and due to the critical nature of Australians including the Tall Poppy Syndrome, anonymous peer review. Further, as part of the work we conducted a survey with the results indicating that the next generation of entrepreneurs feel somewhat limited by the bounds and rigidity of tertiary education at the tertiary institution they were attending. Further, they recognize the importance of creativity and felt that innovation should be included within the curriculum.

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, due to ethical considerations and initial scope only students from one tertiary institution were able to be surveyed. Secondly, only those students in an ICT type program were surveyed. It is planned that one of the next stages of the research is to update the survey questions and expand the survey participant across a number of disciplines and Australian tertiary institutions. Time and ambiguity were two other major limitations in the research. The nature of the study subject involves a number of diverse disciplines, including IT, business, and psychology. For example, 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 is primarily aimed at developing ICT software application tools and collaborative environments for managing ICT innovation.

The research has had success in achieving this aim with the development and implementation of the I-CAN software application tool. I-CAN operates in a digital collaborative environment and provides a useful tool for managing innovative ideas. Further, its mode of operation encourages member participation while also fostering further innovative idea creation. Through extensive prototype testing it was discovered that I-CAN can be further enhanced through the addition of an evolutionary function or what the researchers have termed an II Mutation. A major part of our future work will include the design, development and implementation integration of this capability into the I-CAN tool. Initial conjectures see this as quite challenging but achievable as both the anonymity of each user 'contributing' to the II evolution will need to be preserved. This is in addition to devising an equitable remuneration scheme for rewarding Mutated II's that elevate above the 'cream' threshold. However, it is feasible that additional tags can be added to an II entity that will store such things as 'Original II', 'Mutation Date' and encrypted data tags containing the PKI keys of each contributing user.

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