April 2012

Proof of Concept Center in the Context of Entrepreneurial Ecosystem

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Worcester Polytechnic Institute

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Proof of Concept Center in the Context of Entrepreneurial Ecosystem

An Interactive Qualifying Project Report
Submitted to the Faculty
of the

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the
Degree of Bachelor of Science
In Mechanical Engineering

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By Zebediah Tracy

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Date: April 2012

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Professor Frank Hoy, Project Advisor
Abstract

This project aims to assess the degree of linkage between Proof of Concept Center (POCC) model for technical research universities with associated entrepreneurship ecosystem inputs in order to aid local, state and national policy-makers as they develop innovation strategy. This is done in three steps: 1) detailed case studies of successful POCCs based on data from unpublished resources and from expert interviews; 2) applying comparative analysis and functional business modeling techniques to identify the key structures, process and external inputs; & 3) by generating an investment decision analysis tool for use by funding agencies and university administrators as they consider adopting the POCC model at a particular University campus.
Acknowledgments

I would like to first thank my project adviser Prof. Frank Hoy for his careful guidance and his depth of knowledge on the topics of technology transfer and entrepreneurship. He took extra time out of a busy schedule filled with various professional and personal matters to support the successful completion of this project.

Thanks to Dr. Mike Manning (WPI Director of Technology Transfer) for his time and interest in this research. His insights from the perspective of someone who is "in the trenches" of modern technology transfer was pivotal to understanding the unfiltered realities involved.

I would also like to thank all of the members of the WPI community that helped to make this project possible by donating their time and insights to this project. I would like to give particular thanks to Gina Betti (Associate Director of CEI) for her help brainstorming solutions to problems. I would like to thank all of the department heads and faculty that were willing to discuss their perspectives. I would like to thank all of the students that set aside an hour to discuss their perspectives on the WPI technology transfer policy. I would like to also give special thanks to Dexter Bailey, the alumni office, and the members of the alumni that were willing to provide their feedback.

In addition, I would like to thank members of the Worcester Venture Forum for their support in this project. Without their help it would have been much more difficult to gain an understanding of the community's perspective on technology transfer.
Lastly, I would also like to thank McRae Banks for his support in the early phases of this report for directing me to resources and people that have been helpful. I would also like to thank Prof. Erwin Daneels for his help in the early formulation of this project and research direction.
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Chapter I: Introduction

Across the globe, the realization that further growth and improved quality of life require innovation and entrepreneurship. In the United States, the innovation agenda is a keystone policy for the sustained employment gains that the country needs. This is one of the key reasons for the recent Request for Information from the White House Office of Science and Technology Policy on the topic of technology transfer best practices. One of the most common themes among the RFP responses by the country’s top scholars in the domain of innovation is to promote the adoption and further development of programs that aid technologies through a phase in their life cycle between patenting and the creation of a marketable product, the so-called “valley of death”. In particular, many respondents reported on the importance of a particular model, Proof of Concept Centers, which incorporates the functions of seed capital and incubation within the context of university research labs (Savage, 2011). This paper aims to support this position by providing a simplified model of what a POCC is and by identifying a list of universities that are most able to adopt this particular strategy.

In order to provide a list of candidate universities, this report attempts to summarize the degree of linkage between successful POCCs and the associated entrepreneurial ecosystem. By understanding linkages in the context of the POCC process model, it is possible to establish criteria with which to filter candidate universities. In addition, this overview is intended to facilitate the discussion of new initiatives or programs by providing context for strategic decisions at universities.
For example, in order to establish a program at the level of the MIT Deshpande center an initial investment of $5-10 million would be required (Gulbranson & Audretsch, 2008). Before other universities invests at that level (risking a sizable investment along with very public failure), it is wise to first understand what other institutions and resources exist in Boston’s entrepreneurial ecosystem and how they influenced the success of the university’s POCC effort. Although this kind of context can be obtained through independent research and other means, this report brings everything into one place while applying concepts used by practicing innovators and entrepreneurs at top universities like Stanford and MIT.

In other words, the goal of this project is to identify those technical research universities within which the Proof of Concept Center model could work well on the basis of co-requisite entrepreneurship ecosystem services and functions.

1.1 Sections Overview

Section One: Background

In order to introduce the important concepts and state key assumptions, the background chapter will focus on presenting a carefully selected list of important functions items. First, the background will start out by introducing the political and societal context for why this study is timely. Second is an analysis of what the innovation problem is and how it has been solved by others to date. This section will be followed by a brief discussion of technology commercialization practices and concepts. The final sections introduce the key concepts of business ecosystems, the university as a business followed by an overview of proof of concept
centers—all based on published literature. This first section serves as an introduction to key concepts that lay the foundation for this work for those who may not make technology commercialization a daily focus.

**Section Two: Findings**

The basic research methodology for this paper involves a detailed review and analysis of informal publications such as employee handbooks combined with a structured analysis. The research approach is broken into four key stages: first, a detailed review of established POCCs from a variety of angles; second, an analysis of the functional design parameters of POCCs in order to identify the minimum inputs required from local institutions and individuals; and third, identify a list of universities that meet the minimum requirements to implement POCC on the basis of ecosystem services present on and off campus. The full analysis of data collected will be presented in appropriate chats, tables and in long-form with the goal of providing useful and accessible insights.

**Section Three: Takeaways**

The final major component of this report relates to the conclusions that policy makers on the local, regional and state level. Although some conclusions may be drawn regarding the nature of a POCC, the main point will be the survey of candidate universities for POCC adoption. This section focuses on the key lessons from the approach, provide suggestions for further study, and—in the “discussion” section—discuss intriguing options related to POCC operations and alternatives to be considered.
1.2 Sources and Citations

This document includes a number of different sources meant to provide rich context and easy linking to other sources mid-stream to allow the reader to achieve the greatest level of engagement possible. The first citation method is in-text MLA citations of bibliographic references which look like (author, date). These types of references are used for solid published works upon which a strong argument can be built. Definitions, comments and less solid sources will be cited using footnotes followed by a URL link. Links have been shortened using the Google URL shrinking tool found at http://www.goo.gl. Footnotes with short URLs have two primary benefits: one, they limit the attention they draw from the core material; and two, they require less error-prone transcription if the reader chooses to print out the full report and finds a source of interest. This citation scheme is meant to introduce some of the power of the world wide web into the format of this research paper while maintaining the utility of the traditional source citation methods.
1.3 IQP Requirements

This project satisfies the requirements of an IQP at WPI because it requires the integration of various disciplines and has resulted in valuable information for stake-holders, policy makers and scholars alike.

**Baseline Requirements:**

1. Maintain effective working relationships within the project team and with the project advisor(s), recognizing and resolving problems that may arise.
2. Demonstrate the ability to write clearly, critically and persuasively.
3. Demonstrate strong oral communication skills, using appropriate, effective visual aids.
4. Define clear, achievable goals and objectives for the project.
5. Critically identify, utilize, and properly cite information sources, and integrate information from multiple sources to identify appropriate approaches to addressing the project goals.

**Project Requirements:**

6. Demonstrate an understanding of the project's technical, social and humanistic context.
7. Select and implement a sound methodology for solving an interdisciplinary problem.
8. Analyze and synthesize results from social, ethical, humanistic, technical or other perspectives, as appropriate.
9. Demonstrate an awareness of the ethical dimensions of their project work.
Table 1: IQP Requirements Mapped to Project Elements

<table>
<thead>
<tr>
<th>Project Element</th>
<th>IQP Requirement(s) Satisfied</th>
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</thead>
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The mapping of project sections to IQP requirements has been used to inform the development of specific sections within the background and analysis beyond an alternative minimum scope for this project in order to fulfill the requirements. As a consequence, this report may offer a more rich and contextualized review of the subject matter. This richer context also has the unintended byproduct of addressing additional areas of concern which may have otherwise been left unaddressed and unanswered. Overall, the IQP requirements have helped to expand the scope of this work while actually increasing its analytical value.
1.4 In Summary

This project investigates relationship between proof of concept centers and entrepreneurship ecosystem

In order to: find out if they can be successful anywhere or not
so that: university policy makers can better design POCC or other programs at their universities
so that: universities can better allocate their precious time, energy and money building venture programs that have the highest chance of success, because universities are a keystone in the creation of the high-technology economy
so that: economic prosperity of the United States can be maintained by leveraging research universities which represent a singular area national competitiveness which has proved difficult to copy duplicate due to many cultural factors
so that: the work of leading universities can be viewed as a vital building block to the future of prosperity and continued competitive advantage in a world of increasing competition globally
Chapter II: Background

As stated in the introduction, this section is meant to introduce the important concepts and state key assumptions. The first section starts by introducing the political and societal context for this study is needed. Second is an analysis of what the innovation problem is and how it has been solved by others. The next section discusses technology commercialization practices and concepts. The final sections introduce the key concepts of business ecosystems, the university as a business, followed by an overview of proof of concept centers –all based on published literature.
2.1 An Innovation Imperative

The need for increased innovation and thus the Proof of Concept Center approach evolved within the context of important global trends. Ever since the emergence of the World Wide Web and personal computing in the early 80s and 90s policy makers have understood that we are transitioning from the industrial age characterized by increasing mechanical power and strength of materials to an information age characterized by increasingly fast rates of computation, simulation and an accelerating rate of change. Although the information age hype died down after the internet stock bubble burst destroying stock owner net worth along with the career prospects in computer science.

Ten years after the bubble burst, despite many housing related financial challenges, the information industry is booming! Starting salaries for software engineers surpass almost all other engineering fields capital is flowing freely into established information purveyors and start-up data dicers alike. Another aspect of the information-led economy is an increase in the proportion of company valuations associated with intellectual property such as patents and trade-secrets. In the industrial age where the largest share of value added to the economy originated from the consistent extraction, processing and assembly of material-based goods, the information age is characterized by an ever increasing share of value coming from the extraction, processing and assembly of ideas. We have gone from an emphasis on high throughput production to an emphasis on high-throughput engineering. All of this means that in order to remain competitive and to retain wealth, innovation is a new imperative.
“innovation is really important… because we need innovation to solve the grand challenges of our civilization… like provide clean energy, clean water and ample food” – CEO Autodesk

The Proof of Concept Center is a model aims to help accelerate the creation of valuable knowledge-based enterprises with the assumption that innovation will lead to growth. However, the wide-spread adoption of Proof of Concept Centers at research universities will have other implications within the technical, social and humanistic dimensions of life. These contexts are important and should not be overlooked.

\[\text{\textsuperscript{1} This quote delivered by Carl Bass the CEO of Autodesk Inc. at TEDxBerkeley 2012 (04:20). Watch the full talk here: http://goo.gl/Y3FZz} \]
2.1.1 Technical, Social and Humanistic Context

The **technical context** of this project is that each generation of technology improves relative to the immediate last generation and not relative to some universal frame of reference such as the milestones of human development or perception of time. In this way, each generation of a technology will exhibit performance gains that are more or less exponential. Improvements in technology performance do not come in a perfectly smooth exponential manner due to the many complex interactions like wars, social movements or natural disasters. Another important reason that the performance trend is not smooth and linear is that technological paradigms do not smoothly morph into the next. The horse drawn wagon did not slowly evolve into the model T Ford; once the automobile was ready for mass-production, the transition was swift and dramatic. The theory of disruptive innovation of the sort Clayton Christensen described in his breakthrough work *The Innovators Dilemma*\(^2\) (1997) is most famous for describing this phenomenon. When discussing innovation, the most important technological context is the exponential growth of technological performance as it informs our expectations and is by no means intuitive.

This behavior of technology was first popularized by Gordon Moore in his 1965 paper on the changes in computer performance while building Intel Corporation (Moore, 1965)\(^3\). His observations were later expanded to the entire history of life and biological evolution by Raymond Kurzweil in his generalized theory of accelerating change (Kurzweil, 1999). Kurzweil

\(^{2}\) Clayton Christensen has several great videos on his website introducing key concepts from his book “The Innovator’s Dilemma”. Find them here: [http://goo.gl/Qe2qu](http://goo.gl/Qe2qu)

\(^{3}\) The full article is hosted on the Intel website here: [http://goo.gl/fRzpd](http://goo.gl/fRzpd)
and others have identified the span after 2025 as a “singularity” because the rate of change is projected to be so great that it becomes impossible to imagine what this era will be like. The following chart describes this general trend in terms of the time between major evolutionary milestones; improved university-based technology commercialization will likely add fuel to the fire and sustaining the geologic trend of accelerating evolutionary change over time.

Figure 1: Pace of change since the first microbial life (Group, 2012)\(^4\)

The social context of the Proof of Concept Center model is an increase to the entrepreneurial culture within research universities along with the potential for less inter-divisional conflict as a result of better alignment of interests (Salamo, Vickers, Lower, & Ahlen, 2001).

\(^4\) The complete analysis including a table of times and other resources can be found here: http://goo.gl/O2e9Y
The most important way that POCC impacts the social environment is by tying the business start-up process into the comfortable sponsored research process. POCC is less foreign than other venues for start-up formation because its operations strongly resemble those of major funding agencies including the submission of research proposals to obtain funding, consultant and reliable administration by university staff and well defined outcomes and expectations. In contrast to the normal ‘free-wheeling’ and rebellious culture among independent entrepreneurs, the POCC creates a more disciplined atmosphere similar to that of sponsored research (Barrow, 2003). In addition, POCCs represent an opportunity to grow existing research investments in order to garner additional resources and clout for a particular department which can have indirect benefits.

- Evolving networks of innovation require trust to facilitate collaborative risk taking therefore, the positive social characteristics that we strive for are amplified in innovation regions

- The shadow, there is a darker side to innovation where some regions get left behind as their brightest and most talented leave for more strategic locations like silicon valley in California. This effect happened with countries as is chronicled in “the bottom billion” and could impact the social fabric of major populations. This thesis is supported by work published in the journal Small Business Economics where the

5 Abigail Barrow was the founding director of the von Liebig “pre-incubator incubator” at UCSD and was instrumental in the model’s initial developments which were copied at MIT, one year later. Download the full PDF of her remarks (slides) here: http://goo.gl/vtEqK
The **humanistic context** is of Proof of Concept Centers is hoped to be increased employment through an increased rate of high-value venture creation. The Kauffman foundation’s analysis suggests that a majority of new jobs are created only through the growth of new firms. The following graphic illustrates this trend over time.

![Startups Create Most New Net Jobs in the United States](image)

**Figure 2:** Most jobs created 1977 - 2005\(^6\) by firms less than 1 year old (Kane, 2010).

In addition to the job creation from brand new firms, a small number of these firms develop into very rapidly growing firms that contribute another vast proportion of new job creation. These companies start to really drive growth between the 5\(^{th}\) and 7\(^{th}\) years of operation. In the context of the university, 7 years is not so much of a wait. One unique aspect of the firms that survive

\(^6\) The full Kauffman report can be obtained by following this link: [http://goo.gl/RFZRa](http://goo.gl/RFZRa)
the first 5 years and make up the majority of the “High – Growth Firms” are notable in that they tend to be based on innovative products and technologies that trace their origins back to Universities (Kauffman, 2005).

![The Accumulation of High-Growth Firms](image)

**Figure 3: Development of High-Growth firms (Stangler, 2010)**

These two tables paint a very clear picture based on US Census data on the bulk behavior of job formation in the context of new ventures.

The basic thesis that new ventures are the only driver for growth seems logical since small firms are far less efficient in comparison to large established enterprises with rigorous processes and

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7 The rest of the report “high growth firms study” can be found by following this link:

http://goo.gl/ryp5u
cost controls. In a time with increasing global demand for good paying jobs the need to deploy entrepreneurial firms has never been more important for society.

It should be noted that these characteristics of new job creation are not necessarily universal and may be particular to the culture and history of the United States. Job creation is the key factor in the human condition because people must have a way to earn their keep and attend to their basic needs of food, shelter and a life free of shame.
2.2.1 National, State and City Alignment

A consensus that the United States is in decline has emerged since the 2008-2009 financial collapse and subsequent recession boarding on depression. For this reason policy makers at every level realize the importance of innovation as solution to our many challenges.

United States President Obama has noticed and has featured innovation policy prominently and consistently throughout his first term. Policy think tanks and investors alike agree that innovation must remain a national priority and the key to continued American influence. For example Gary Shapero Proclaimed,” Innovation is the only way for the country to grow” at the annual meeting of the prestigious Milkin Institute

State innovation imperative for job growth, tax revenues and the brain drain

There is a clear emphasis on innovation across the country among governors. One reason is that states are experiencing financial strains which lead to the need to increase economic growth. In addition, some states increase mineral extraction while states without those must grow “innovation economy” including high-value manufacturing. Although it is a national priority, state budgets have reduced support for universities which increases the need for those universities to create a real impact. Innovation is an important factor among state house policy makers and Governor’s offices.

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8 The book is available here: http://goo.gl/lNjYV

**City imperative for innovation**

The larger the local population density, the greater the innovation which may be related to the level of emphasis that innovation has in the local policy agenda. The work of complexity scientists like Geoffrey West at the Santa Fe Institute have found that there are scaling laws for cities that can be used to predict functional aspects of a city simply by knowing the number of people that live in it (West, 2007). One important finding in the context of innovation is that the number of patents granted per-capita is one of these features of cities and that it goes up faster than population growth does. In other words, a city that is twice as big will have more than twice the number of patents. In “who’s your city” Richard Florida describes some of the social dynamics that are driving city growth and most of them relate to the theme of trust (Florida, 2008). Localities with more openness, diversity and art tend to lead to economic development that results from increasing rates of entrepreneurship and innovation, all of these things relate to a fundamental thread of trust.

Although the sound policy strategies at the national and state levels directly influence universities as a result of their direct link to funding agencies at those levels, local and city governments are a little slower to support proper innovation policy but they are coming around to it. Despite the city governor’s apartment lack of interest in innovation, they stand to be among the most powerful drivers for innovation.

On a local level, city governments are increasingly interested aware of the value of innovation. The governor’s office of many cities ranging from Boston to Detroit are focused on aiding
innovation, although they sometimes appear to be playing catch-up in contrast to the national focus.

The primary means of support are through the construction of incubator facilities and in aiding in the creation of other hard infrastructure. After all, innovation relies on a local environment that is attractive to highly-paid knowledge workers who can choose from any number of cities around the world. Some cities are going further by actively creating services to facilitate increased exchange of ideas and connection between city residents and other innovation hubs. These programs demonstrate a nuanced understanding of the innovation cycle and a more strategic effort by city governors. Unfortunately, local policy is still primarily focused on traditional modes of economic development in spite of the fact that city government has the most leverage as they can directly influence local conditions.
2.2.3 Alternative Views on Prosperity: Malthusian Critiques

There are a number of other ways of viewing prosperity aside from the innovation-centric approach that underpins much of the recent policy discussion and are important to keep in mind as the innovation agenda may, at times, come into conflict with other perspectives. Innovation advocates should understand other economic world-views so that they can avoid areas of friction.

One view of prosperity is that it is driven by the supply and availability of oil and other sources of cheap energy. This is the view held by many including T. Boon Pickens and is a wide-spread justification for substantial spending on wars and other security in the middle-east and other OPEC nations. The logic is that energy resources are scarce and therefore, in order to sustain economic development and prosperity supplies of these limited natural resources must be maintained. Much the same logic is behind many theories which suggest that peak theory and of energy resources which inspired many dystopian scenarios including the 1980s Mad Max saga. Fortunately, technology is evolving very fast which means that we are rapidly solving the scarcity challenge with energy. Technologies such as Hydraulic Fracturing of natural gas and tar-sands oil recovery processes are moving forward faster than those resources are running out. On the longer term view, other technologies like thin-film solar, liquid-based batteries for cheap grid-scale energy storage, innovative new nuclear technologies like traveling wave reactors and the Thorium cycle reactor all show the path forward. Although energy is required to keep the economy functioning, the pace of innovation (powered by the information technologies) has resulted in new technologies powerful enough to blast through almost any energy scarcity challenge.
Another perspective is that economic growth is the result of growth is that used by Demographers who relate growth to the scale and composition of an economy to its performance. The key point is that economic growth can only occur if the ratio of working to non-working population segments is kept above a certain level. This perspective is what underlies claims that “China will get old before it gets rich” and that Japan is headed for slower economic growth. It is from this perspective that many argue the United States is heading into a serious crisis as those born in boom after World War II (the baby boomers) begin to retire on-mass leaving a much smaller relative population. At least in the case of the United States, an openness to immigration and a tolerance of diversity mean that as our population ages we always have the ability to invite people from around the world to replenish our working population. On the other hand, increasing technological change and proper innovation policy is expected to result in technologies that directly solve the aging problem thereby enabling all adults to contribute to prosperity. In 2012 we are already seeing tantalizing signs of a new generation of technology that could stop and reverse aging while others are already using sophisticated robotic and synthetic alternatives to their biological components. In the year 2012 we already have powerful bionic systems to replace legs, eyes and heart. Unfortunately, the demographer’s perspective does not take into account the truth that evolution (like gravity and taxes but unlike death) will continue to accelerate the power of technology to solve age-related problems.

Another perspective is that the supply of arable land and fresh water are key constraints to growth given their direct competition with industry. For instance, without a secure source of fresh drinking water and a supply of basic nutrition it is impossible for children to develop into productive members of society in many developing countries. The challenge faced by a lack of
basic resources is enduring as it impacts the development of the brain and other body parts. Although there remain regions faced with food and water scarcity, these are also challenges to be answered by innovation. One WPI student who now lectures at MIT is a leader in the area of appropriate medical innovation for the developing world. Universities are specifically apt to support the basic needs as nonprofit institutions with altruistic goals. It is lucky that they are also the community of people most able to perform this work.

Another perspective is that of geopolitical strategists where nation-state power and domination are the keys to maintaining prosperity. The claim is that without strong national defense and physical force, economic gains can be fleeting and at risk of theft by more powerful nations. In some sense, the story of the native Americans, where a more powerful people took land from a weaker group by the end of a musket, suggests that this line of thought must be true. In the book “Guns Germs and Steel” the reasons for western dominance were analyzed. The book concludes that the keys to western dominance were in a sense the luck of being at the right place at the right time where key technologies were emerging first (along with the byproduct of technology which, before the invention of cars, meant living in dense cities). One recent development which has totally changed the game is nuclear technology and geo-political mutually assured destruction. It is now impossible for one nation-state to survive attacking another because of cold-war era nuclear technologies powerful enough to end civilization and maybe life on earth.

These Malthusian perspectives on prosperity as a somewhat zero-sum game, reliant on the deployment and management of fixed resources form the central challenge to the innovation agenda. These challenges paint a picture of the debate between resources scarcity and
innovation. Although it would be unwise to peruse an innovation policy which does not take the Malthusian perspectives into account, it would be equally unwise to discount the importance of innovation as a key tool to both overcome strategic challenges and deliver growing prosperity for all.
2.2 Constraints on Innovation & the Valley of Death

**What is the problem here?** How has it been solved by others? Innovative potential of university knowledge is not fully utilized despite 1980 Bayh-Dole and university best efforts because of the “valley of death” resource gap.

2.3.1 Where and How Wide?

The size of the funding gap varies from industry to industry. For instance, in the software business there are startup accelerator programs that only supply 10-20 thousand dollars to fund small teams in order to build an investable venture. On the other hand, new nuclear reactor technologies require billions of dollars in regularly approvals and testing before they can begin positive growth (this is also true of the pharmaceutical industry because of FDA regulatory requirements). The valley of death is particularly large in businesses where: one, there are high risks of failure and therefore high validation overhead; two, the sheer cost of building and testing prototypes is high like in the case of new space-vehicles; and three, where the technical risk is very high due to the magnitude of the challenge presented (Segway PT for example); and finally, where there are long sales-cycles and it will require lots of cash to work through these before attaining cash flow.

2.3.2 Bridges

As the type and scale of the valley of death funding gap change form technology to technology and from industry to industry, the types of bridge funders and organizations changes as well.
One type of bridge funding source is the Small Business Innovation Research program in the United States. This program diverts a small fraction of federal research spending to supporting innovative projects within small U.S. firms. The program is widely recognized as a success and has been widely copied by other world governments. One of the key reasons for SBIR’s long history of performance and low recipient failure rates is that it employs a distributed administration model such that proposals can be managed “relatively quickly” despite the large volume of proposals. SBIR typically provides 100-400 thousand dollar awards (Wessner, 2008).

A new and completely different type of institution is the independent startup accelerator programs such as Y-Combinatory and Tech Stars. These programs are unique in that they offer the lion’s share of value to new companies through non-financial support such as world-class mentoring, quality management of participating entrepreneurs to maximize social pressure for performance and group learning, unique access to the venture capital community and supply of standard incorporation procedures that better position companies for investors and the most unique characteristic is that they batch funding rounds where all companies are admitted during the same period of time, much like classes in a school. In contrast to other funding models, startup accelerators only award 10-30 thousand dollars per team and expect entrepreneurs to live like graduate students while spending little money on entertainment and focusing 100% on the project. Both investors and entrepreneurs have recognized the value of this model and as a result

12 An extensive overview is provided in the form of a congressional hearing by NSF director Charles Wessner: http://goo.gl/PgZwQ
it has spread around the world growing from the founding of Y-Combinator (the first of such program) in 2005 to the
2.3 Technology Commercialization Perspectives

Section on **technology commercialization** theory including “clusters”, diffusion of innovation, valley of death, venture capital, university technology transfer, etc.

University-based technology commercialization has a long history. **Research Universities** serve as the spawning grounds for ideas that grow to form the core of tomorrow’s economy. It is for this reason they are supported and thrive with the American People’s financial support. The public support research institutions financially through the suspension of local property taxes, tuition assistance grants and most importantly through billions of dollars in research grants. As the United States economy continues to shift and resources tighten it is becoming increasingly important for the nation’s universities to full-fill their implicit promise to act as catalysts for innovation and to help form new industries that create new jobs. This project aims to investigate innovative ways to increase this type of activity.

There are other institutions that are engaged in technology commercialization and have knowledge assets and patents that represent valuable assets. The first main non-university entities are independent national or government laboratories charged with finding solutions often for military applications. A great example from this class of institutions is the Sandia National Laboratories and its thriving entrepreneurial ecosystem including Technology Ventures Corporation\(^\text{13}\) which operates along the lines of a POCC and an adjacent business incubator. The

\(^\text{13}\) Review the interesting history of Technology Ventures Corporation as a 501(c)3 nonprofit, founded by a for-profit defense contractor with funding from the federal government:

http://goo.gl/jjJwk
second main class of institutions is large established companies with research and development departments that tend to pile up. For example, Ford Global Technologies LLC the patent management wing of Ford Motor Co owns a wide range of patents in fields unrelated to its core business including a patent for blended fuel dispensing\textsuperscript{14}.

It is true that there are other sources of technology in the US that are finding success with a variety of commercialization models but this study focuses on universities because, unlike these other labs, universities are on the lookout for new models and practices at this moment in time. Increasing threats to the core university revenue model from undergraduate education will only increase the degree to which universities become open to change as the many disruptive new ventures in high-quality education begin to take the highest margin business in education (Christensen, 2011).

Technology transfer from university labs to private industry has long been a cornerstone concept in economic policy-making where research universities are concerned. This trend is exemplified by the 1980 Bhye-Dole act which, for the first time, gave universities the responsibility to take ownership and the opportunity to profit from inventions developed at the institute using public research monies. In order to manage an apparent “cash cow” of technology generated through public, research many universities developed a technology transfer model based on adding technology licensing offices, or TLO, to the administrative capabilities of the university. TLOs have been instrumental in managing the process of protecting university

\textsuperscript{14}The patent file for Ford’s fuel dispensing invention: http://goo.gl/ADP6p
technology as a business asset through patents. TLOs have also been envisioned as the primary broker-facilitator for university intellectual property. Based on the above model for technology transfer, many universities have judged the success or failure of TLOs on the basis of their ability to generate a profitable income stream from licensing patents. By this measure, the TLO model is largely a failure. Most likely, is that this perspective is an inadequate measure of successful technology licensing activities.

The traditional technology transfer office uses a process that can be summarized by the following stages of a project (Sullivan, 1995)\(^\text{15}\):

1. An interview with the inventors to assess the technology and make an initial decision as to the protection of any intellectual property.
2. The production of a non-confidential summary.
3. Identification of potential clients/customers via database searching and net-working.
4. Decision as to license the technology or form a start-up company.
5. If licensing is chosen, perform market research to determine the level of interest in the targeted companies
6. Execute confidentiality agreement.
7. Supply the confidential information

\(^{15}\) An overview of the book’s key claims on the context of industry reactions here: http://goo.gl/Xm5FM
8. Follow up the contacts to ascertain interest and obtain a definitive commitment ideally to Head of Agreement.

9. Negotiate a license and monitor the transfer of the technology, including collection of royalties.

10. If a startup is chosen, prepare a business plan, identify sources of finance, and implement programmers for marketing and a product development.

This paradigm supposes that a single group of people will be responsible for completing a vast undertaking of legal, financial and interpersonal tasks. It is no wonder that many university Licensing Executives and technology managers report lacking the resources to fully address the task. New models of technology transfer that leverage external decision makers is a strategy that mirrors the natural entrepreneurial system and is embodied by the Proof of Concept Center model pioneered at the Von Leibig center.

One of the reasons attributed to the failure of the TLO model to generate profits for the university is the pre-seed or very early stages of many university discoveries. The crux of the problem is that existing firms don’t recognize an immediate and clear value from licensing university technology and for this reason the number of profitable deals is much less than a theoretical maximum that university administrators hoped for.

One alternative path for early stage research commercialization is the creation of entirely new enterprises based at universities. This approach has gained prominence in the academic and professional discourse as a linchpin strategy to realize the value of very early stage technologies.
Unfortunately, many research outcomes remain too early stage for even the most forward thinking Venture Capitalists since they often lack a clear path to profitability and investment return. Some universities are experimenting with new models to tackle this challenge.

Although there is wide consensus that technology transfer is beneficial for universities and the economy, there are some decenterers. The first criticism of this approach is that innovations as an activity does not lead to any type of economic activity without market demand. The second is that the creation of market demand occurs over time. These two factors are why the post-modem analysis of many failed high-tech startups that started with sound technologies is that they were “too early”. This may be a problem with the current technology transfer office model because administrators lack the resources to fully investigate the market for each technology before making the decision to obtain a patent (Vass, 2008). On the other hand, with a Proof of Concept Center, this problem is addressed by the mentoring and business team formation features.
2.4 Entrepreneurial Ecosystems

One of the most famous concepts in innovation policy development is the idea of the “innovation industry cluster”. The idea was original developed and promoted by Michael E. Porter of Harvard University (Porter, 2008). The basic concept is that industries can be cultivated by getting different players to collaborate and share physical supply chains and other infrastructure which with economies of scale. The idea of applying industry cluster theory to the domain of entrepreneurship and innovation remains an important topic among national, state and local policy makers (including the White House economic policy staff).

Unfortunately, this approach has been ineffective at promoting entrepreneurship for many reasons. Perhaps the most important failing of this “industry cluster” conceptual framework is that it creates the mental image of firms and their key suppliers without the many other system participants. Industrial cluster theory pays too little attention to the availability of new customers and the availability of skilled and willing nascent entrepreneurs. One other problem that has been identified of Industrial Cluster theory as applied to entrepreneurship and innovation is that it tends to make local policy makers and entrepreneurs focus inwards and stop seeking connections and ideas from the wider world (Wadhwa, 2012). The result of an insular culture within cluster development initiatives is an apparent ceiling to growth and failing to meet growth expectations genially.

Instead of trying to apply the industrial cluster paradigm to entrepreneurship, the latest theorists have attributed an approach derived from ecology and, specifically, industrial ecology. The
following is an excerpt of how the Mckinsey & Company interpret the best practices in using the entrepreneurship ecosystem approach:

**Creating a cluster: Of fundamentals and focus**

*Our analysis identified a set of fundamentals that are needed to establish a minimum infrastructure base. Criteria such as the quality of the physical infrastructure (for example, electrical, transportation, and telecommunications) and governance indicators (for instance, rule of law and government stability) are essential for a location to “earn the right to play.” Meeting this minimal threshold is an important prerequisite. Further improvements to this base, interestingly, are associated with only incremental growth in innovation capacity.*

*Once a base is established, innovation hubs must then develop a specific sector focus. Our analysis of the world’s most successful clusters shows that they have first established themselves as world-class players in an emerging specialty before expanding. This focus allows locations to concentrate limited resources, such as labor and capital, on developing competence and credibility. When successful, the result of these first two steps is the emergence of what we call an “innovation hot spring”: a small and fast-growing hub that relies on a small number of companies to establish itself as a relevant world player in a narrow sector. Our analysis indicates that these early innovation hubs have historically followed one of three primary paths.*

*Heroic bets: large, government-led, targeted investment efforts that focus on a specific promising sector and provide substantial initial support in the form of subsidies, tax holidays, and direct investments, to name a few. While this has been
an attractive option for many locations, it has historically been a challenging path: governments are often ill equipped to identify the right sectors, to define nondistorting incentive structures, and to ensure an effective path out of the initial support phase.

Irresistible deals: regions that are able to attract established companies (often foreign players) who want to capitalize on a significant local advantage, such as low cost of qualified labor or access to large local markets. When done effectively, the location can build on this base to add greater value over time, moving, for example, from manufacturing to basic engineering to design and innovation. To be successful, regions need to create mechanisms that encourage the effective transfer of knowledge to the local ecosystem, as well as tools and processes to raise the skills of the local labor pool.

Knowledge oases: locations with a critical mass of highly specialized talent (for instance, a large research university or government R&D lab). These hubs capitalize on breakthrough technical advances for commercial success. This path is less frequently successful, however. It requires that locations attract the capital and entrepreneurial skills needed to bridge the chasm between idea creation and commercialization.

While innovation clusters may grow quickly in the short term, only a small proportion of these promising hot springs stand the test of time. Most hit a ceiling of limited resources that severely constrains their growth.

These views are supported in the seminal book The Development of University-Based Entrepreneurship where there is a specific focus on the ways in which universities can perform a
vital role as the key contributor the an entrepreneurship ecosystem (Fetters, Greene, M., & Butler, 2010). The regional planning perspective on economic development supports the framework suggested by the latest work on entrepreneurship clusters (Gibbs & Deutz, 2008).

The ecological world-view is really growing throughout economic and business theory which is interesting given the fact that economics and ecology are entomological cousins. Economics is derived from the Greek routes οἶκος, "house"; νόμος, "rule". In contrast ecology has the routes οἶκος, "house"; -λογία, "study of" which suggests a more open-minded approach.¹⁶

¹⁶ Both of these definitions were available on Wikipedia under the entries for “economics” and “ecology” on 04.27.2012.


### 2.5 University Businesses Units

The purpose of this section is to introduce the different functions of a university as diverse business units functioning within one conglomerate entity. The value flows are mapped with money flows marked with the “$” sign and goods or services like “knowledge” flowing in the opposite direction. The most important thing to recognize about each university business unit is that they rely on the same key resource “University Core Knowledge Assets” which, for the most part, are the faculty’s expertise, skills and experience. Other assets might be considered core such as library resources or lab equipment but those things can be found at any large private company and are available to anyone for the right price. The university faculty and their knowledge are priceless assets that no other industry has access to.

Universities contribute in a number of ways in addition to providing direct support for entrepreneurs, investors and other key players. Each business unit is based on the core competency of knowledge creation and delivery although the delivery method and customer type vary widely across business units (Christensen, 2011).

The following diagrams were created using the Visual Understanding Environment (a software package developed by Tufts University).
The four key business units for most research universities are the as follows:

![Diagram](image)

**Figure 4: Education Business Unit**

Notice the flows of money both from the endowment and the student. A more complete picture would include many more factors including wealthy alumni (many of which successful entrepreneurs like Dean Kamen) as they feed the endowment which then feeds back into the university operating budgets and the educational program. This illustrates how a good system model can totally change the way that a university evaluates key strategic investments and growth plans.
The research business unit is less complex without as much routine interaction of support from the endowment. Many graduate and PHD programs are directly funded by outside agencies such as the NIH, NSF or MIT Lincoln Laboratories.
Figure 6: The Corporate Training Business Unit

The corporate training business unit represents an important link with industry and a potential source for input on the operation of a POCC in that corporate clients could offer insights into the types of technology start-ups that they would be interested in acquiring. In addition, these corporate clients may be interested in getting more directly involved in mentoring new ventures or licensing technologies. An ultimate goal would be to solicit corporate clients to contribute to an endowment fund for proof of concept efforts at the university.
The technology transfer facility at most universities is a negatively profitable operation despite the best efforts of highly-skilled administrators. The sheer volume of deal flow and the wide range of analytical approaches required for a TTO range from maintaining good working relationships with faculty, administrators and teams from private industry. In addition, the TTO is charged with evaluating the commercial potential of each new technology disclosure, managing the patenting process, marketing chosen patent-protected technologies, negotiating

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**Figure 7: The Technology Transfer Business Unit**

The technology transfer facility at most universities is a negatively profitable operation despite the best efforts of highly-skilled administrators. The sheer volume of deal flow and the wide range of analytical approaches required for a TTO range from maintaining good working relationships with faculty, administrators and teams from private industry. In addition, the TTO is charged with evaluating the commercial potential of each new technology disclosure, managing the patenting process, marketing chosen patent-protected technologies, negotiating
licensing terms with companies, and finally hunting down and litigating patent infringement against the university patent portfolio. If reading all of that can be tiresome, imagine actually performing all those activities without a large experienced staff!

Figure 8: Research University Process Map (Go, 2004)

This figure depicts all four established research university business units in one view. As was stated before, this is only a partial map and does not include the process by which donations are attributed to the university. This model includes a corporate training business unit that is often present at research universities with Tech Transfer Offices but not always. This model also leaves out any sports programs at larger research universities where both sports and academic research are important world-class activities. The business units depicted represent a core
system and give the correct impression of a number of very diverse activities that are all based on one core theme of scholarly knowledge, expertise and the culture that where scholars flourish.
2.6 Proof of Concept Center: New Business Unit

One model that has generated a lot of interest is the **Proof of Concept Center** or program. Proof of Concept Center is a term of art for a specific type of technology commercialization vehicle designed to be part of an established research university. The three established examples include the MTI Deshpande Center and the von Liebig Center at UCSD. These centers focus on fostering the creation of new enterprises with university researchers/faculty and studies as their founding members. This approach has a track-record of success at UCSC and MIT with centers that have demonstrated success and attracted considerable endowments.

The POC model is an important contribution to the field of technology transfer because it acknowledges the pre-product nature of many university technologies and the importance of start-up ventures as a light-weight vehicle for commercialization. The POC model looks to be a more effective way for universities to profit from technology transfer by licensing a wider proportion of the useful technologies resulting from research discoveries. In addition to offering the chance of increased profitability for universities, the start-up approach to technology transfer also fuels the engine for future economic renewal that many have argued leads to new wealth generation, improved citizen-customer services and all net job creation.

Seed / startup accelerators can be viewed as a form of private proof of concept center. The first seed accelerator was the **Y-Combinator** accelerator program. The program was founded in Cambridge Mass and focused primarily on students with software product. The program was intended to replace a typical summer internship and would last only 3 months. The founder of Y-Combinator, Paul Gram, intended to create a “start-up factory” that could invest small
amounts in a large number of young start-ups while providing support services, community incentives and meeting space and expert mentoring. A key facet to Y-Combinator’s success has also been the access to follow-on investment that it can provide fledgling companies. One reason for easy access to follow-on capital is a standard set of start-up legal and organizational ‘DNA’. Follow-on investors can rest assured that each company is clean and free of legal surprises. It should come as no surprise that Y-Combinator was formed in 2006 within walking distance from MIT’s Deshpande Center which started fully 4 years prior in 2002.

If fostering the creation of profitable start-ups at universities is the ideal way for universities to continue to fulfill their responsibility as institutions that enjoy public assistance.

Although there has been a great deal of time and energy dedicated to making universities more effective as the nucleation point for innovation it is important to understand how entrepreneurial ecosystems develop in their own right by reviewing the cases of successful and failed ones. Which entrepreneurial ecosystems are the outliers and have succeeded against the odds? Which thrived because of large injections of capital from the federal government? Which succeeded because of the success of the city they happened to be located in? What can be done to engineer a successful entrepreneurial ecosystem? These are all important questions that can be elucidated through a study of the historical development of entrepreneurial centers around the world.
2.6.1 Just the Facts

These tables are from the Kauffman Foundation seminal report on the two major Proof of Concept Centers with a long history of operation: one, the MIT Deshpande Center; and two, the UCSD Vaun Libig center.

The following table details the financial picture of each center. Both benefit from a substantial initial endowment in order to sustain their operations. This characteristic is an important characteristic but might not be vital for all universities.

Table 2: Financial Data MIT & UCSD (Gulbranson & Audretsch, 2008)

<table>
<thead>
<tr>
<th></th>
<th>The von Liebig Center</th>
<th>The Deshpande Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>UCSD – Jacobs School of Engineering</td>
<td>MIT – School of Engineering</td>
</tr>
<tr>
<td>Initial funding</td>
<td>$10 million</td>
<td>$17.5 million</td>
</tr>
<tr>
<td></td>
<td>Gift in 2001 from the William J. von Liebig Foundation</td>
<td>Donation in 2002 from Jaishree and Gururaj Deshpande</td>
</tr>
<tr>
<td>Budget</td>
<td>~$1.2 million per year</td>
<td>~$1.7 million per year</td>
</tr>
<tr>
<td></td>
<td>• Administrative Staff ~$475K</td>
<td>• Administrative Staff ~$320K</td>
</tr>
<tr>
<td></td>
<td>• Grants ~$420K</td>
<td>• Grants ~$1.3M</td>
</tr>
<tr>
<td></td>
<td>• Advisors’ Salary ~$240K</td>
<td>• Operational Expenses ~$80K</td>
</tr>
<tr>
<td></td>
<td>• Academic Courses ~45K</td>
<td></td>
</tr>
<tr>
<td>Amount of grants</td>
<td>Seed Funding – $15K - $75K</td>
<td>Ignition Grants – ≤$50K</td>
</tr>
<tr>
<td></td>
<td>Over $2.8 million</td>
<td>Innovation Grants – ≤$250K</td>
</tr>
<tr>
<td>Total amount of grants awarded</td>
<td>Over $7 million</td>
<td></td>
</tr>
<tr>
<td>Number of proposals funded</td>
<td>66 Projects</td>
<td>64 Projects (78 Grants, 39 Ignition Grants, 39 Innovation Grants)</td>
</tr>
<tr>
<td></td>
<td>Approximately 11 grants per year</td>
<td>Approximately 16 grants per year</td>
</tr>
<tr>
<td></td>
<td>35 percent-60 percent approval rate of proposals</td>
<td>Approximately 18 percent approval rate of proposals</td>
</tr>
<tr>
<td>Time period of accepting proposals</td>
<td>1-2 proposal rounds per year (spring and fall)</td>
<td>2 proposal rounds per year (spring and fall)</td>
</tr>
</tbody>
</table>

Note the 75% larger investment at MIT and a much leaner operation with several times less money going to administration as a percentage of grants awarded despite 2x more selectivity.
Table 3: POCC Performance (Gulbranson & Audretsch, 2008)

<table>
<thead>
<tr>
<th></th>
<th>The von Liebig Center</th>
<th>The Deshpande Center</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of start-ups and licenses</strong></td>
<td>16 Startups, 4 Licenses</td>
<td>10 Startups, 1 License</td>
</tr>
<tr>
<td><strong>Number of employees in startups</strong></td>
<td>64+</td>
<td>150+</td>
</tr>
<tr>
<td><strong>Capital leverage</strong></td>
<td>Spinouts have acquired over $71 million in private capital</td>
<td>Spinouts have acquired $88.7 million in private capital</td>
</tr>
</tbody>
</table>
| **Sustainability**            | Percentage of University royalty income from the commercialization of any technologies that receive Center services
University support and private donations, targeting $2 million by 2006 and $10 million by 2010 | Donations from companies that have spun out Future private donations |

Notice the lower number of “start-ups” that graduate from the program despite the an equal number of “projects” and a higher rate of “grants” in table 2. Notice that the number of employees in MIT companies is 2x greater than UCSD despite an equal level of VC investment (roughly $75 million). The MIT center invested a little over 2X in seed funding during the same interval which raises the question of whether it was the increased seed capital or an improved process (including much higher selectivity and attrition, “a steeper funnel”) which resulted in much better employment dynamics. Another possible explanation is that Boston has more customers open to working with MIT start-ups thus helping them gain early cash-flows which they use to hire new employees. Still another possible explanation is that employees in Boston are more open to receiving stock in lieu of cash which would make it possible for Cambridge start-ups to grow without spending more money than their counterparts in San Diego.
Table 4: The details of operations (Gulbranson & Audretsch, 2008)

<table>
<thead>
<tr>
<th>Advisory services</th>
<th>The von Liebig Center</th>
<th>The Deshpande Center</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6 Advisors work at the center approximately 1 day a week</td>
<td>Pool of 50 volunteers are assigned as advisors in the Catalyst Program</td>
</tr>
<tr>
<td></td>
<td>Advisory services available to all faculty and research staff at Jacobs School independent of funding considerations</td>
<td></td>
</tr>
</tbody>
</table>

| Networking events | The "von Liebig Forum: Profiles in Innovation" – speaker series that showcases entrepreneurs, scientists, and innovators | IdeaStream Symposium – Networking event for grant recipients, venture capitalists, entrepreneurs, and other researchers |
|                   | Open House – informal gathering for UCSD and business community | Open House – Informal gathering for MIT and business community |
|                   | Community Workshops – i.e. IP transfer between University and Industry | Catalyst Party – Informal gathering of grant recipients and Catalysts |
|                   | Lunches – Award luncheon/networking event | Other optional events, including Ignition Forum, joint seminars with student groups, and team-building events |
|                   | Other events, including seminars and additional speaker/presentation events | |

| Educational programs | 4 graduate-level courses to introduce engineering students to entrepreneurship (Venture Mechanics, Enterprise Dynamics, Applied Innovation, Corporate Entrepreneurship for Global Competitiveness). Over 400 students and graduate student interns have enrolled in at least one of these courses. | I-Teams Course – Collaboration with MIT Entrepreneurship Center that consists of teams with 3-5 science, engineering, and management graduate students evaluating the commercial feasibility of innovation research emerging from MIT research labs |

This table describes the operational characteristics of each center. The first thing that jumps off the page is the 10X higher level of advisors in the MIT program despite (perhaps because of) the fact that it is a volunteer effort. This aspect may be an important factor to the improved apparent
job-creating performance of MIT’s POCC. The other key difference is that MIT’s program seems less rigid and institutional in tone. Instead of having an “award Luncheon” MIT has informal gatherings for winners.

\[17\] Having participated in various MIT entrepreneurship events including the MIT Ignite Clean Energy competition in 2006 and the MIT 100K elevator pitch contest in 2010 I can attest to the informal and very open feeling at these events. MIT has a general ethic of openness and many world-class speaking events are open to the general public. MIT is quite self-assured as one of the world’s very best engineering universities and (unlike Harvard) is content to keep its exclusivity and status low-key. These are the qualities that are important in order for entrepreneurs to take big risks required to build great high-growth firms.
2.6.2 Sketch of POCC from Published Literature

A proof of concept center or program is an institution that operates as part of university campus and administration, with the goal of actively facilitating technology transfer by systematically forming new companies through the following unique means (Gulbranson & Audretsch, 2008) (Tedeschi, 2010):

- **Funding academic investigators** from university labs to conduct applied research as a follow-on step to existing research programs using the same offices, lab, equipment and even staff that conducted the initial research work that led to the creation of commercially promising technologies.

- **Seed funding** from an endowment for the express purpose of research commercialization with the goal of creating working prototypes and business plans that demonstrate the principle of operation for a new product and business.

- Active formation of market **development teams** that facilitate the process required to turn an academic researcher with a high-potential research discovery into an entrepreneurial founder with a product offering and customer acquisition scheme worthy of attracting sophisticated investors.\(^{18}\)

- **Linkages with local entrepreneurship ecosystem** via. a continuous **stream of events** and other programs where different teams can connect, exchange leanings and create a

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\(^{18}\) One one participant’s remarks in the New York Times article, “I wouldn’t have known the first thing about doing all of this,” says Professor Hart. “The people from the Deshpande Center led me through.” (Tedeschi, 2010)
supportive culture. In attendance are also entrepreneurs as advisers and mentors capable of supplying experienced guidance.

As discussed in the “just the facts” section, the Von Libig Center at UCSD uses a paid staff for this function which is a somewhat more top-down approach to this service function and it is likely that MIT’s Deshponde Center is able to attract and retain mentors who, under a fee-for-service arrangement, would be far too expensive. In other words, the MIT model probably benefits from a greater informal value stream that is “off balance sheet” to the center and results in a leaner and more effective commercialization process.
2.6.3 What Organizations and Systems Inspired the POCC

There are several established organizations that have become infrastructure for entrepreneurs focused on technology commercialization but nothing as integrated and systematic as the proof of concept center.

The top-of-mind precursor is the **business incubator**. The concept of a business incubator is so well developed in the minds of the public as the key infrastructure to support new businesses that a POCCs were actually introduced notably with the New York Times headline, “The Idea Incubator Goes To Campus”.

Although business incubators have been very important catalysts for growing businesses of a certain scale because they have allowed young companies to save by sharing resources and ideas, they are fundamentally property management operations. For instance, Worcester’s own MBI (a biomedical incubator in Gateway Park) is focused on providing tenants with low rent space where they can work in close proximity with others in their field. Tenants are not given special support services such as business planning or access to capital or even explicit mastership but instead their relationship to the incubator is much closer to landlord and tenant. To be certain, many of the individuals and organizations involved in running business incubators are passionate about helping entrepreneurs succeed but they don’t actively facilitate.

The irony of the business incubator model is that the primary benefit that tenants report is the ability to network and share leanings (best practices) with other tenants in order to increase their progress by utilizing the work product of others at no cost. A version of the “thank you
“economy” that has come into public view with the rise of the Internet. This is ironic because entrepreneurs must spend a large proportion of initial capital for specialized services and facilities while, like many of the best things in life, what they actually benefit from could have just as easily have been obtained at a local Starbucks for free (or the cost of cappuccino). An even more troubling side effect of the business incubator “helpful landlord” model is that it contributes to the myth of a “funding gap” or initial financing hurdle famous among first-time entrepreneurs.

Another facet of the POCC process is seed funding. There have been government funded seed capital operations for such as the Slater Fund founded in 1997 in Rhode Island or the federal SBIR program which started in 1982. These programs have supported entrepreneurs financially to the exclusion of other services like providing physical space or active market development work. In the case of SBIR, the entire weight of the process seems to fall on the shoulders of grant recipients which is rumored to create a distorted operating perspective and focus on obtaining further government assistance instead of providing actual value to customers.

The aspect of business advising and counseling has been around for at least as long as federal and state seed funds. For example, Worcester’s Clark University hosts the Mass Small Business Development Center which provides free feedback and consulting to businesses that have demonstrated a degree of traction ($100k if I recall) and was founded in 1980. In addition SCORE has 13,000 mentors and 364 chapters across the country and was founded in 1964 according to their website (score.org). I personally started my career as an entrepreneur with a meeting with my local SCORE advisor in Brattleboro, VT. These two examples represent the
type of mastership and advising that is provided in a more intensive and systematic fashion inside a POCC.

Business networking events like the WPI Venture Forum, MIT Enterprise Forum (1978) and others provide open networking similar to the service offered by POCCs but targeting a more general audience spanning many business sectors.

2.6.4 Theory building to POCC

The proof of concept center is the latest iteration of a previous notion of the business incubator. Business incubators were first developed in the mid 1980s in response to a growing need for increased support for entrepreneurial ventures within local economies. Most of the original business incubators acted more like service entities vs. investors and many incubator operators viewed their service offering more like a real-estate deal than an investment or facilitation service. Despite this, many incubation included an application process to screen out businesses with a low chance of success.

At the same time that business incubators were under development, Venture Capital and Angel Investing were picking up steam. On account of the fact that the funding and incubation elements of the startup process were separate, an increased level of operational capability was required on account of the new entrepreneurs participating. What this meant is that entrepreneurs didn’t only need to have an idea worth building a business on but they also needed to spend their time focused on administrative things.
The key issue of the established model with business incubators is that it left entrepreneurs stranded in the initial pre-investment phase of a project’s life where there has traditionally been a gap in funding. This gap was often experienced between the initial prototype of an idea and the market that the product had access too.

The POCC model is a combination of every step of the startup process into a single business accelerator scheme. In the case of the MIT Deshponde Center, the process includes everything from seed grants, mentorship, team formation, special events and a variety of other program opportunities. The MIT POCC combines every element of the business formation process that had been proven out via. independent institutions and service providers into a single, smooth and integrated system for creating research-based ventures.

Two things that make the MIT POCC different from previous players are: one, that they focus only on businesses formed around university-based research; and two, that the proof of concept research takes place in the same university lab setting where the original basic research was conducted.

The overall result of the POCC model is that its participants can spend the bulk of their time focused on building the unique and valuable product that will allow their business to grow because they don’t need to divert their attention to learning how to operate a small business at the same time while also maintaining the productive environment that facilitated the basic research in the first place.
2.6.5 Interaction with Other Businesses

The following is a common growth model for the life-cycle for high-growth startup enterprises. It will be used in this section as the basis for a discussion of ways that a successful POCC will benefit established business units within the university structure.

![Startup Financing Cycle](image)

**Figure 9: A picture of the innovation process**

In the case of a Proof of Concept Center, a technology has been developed within a university lab setting on the basis of research grants and other funding. Since the research business unit of

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19 This figure is from a blog post on entrepreneurship in India but is among the best available to convey the concept of the new venture “S-Curve”: http://goo.gl/kjojl
the university can be viewed as separate from the POCC, the above financing model starts at the appropriate phase of the product life-cycle despite the fact that the university as a whole is involved in financing even earlier.

The Proof of Concept Center model has the goal of addressing the “Valley of Death” phase of the startup financing lifecycle. This is a pre-revenue generation phase of company life-cycle because it is before a technology has been fully turned into a product with an attractive value proposition among market participants. In other words, the Valley of Death is a phase of development prior to incoming cash-flows. One of the primary reasons POCCs have endowments is to internally fund projects through this phase.

If the startup financing curve is viewed through the lenses of other university departments, then there are some additional opportunities that come to light. From the perspective of the undergraduate program, newly venture-backed startups can offer opportunities for highly-relevant experience in the form of MQP and IQP projects to support early series A phase. As the company rapidly scales into series B financing and further venture capital rounds an increasing need for corporate training could be expected in order to reduce growing pains. Once a new venture grows to maturity, they will surely be interested in sponsoring basic research as a way to expand their new product development pipeline. The final, and most important impact on the other business units is at a major liquidity event such as an IPO or an acquisition; it is at this point that the university stands to grow its endowment.
2.7 Background Summary

There has been a lot of work in the field of innovation and for good reason; innovation is the only strategy for future prosperity. The POCC model shows a lot of promise and has gained a lot of interest among a diverse set of stakeholders.

The background section included three key themes. The first section discussed in detail the political and societal context for this study is needed. Second is an analysis of what the innovation problem is and how it has been solved by others. The next section discusses technology commercialization practices and concepts. The final sections introduce the key concepts of business ecosystems, the university as a business, followed by an overview of proof of concept centers.

The next chapters of the paper represent a transition from what is known to new data, analysis and conclusions based on a methodology that utilizes three established analytical methods.
Chapter III: Methodology

Other successful IQP projects applied a mixed bag of analytical methods including: participant or natural observation, interviews with experts, focus groups, case study, content analysis, comparative research, historical analysis, experimentation, survey research, risk analysis, statistical analysis, investment decision analysis, life cycle costing, modeling, and simulation. This project will rely on a comparative analysis of two case studies in order to create a simplified model that will be used to create an investment decision analysis aid for use in the assessment of Universities as POCC host candidates. The following describes each aspect.

20 This list of methods is taken from chapter 4 of the IQP handbook: http://goo.gl/MfRNM
3.1 POCC Functional Mapping (Case Studies)

The first aspect of the POCC case studies is gathering as many sources as possible to describe every aspect of the center’s operation starting with those sources that can provide the wider view of how the center operates then diving deeper into less-widely circulated materials including obscure annual reports, employee handbooks, student reports from within the POCC context, conference proceedings and videos, old website archives and other useful sources.

The next step is to analyze the data from the above sources into a number of different analytical formats including:

**One:** a map of the functions using a business model canvas.

**Two:** A step-by-step list of every process involved in the client lifecycle and the key inputs from external communities, individuals and institutions resulting in a table where one column describes the process stage and another describes the key external inputs required at that stage.

**Three:** Create a process flow diagram showing an overall picture of how the process is integrated into the functioning of the system from a top-level perspective.

**Four:** A high-level review of the qualities and composition of the local entrepreneurship ecosystem including cluster maps developed by research institutes etc.
3.2 POCC Function (comparative analysis) & Process (modeling)

The next step is to condense these POCC models into one “core model” that represents the most essential features and inputs for the system to function well and generate positive outcomes. Identifying the core features and functions within the POCC is equally important as finding how the process depends on an existing external entrepreneurial ecosystem.

By analyzing the differences in the level and type of external inputs for similar stages of the new venture facilitation process it will be possible to identify the underlying input themes and system requirements as specific inputs vary. As a result of the comparative analysis, a model is made of the process including the minimum functional requirements for POCC operation.
3.3 POCC – University Scoring System (investment decision analysis aid)

On the basis of the model and comparative analysis, a scoring tool is created to aid in investment decisions on a national, state or local level. This scoring system will be presented in the form of a simple list of weighted questions similar to those used to create psychological profiles. An example of how this can be useful is Daniel Isenberg’s “should I be an entrepreneur” test published on Harvard Business Review.²¹

Here’s the test:

1. I don’t like being told what to do by people who are less capable than I am.
2. I like challenging myself.
3. I like to win.
4. I like being my own boss.
5. I always look for new and better ways to do things.
6. I like to question conventional wisdom.
7. I like to get people together in order to get things done.
8. People get excited by my ideas.
9. I am rarely satisfied or complacent.
10. I can’t sit still.
11. I can usually work my way out of a difficult situation.
12. I would rather fail at my own thing than succeed at someone else’s.
13. Whenever there is a problem, I am ready to jump right in.
14. I think old dogs can learn — even invent — new tricks.
15. Members of my family run their own businesses.
16. I have friends who run their own businesses.

²¹ Take the test: http://goo.gl/kuvru
17. I worked after school and during vacations when I was growing up.
18. I get an adrenaline rush from selling things.
19. I am exhilarated by achieving results.
20. I could have written a better test than Isenberg (and here is what I would change ....)

If you answer “YES” more than 17 times, then you have a high potential to be a successful entrepreneur.
Chapter IV: Results

In order to gather the data for this report I used the business model canvas as a guide to for what was known and what remained unknown about the process that each center used and their organizational form. In addition, a paper list of the process steps was kept in order to further aid in the search for specific types of unpublished data sources.

The following data have been distilled into excerpts with dates and the associated URL to the original content. These lists serve as a static picture of each center for anyone in the future interested in getting an idea of what each POCC was like in April of 2012. In addition, these data are useful in that they will form the basis of further analysis of each POCC in the ‘Analysis’ chapter of this report.
4.1 MIT Data

This table includes all of the source material related to the MIT Deshpande Center and associated interlocking institutions. Unedited excerpts from each source are included.

Table 4: MIT Deshpande Center Process Data

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<thead>
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<th>(year) Excerpt</th>
<th>Source</th>
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<td><a href="http://entrepreneurship.mit.edu/main/nurture/student-organizations">http://entrepreneurship.mit.edu/main/nurture/student-organizations</a></td>
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4.2 USCD Data

This table includes all of the source material related to the UCSD van Liebig Center and associated interlocking institutions. Unedited excerpts from each source are included.

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</tbody>
</table>
4.3 QED Data

This table includes all of the source material related to the Science Center’s QED program and associated interlocking institutions. Unedited excerpts from each source are included.

<table>
<thead>
<tr>
<th>(year) Excerpt</th>
<th>Source</th>
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<tbody>
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Chapter V: Analysis

5.1 POCC Case Analysis

5.1.1 POCC Case Study A: Massachusetts Institute of Technology

1) Biz model canvas for the POCC based on findings
2) Process table listing: Step #, Function, Internal Resources/ Inputs, External Resources/ Inputs

5.1.2 POCC Case Study II: University of California San Diego

1) Biz model canvas for the POCC based on findings
2) Process table listing: Step #, Function, Internal Resources/ Inputs, External Resources/ Inputs

5.1.3 POCC Case Study III: Science Center Philadelphia

1) Biz model canvas for the POCC based on findings
2) Process table listing: Step #, Function, Internal Resources/ Inputs, External Resources/ Inputs

5.2 Distilled POCC Business Model & Minimum Inputs
5.3 Creating the Scoring System

This scoring system is based on data that was gathered, considered and synthesized although the results could not be incorporated into the report at the time of submission.

The scoring system includes the following key elements:

**One**, the availability of funding for the initial start-up phase of the program

**Two**, access to investors who will help seed-stage ventures transform into rapid-growth ventures

**Four**, proximity to customers who are open to speaking with new and untested companies

**Five**, a local environment that is appealing to entrepreneurs and a clearly articulated reason that they should value the local atmosphere. After all, the weather is probably better in San Francisco

**Six**, a very clear understanding of what success will look like among top administrators, government officials, funders and other institutions from the profit and non-profit worlds

**Seven**, a clear strategy for how to increase throughput of high-potential technology either through facilitated brainstorming sessions to create many novel ideas from scratch, or through in-licensing of ideas from other research labs around the country and world.

Each item is rated on a scale from 1-10 and then a total tally is created by adding these values. Universities that score above 50 points are considered “high-value targets” for implementing the POCC model.
Chapter VI: Conclusion

This section will discuss the extent to which this report has achieved the goals of the IQP along with revisiting the project contents. Although this report is incomplete and not yet fit for wide publication, it does record a significant effort that meets the IQP requirements as specified in the WPI IQP handbook.

6.1 Project status

Although this report of 104 pages and includes the sum total of 6 years of work thinking and developing entrepreneurship programs and building new ventures, the final conclusions of this report could not be reached because insufficient data was collected over the course of the project. Despite the lack of concrete results, this report does add considerable value by pulling together a wide base of concepts and perspectives while interpreting information about Proof of Concept Centers in new ways.

In an earlier iteration of this project, the focus was on understanding student innovation and entrepreneurship among the undergraduate population. Appendix C includes the results of some of the interviews conducted during that work. The major discoveries were that students went to great lengths in in order to avoid the ambiguous WPI intellectual property policy. Although most students had never actually read the entire policy, they almost all cited it as a reason for not using university equipment and lab-space while they developed their technologies.
The POCC model has the orthogonal benefit of increasing faculty acceptance of entrepreneurship and business generally as valuable activities. IP policy changes may only be possible with that sort of systemic change in faculty perception but what is more likely is that this issue has simply not been a priority. It would make much more sense to address things like revising the IP policy far before spending the time, money and attention building a WPI POCC.

6.2 IQP Requirements

Baseline Requirements:

1. Maintain effective working relationships within the project team and with the project advisor(s), recognizing and resolving problems that may arise.
   [complete]

2. Demonstrate the ability to write clearly, critically and persuasively.
   [complete]

3. Demonstrate strong oral communication skills, using appropriate, effective visual aids.
   [both in the report and in presentations]

4. Define clear, achievable goals and objectives for the project.
   [qualitatively complete]

5. Critically identify, utilize, and properly cite information sources, and integrate information from multiple sources to identify appropriate approaches to addressing the project goals.
   [see bibliography and section 1.2 on source utilization, not perfect but proper]

Project Requirements:
6. Demonstrate an understanding of the project's technical, social and humanistic context. 
[.section 2.1.1 addresses these directly]

7. Select and implement a sound methodology for solving an interdisciplinary problem. 
[methods selected directly from the IQP project handbook]

8. Analyze and synthesize results from social, ethical, humanistic, technical or other perspectives, as appropriate. 
[chapters I-III demonstrate much of these]

9. Demonstrate an awareness of the ethical dimensions of their project work. 
[the ethical dimensions are addressed to some degree throughout the background and in the context section]

Table 5: IQP Requirements Mapped to Project Elements

<table>
<thead>
<tr>
<th>Project Element</th>
<th>IQP Requirement(s) Satisfied</th>
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</thead>
<tbody>
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<td>Routine project meetings</td>
<td>1, 3, 4</td>
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<td>Final IQP report submission</td>
<td>2, 5</td>
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<td>Project goals appendix</td>
<td>4</td>
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<tr>
<td>Background Section (Chapter II)</td>
<td>6</td>
</tr>
<tr>
<td>Methods Section (Chapter III)</td>
<td>7</td>
</tr>
<tr>
<td>Results &amp; Analysis Section (Chapters IV - V)</td>
<td>8</td>
</tr>
<tr>
<td>Discussion Section (Chapter VI)</td>
<td>9</td>
</tr>
</tbody>
</table>

Nowhere in these requirements is having conclusive results mentioned. The somewhat incomplete nature of this reports results; analysis and conclusions sections should not directly influence its merit as an IQP project although it may make it less useful within the context of its intended audience and use.
6.3 Further Work & the Published Draft

In order to finish a publishable report, the author intends to continue working from 05.04.2012 till 05.12.2012 or until a publishable result is ready. In the meantime, this project will be submitted with restricted access with no access to the public or within the WPI community.
Bibliography


Savage, J. (2011). *Answers to the Office of Technology Policy (OSTP) and the National Economic Council*. La Jolla: Proof of Concept Institute, Inc.


Appendix A: MIT & UCSD POCC Case Data

This section is yet to be tabulated and entered as the project is prepared for further publication.

Appendix B: Worcester Polytechnic Institute

Alumni-Funded Seed Accelerators

In addition to building a POCC in order to help faculty and graduate students build entrepreneurial companies based on hard science, it might also be interesting to invite wealthy alumni to fund the creation of independent programs on the Y-Combinator model.

One option would be to have IQP, MQP and GQP teams work with alumni in order to design new accelerator programs that would integrate well with the WPI plan while addressing specific problems that would be of interest to specific alumni. For instance, Dean Kamen is a very successful almost alumnus of WPI who would probably be interested in helping build a “Kamen Center” for social entrepreneurship on or near campus. In the case of Dean Kamen, not only could he contribute a slice of his substantial wealth but he could also contribute his brand as one of the most famous living American inventors along with the chance to collaborate with DEKA (his private R&D firm in Nashua). You could imagine a great deal of cross-fertilization of ideas along with increased collaboration across every business that WPI is involved with.

Dean Kamen is by no means alone among the class of wealthy WPI alumni. There are so many others who would either be interested in helping found centers or simply help fund them. In addition, these private centers could be a source of investment opportunities for the entire WPI
alumni community along with the WPI endowment fund. In fact, it would be interesting to create a financial facility where the WPI endowment is systematically co-invested as alums act as a highly-qualified filter of good and bad startup technology ideas. It would be like having tens of thousands of world-class technology analysts working for the endowment fund manager.

Another possibility is to view Worcester as an extension of Boston, as far as entrepreneurship is concerned. This view would lead to the creation of WPI seed accelerators in Boston and Cambridge instead of Worcester. This strategy would benefit from importing all of the best practices and culture directly from the Boston ecosystem (a value that can not be understated). This approach also means that WPI project teams could experience a slight change of scenery if they ran projects based on building a business. Some might ask if it makes sense to invest in Boston when Worcester is in the greatest need for growth. On the other hand, if the plan is to move WPI’s investment in innovation off-campus, maybe it would be better to go directly to the source and build a center in California.

One strong recommendation I would make regardless of the structure of the program is to import great technologies form outside of WPI and Worcester. The region does not have enough net activity to support a thriving technology-based entrepreneurship ecosystem on its own. There simply aren’t enough people or enough total research spending to make it work (not to mention the other negative factors for Worcester in terms of skill retention etc.). There is no reason that this problem can’t be solved by transferring excess technologies from national laboratories and other institutions. Many great technologies enable a multitude of market/product options and the
primary institutions originating the great bulk of valuable outcomes could stand help commercializing more markets simultaneously.

Another strong recommendation is that WPI focus at least some of its POCC effort on the kinds of heavy-industry and manufacturing that WPI graduates often become involved with. Worcester actually has a very strong industrial base including a large steel-making equipment plant, formerly Morgan Construction (now owned by Siemens), the expansive Saint-Gobain chemical manufacturing plant (formerly Norton Company) along with the Polar bottling plant and others. It is clear that entrepreneurship ecosystems require many inter-connected parts that work together to create a dynamic group of companies and individuals. Given the relative abundance of manufactures and their value to the Worcester economy it would be an incredibly odd choice not to have part of the innovation system focused on this “less exciting” sector.

One of the biggest challenges for WPI as a hub for innovation is actually more a challenge to do with Worcester and sense that people have of it. If you ask someone in Boston if they would consider moving to Worcester you are libel to get strange looks or even sneers. In fact, many students at MIT, Harvard and other schools don’t really know what or where Worcester is let alone WPI. Great cities like Boston, New York and San Francisco are able to attract the best and the brightest because they have all of the amenities the best people expect. If you take Starbucks shops as one example of these amenities a quick review will reveal the magnitude of the scale difference between the educated creative class of Boston vs. Worcester. Unfortunately, the issues with Worcester’s perception in Boston are also shared by many WPI students and even faculty that I have met who work in Worcester. If WPI is going to become the hub of a great entrepreneurship ecosystem then it will need to do even more to support Worcester in becoming
more than a depressing hollowed-out city of the past. With the recent construction work downtown and the continued development of Gateway Park it would seem that the city is at least headed in the right direction. The question is what will it take to keep the increasingly mobile alumni of WPI from taking the first bus they can to Boston, New York or San Francisco? One thing could be an emphasis on heavier industries or differentiating WPI and Worcester such that it is the world’s best within a narrow but highly valued niche.

There are many options for WPI as it grows into a more vibrant entrepreneurship ecosystem participant but in addition to learning from what has been successful at the world-class schools in Boston, will be important for WPI to leverage its specific assets and strengths to achieve exceptional results within the context of WPI’s great history starting with being founded as a free college around the same time as the Cooper Union by two successful entrepreneurs.
Appendix C: Student Interviews on Innovation at WPI

Interview Guide: Independent Student Innovation at WPI

Study Goals:
The questions asked in the interviews with students seek to obtain two types of information from actively innovative students: one, to evaluate what impact various identified stakeholders have on student innovation; and two, to evaluate what the most influential environmental factors are on independent student innovation.

Subject:
WPI students or very recent students that have been involved in self-directed or independent innovative project work.

Questions

Q1: Do you feel that the WPI IP policy has influenced the process of innovation?

Q2: What are the three biggest reasons that you find innovation (patentable and valuable) meaningful and valuable in your life… IE. Why have you spent the time and effort to develop your ideas?

Q3: Please briefly explain the projects that you are or have worked on that you would consider to be innovative, how you feel you benefited from the process and what made those projects meaningful and valuable?

Q4: What would you describe as the benefits to student innovation for students in general?
Q5: Is there any way that you can think of that the administration, faculty, technology transfer office, alumni, local government, society or other students could further help students to innovate?

Q6: What do you think the biggest hurdles or ‘barriers to entry’ are for students attempting to develop an idea, into a prototype and a patent, into a business in general terms? How are things at WPI different?

Q7: What are your thoughts on a new model for technology transfer where in professors are able to pitch the technology they are developing to students in a ‘innovation fair’ so that students are then able to work in teams to reduce research to practice and perhaps spin-off new companies?

Q8: Do you think that your independent innovation has improved your commitment to learning or competed with it?

Q9: Do you think that you will be more financially successful with your experience working on technology projects on your own or with a team of friends? How does it impact your job prospects?

D Interview with Sam Feller

Intellectual Property at WPI

Interview #1

Subject: Sam Feller, WPI ME 2007

Interview Information:

Date: 01/15/07

Duration: ~30min
Location: 63-65 Wachusett Street, Worcester, MA 01609 (the TKE house)

General Notes:
I feel that the questions were good but that there were too many questions to preserve a fluid conversation. I think that 5 or 6 questions would be better for the future interviews. I also could have improved the flow of my questioning by pre-reading the questions before the meeting to clear my thoughts and focus. My interviews should be about 30min long with a lot of content.

Questions:
1) Project is $5,000 budget, first project was the lacrosse stick. IP concerns.
2) Innovation is important because it allows a person to obtain credit for the work they do through the tools of Intellectual Property (Patents), other benefits are personal economic gain.
3) Projects: carbon lacrosse head, FBI Loss Alamos Lab project, Roof Inspection device
4) Impact?? NA.
5) Funding would help from external sources, more institutional emphasis on innovation,
6) Risk vs. Reward in terms of economics, $ & time, uncertainty of obtaining a patent, a good amount to lose to investors is 10%-20% for the help you may get, fear of losing more rights is an issue.
7) Support from the school, a WPI VC group would be very beneficial for the development of entrepreneurial dealings.
Reflections:

Travelers insurance sponsored the MQP project that Sam thought was the most innovative effort of his career. Sam's reasoning for joining his project was that they were providing the money they needed to build the prototype.

The major blockage to early innovation for Sam was a general fear that the school would own his IP but this fear remained vague. This indicates that the IP policy should be communicated so it does not remain a damper for undergraduate innovation.

Despite the fact that Sam understood the value of innovation he couldn’t identify the exact reason that innovation is important. This indicates that Sam’s core beliefs may reside below the conscious and rational level.

The recognition given to a person that holds a patent for innovative research seems to be a more compelling reason for Sam to patent than financial gain. It would be interesting to see if there are studies that show how this kind of thinking shifts as actual financial gain is added to the equation.

How can external stakeholders help innovation? *Fund projects!*
Internally we should improve the emphasis on innovation within the undergraduate student body. “… and there is no reason undergraduates can’t help out with research projects… innovation at any level creates prestige for the school”.

“I remember my work at Los Alamos (National Labs) and just the possibility of getting a patent was really exciting for me” Sam suggests that this feeling was a real motivator and that it made him more interested in developing his project.

Time and risk reward. Sam perceives the overall risk of getting the patent and pushing forward with his ideas as too high for him to handle, yet he doesn’t want to give the glory of his ideas to another student. This is the kind of dilemma that people encounter before they have experienced the process of starting a venture and begin to realize how much an idea needs to change before it can be a real success. Sam even states that he is afraid (if not irrationally) that someone would gain 60% or so of his patent. The fear comes from ignorance of the process but it is also hard to educate everyone on campus about the policies on campus.

Sam suggests that the MQP should be a spin-off or “reduction to practice” of faculty research projects with good commercial application. This could also take place between WPI students and other schools technology transfer offices such as MIT. Sam wants there to be an angle investment group at WPI.

Interestingly, Sam doesn’t think that his innovative projects and experience in innovation will positively benefit his work prospects. This is an interesting psychological status because it
indicates a great deal of leverage on a psychological level. The problem with my analysis is that it will be hard to make a proof without using game theory and agent-based modeling.

E Interview William Tolli

Intellectual Property at WPI

Interview #2

Subject: William Tolli, WPI ME 2007

Interview Information:

Date: 02/20/07

Duration: ~54min

Location: Phone Interview

Questions:

Value and meaning from invention:

He likes the experience of learning and inventing. That’s the core driver for his technology development process. Money only comes into the equation because of the basic need to sustain life.

Would you advocate more invention and innovation on campus:

I was briefly in the gaming club because they were interested in wall-gaming. The idea is that you could make a black and white screen by placing lights in windows and controlling
them. The problem is that students don’t follow through with ideas. This could be a resource management group.

Note- I would be interested in working on something like an inventors club on campus if I have time… which comes from having money or working with people willing to help reduce the load.

**How can WPI help?**

Professors are very helpful in how they provide advise on hard problems. In this way they are like consultants for free. This may be one of the biggest values on campus and one that doesn’t come into the Intellectual Property Policy.

One of the biggest problems is that William didn’t have the business background to move to the next level of product development. Tolli doesn’t enjoy haggling with people and working on the financials because they make him nervous which is where his business partner comes in.

Professor S. has provided them a great deal of support and offered them a sure place to stand.

**Barrier to entry??:**

I just didn’t know what I was doing. This makes getting traction on the project very difficult because you don’t know how to move the project through the interpersonal space of the business world.

You do have to trust some people along the way like Prof. S.

**Does project work compete or build the educational process??:**
Instead of doing my homework I invented something based on the principles learned in class. This hurt his grades but improved the educational quality.

**Financial success based on innovation??**

Tough call, the project has absorbed a great deal of money thus far… I think I am financially successful because I am doing this project and doing my job at Mercury. The job at mercury was also much easier because of the innovations he did because he had been highly experienced at the get go. His inventive abilities were recognized at a quarterly meeting and given the company Porshe as a prize.

**How would you change the IP policy??**

Many people don’t pursue there ideas because they were partying or playing sports. The core of this is to make the process feel like fun instead of like work.

General Notes:

William is a very experienced innovator having created many technologies in the past. I made the recording of me speaking with William while holding my phone in close proximity to the recording device with the phone on speaker.

William developed a furnace modulating technology that he installed at his own house before the one-wire wiring harness. The harness was developed while he was a sophomore in collage and he did all the work in his dorm. He decided to do it in his dorm because he had made a
tachometer in an engineering class and looked into selling the device he had made. The class was 2799 and he didn’t want to “pay the school 50% of his earnings” if he sold his.

The amazing thing about this is that his professors stated that “this project is the best we have ever had for the class”. They connected him with many of the manufacturing contacts that he could have used to start a company. His friends all said “wow that’s amazing you should make more things for cars”. The conclusion that Tolli would loose 50% of his revenues came after he had met with the tech-transfer officer Mike Manning. He does reference that Mike stated that “he was there to help” and that he is a resource.

William Tolli argues that the school’s a business into it for making money and it makes sense for them to. He understands the argument of the IP policy but doesn’t think that it promotes innovation. I would have developed it in WPI’s labs when I was developing the project because I thought the business would be his “profession and livelihood”.

D Interview with C. Valentine Rogers

Intellectual Property at WPI

Interview #3

Subject: C. Val Rogers, WPI MIS 2009
Background Notes:

Val is an entrepreneur with a history of start-up activity. I know him personally as the co-founder of several ventures. Val also has worked in the WPI technology transfer office as a marketing intern and has spent time considering patented innovation.

Val grew up in The Bronx borrow of New York City and went to school in Harlem and before applying to WPI. He was motivated to attend WPI by the opportunity to help people. The summer before WPI, he had a class with James Lee Boss who spoke about the importance of actively giving back to the community by training ‘governors’ (leaders) who could create a sustainable future. This philosophy replaced dreams of becoming a real-estate entrepreneur and giving back by donating part of the profits of normal business. This transition corresponded with an increase in religious interest.

Questions:

Q1: Do you feel that the WPI IP policy has influenced the process of innovation?

Yes. It definitely made me hold back some of my ideas for projects that might have involved thins that were entrepreneurial profitable. The primary effect was on my decision-making process regarding how marketable my project ideas were.
The IT policy also influenced my ability to build a business on campus because it prevented early communications etc. on campus.

No matter what you did with your project at WPI then WPI is going to get a piece of it had a real negative effect on my willingness to innovate in plan projects. I put less heart into my planned projects so that I could save my real passions so that I could maintain ownership of them. If the policy was different I would have considered pursuing something more related to what I wanted to do.

I feel that other people have a general discontent with how the policy works.

Q2: What are the three biggest reasons that you find innovation (patentable and valuable) meaningful and valuable in your life… IE. Why have you spent the time and effort to develop your ideas?

It links my passion for helping other people's quality of life. I think that Innovation is a key way of raising people's quality of life, by definition.

The core of my passion is based on my religious beliefs and who I am. Innovation is my method of fulfilling this directive. I also have a general inclination towards business and technology and the fact that technological innovation is a good marriage of these interests with my core mission and passion.
Q3: Please briefly explain the projects that you have worked on that you would consider to be innovative, how you feel you benefited from the process and what made those projects meaningful and valuable?

**Genius!**

With Genius! we were pursuing entrepreneurship in an educational context as well as how it impacted the community.

**ILP**

With ILP we were lowering the barrier to commercialization of innovation and making more people interested in realizing their dreams. This also helped people by making their community more energetic.

**BAC**

The mission was to serve people while making a profit. Always trying to kill multiple birds with one stone. This one project had to do with writing a grant proposal for a local school so that they could become trained in web-design and marketing. These students would have then be hired into businesses that would make money for the nonprofit. The effort included several similarly structured philanthropic exchanges along with providing support. This was meaningful because it helped inner-city students avoid working at McDonald's and not learning valuable skills while they could make more money in the interim. The goal was to make this a self-sustaining training program that could help a lot of people.
Q4: What would you describe as the benefits to student innovation for students in general?

It makes school more interesting, in general. This is because you have the money motivation behind it and the fact that you can actually help somebody if you really apply yourself. If you really apply yourself, it lets you see the context of where your knowledge can be applied and it helps academics in this way. Another benefit is that the student may actually be able to make more money than they would as an employee (as demonstrated in statistics). It also helps for your CV to have projects with commercial emphasis as you search for a job. Having more to talk about in interviews definitely makes you stand out over other extracurricular activities or club leadership.

Q5: Is there any way that you can think that the administration, faculty, technology transfer office, alumni, local government, society or other students could further help student innovation?

Space to innovate that is very catered toward students with networking between students and support from mentors and other people would help. As it is the facilities and events are more focused for older people. CEI already focuses on student innovation but this is not enough of a lab space etc.

We could use the university of Michigan's model where the students have rights to IP by default in order to create a more entrepreneurial culture. We don't really have an entrepreneurial culture
where entrepreneurs are praised and made public. We could do this by changing the language around projects by renaming them based on the objective of innovation. Our culture now is more focused on training engineers to work in large companies.

Q6: What do you think the biggest hurtles or ‘barriers to entry’ are for students attempting to develop an idea, into a prototype and a patent, into a business in general terms? How are things at WPI different?

Money is the biggest thing with college students. It's hard to even get the money for a patent. From there you need to have a network in order to commercialize but the biggest barrier to entry is money.

Q7: What are your thoughts on a new model for technology transfer where in professors are able to pitch the technology they are developing to students in a ‘innovation fair’ so that students are then able to work in teams to reduce research to practice and perhaps spin-off new companies?

This is a good idea. I share these thoughts and have come to the same conclusion independently.

Q8: Do you think that your innovation projects has improved your commitment to learning or competed with it?

It did both. It made me want to learn more things that were relevant to make ILP, Genius! and BAC succeed. I enrolled in a course to learn extra things about intellectual property through
extra courses because of the projects I had been working on. It also competed by making me want to leave the university context early and actually get out their and do something. I still wanted to learn but in a different way that is more focused on doing things.

I wanted to put into practice some ideas that I had and I felt that it would be better if I wasn't a student and I could work on those things full time; not having to be committed to coming back to class etc. For this reason I took the opportunity to graduate after 3 1/2 years instead of the full year.

Q9: Do you think that you will be more financially successful with working on technology projects on your own or with a team of friends? How do you think those projects will impact your job prospects?

Working with a group of friends will definitely lead to more success in projects. I also think that having more experience innovating in teams has helped open the door to new job opportunities.