

# **AC 2010-2012: CROSS-DISCIPLINARY TRAINING OF RESEARCHERS IN ENTREPRENEURIAL DISCOVERY**

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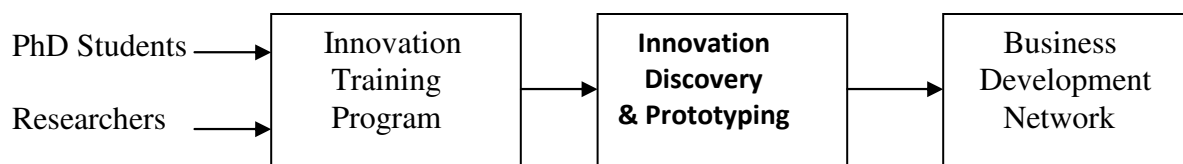
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# Cross-Disciplinary Training of Researchers in Entrepreneurial Discovery

## Introduction

The work presented in this paper are the outcomes from an NSF-sponsored Partnership for Innovations program which involved the development of a new training paradigm in an attempt to:(1) stimulate the transformation of knowledge created by the nationally-renowned research and education enterprise at the University into innovations to create new wealth, build strong local, regional, and national economies and enhance the national well-being; and (2) catalyze and enhance an enabling infrastructure necessary to foster and sustain innovation in the long-term through the training of entrepreneurially-oriented PhD engineering and physiology students as the drivers of bioengineering and new business development in the city. The intellectual merit of the program was the development of a new paradigm for creating and establishing successful entrepreneurial ventures in emerging technologies. The intellectual basis for the partnership is a model derived from a constrained, systematic search of a series of studies and experiments on repeat entrepreneurs, including interviews with 15 repeat entrepreneurs who were responsible for launching approximately 50 ventures, and retrospective evaluation of business plans. These studies showed that successful ventures were due to more than just entrepreneurial alertness, as asserted by the majority of earlier studies on entrepreneurship [1-7]. The goal of the search model is to improve the odds of aspiring entrepreneurs to discover and exploit valuable venture ideas by systematically searching in areas where they already have prior, specific knowledge. The assessment of the model will be accomplished in part by a novel, theoretically-based approach for evaluating the wealth creating potential of business plans resulting from the program. This approach has been used by researchers to successfully classify 31 out of 31 business plans according to their expected financial performance. This program was an experiment to see if the search model can improve the odds of aspiring PhD entrepreneurs to develop successful business ventures in the growing biomedical device industry.

The program consists of three integrated components incorporating the search model: (1) an Innovation Training Program for researchers and PhD level graduate bioengineering students; (2) an Innovative Research Fund to provide “discovery grants” for early stage research projects; and, (3) the Business Development Network to assist innovators with one-stop shopping for patenting, determining market feasibility, business planning, licensing, and new business start-ups (Figure 1).



**Figure 1.** Schematic on the integration of the three proposed key initiatives.

This paper will focus on the Innovation Training Program as well as present updates on the status of the entrepreneurial ventures which were facilitated by this program.

## **Innovation Training Program**

The Innovation Training Program curriculum consisted of developing a series of 'Technology Commercialization Workshops for Biomedical Engineers and Medical Researchers,' which were delivered to program participants in the second year of the project. The program consisted of eight, two hour workshops, which are defined as follows:

- Session 1: Opportunity Discovery and Exploitation
- Session 2: Technology and the commercialization process
- Session 3: Marketing and strategic positioning
- Session 4: Finance/Accounting
- Session 5: Legal planning and intellectual property strategies
- Session 6: Obtaining capital
- Session 7: Management team
- Session 8: Introductory marketing plan and sales

In the third year of the project, the bioengineering and physiology Ph.D. students and faculty participants attended a four-part workshop series called “Theory-based Decision Support for Analyzing the Wealth Creating Potential of Venture Ideas.” These workshops focused on the theory and application of the search model which forms an information-based theory of a constrained, systematic search utilizing prior, specific knowledge and often unconventional information channels. A flow diagram of the model is shown in Figure 2. The program also included training in business planning to transform innovative ideas into commercial enterprises. The business planning was augmented by a framework that describes the attributes that differentiate successful business plans from unsuccessful ones. The four critical attributes are:

- Entrepreneurial fit: does an entrepreneur’s knowledge inform him or her about a specific venture idea?
- Value: does the commercialization of a venture idea lead to increased revenue or decreased costs?
- Rarity: is the number of potential rivals for commercializing the venture fewer than the number required to create perfect competition?
- Inimitability: do potential imitators face a cost disadvantage?

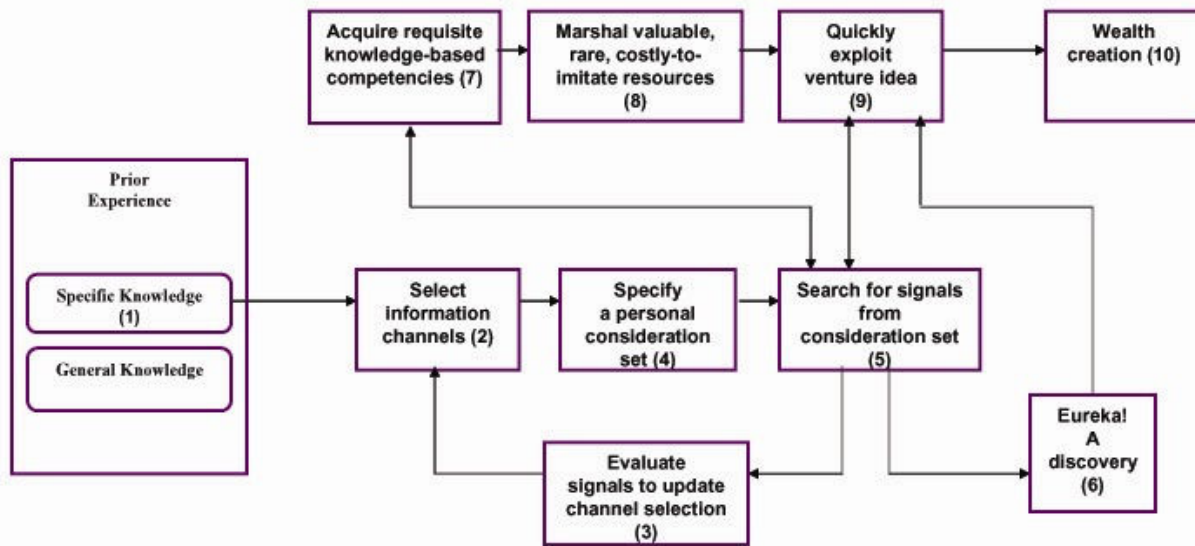


Figure 2. A prescriptive model of constrained, systematic search. The fundamental principle for this model is that entrepreneurial discovery depends on a fit between an entrepreneur's prior, specific knowledge and a particular venture idea, which may be discovered through systematic search. *Specific knowledge* (1) is the recollection of particular information about people, places, circumstances, timing and technology [1,8], which can be leveraged to identify discoveries within one's information channels. Entrepreneurs searching systematically have a greater chance of making discoveries within a consideration set, i.e. a group of information channels (2), which offer frequent low cost access to the type of signals already known to an entrepreneur. Entrepreneurs compose different, fairly unique consideration sets (4) based on their prior, specific knowledge, which enables them to identify (5) and evaluate (3) the different signals; thereby, endowing them with a specific informational advantage, leading to the discovery (6) and exploitation of the venture (9). If the entrepreneur does not have the requisite knowledge base to evaluate the signals, then they need to seek outside expertise to acquire the knowledge (7) and evaluate the inimitability of the product (8). Subsequently, with this new knowledge base, the entrepreneur can exploit the venture (9), which will lead to wealth creation (10).

### Education and Entrepreneurial Results:

The Innovation Training curriculum was delivered by eight Ph.D. students in the College of Business and Public Administration in the first year. Four engineering PhD students and nine faculty/researchers participated in the Technology Commercialization Workshops/Innovation Training program. All participants found the program to be enlightening and enjoyed the interaction and exchange of ideas between the instructors and attendees. The engineers gained better insight into the issues that need to be addressed in taking an idea from the laboratory to a commercial enterprise through examining case studies and group-interactive projects. The business instructors gained a greater appreciation for the fact that researchers from the business school think very differently from the Medical and Engineering Schools. A survey was conducted to obtain feedback and a number of suggestions were made to strengthen the program, some of which will be implemented in future series. A summary of the recommendations are:

1. Include more case studies in the workshop, group activities and interactions.
2. Partner workshop participants (i.e. engineering/medical faculty and students) with instructors/students in business school to form partnerships toward commercializing IP. For example, in the SBIR/STTR workshop, encourage engineering and business to develop a 1-pg specific aims section to then share with workshop.
3. Go more in-depth on legal planning by presenting a step-by-step approach to establishing your own business including greater details on the different avenues for securing financing for the venture.
4. Dedicate a couple of workshops on business and marketing plan development with draft business and marketing plans being an end-product of the workshop.
5. Provide a step-by-step approach on how to take an idea and make it into a product.
6. Provide the presenters with information about the participants, and their projects, via a short write-up of what projects they were involved in and projects they have worked on in the past, so the instructors could find relevant case studies from journals, or better yet take one of the examples of the participants firms and discuss that in detail.
7. Create 'glossary' of terms that participants can go through before they attend the seminar, so less time is spent on concepts and much more time on application.
8. Devote more time to opportunity recognition.
9. Have a Tech Transfer Office representative give a presentation on the university commercialization process.
10. Add guest speakers from the business world that can demonstrate how the theory works with real examples.

In the workshop series on 'Theory-Based Decision Support for Analyzing the Wealth Creating Potential of Venture Ideas,' participants were trained in how to use theory-based decision techniques to evaluate the probability for success of a proposed business venture/plan. The participants in these series of workshops consisted of seven bioengineering and one physiology Ph.D. graduate students and ten bioengineering faculty/researchers. The participants broke up into teams of 3 and were required to implement the technique to evaluate the different business plans. Five out of the 6 groups successfully predicted the outcome of the business based on the implementation of the systematic search model learned.

The majority of program participants gained a deeper appreciation of the value of Intellectual Property in the creation of entrepreneurial ventures. As a result, they were more diligent in filing IP. Specifically, the faculty/researchers participating in the program, together with several of their students, submitted a total of 28 patent disclosures; seven of which are provisional/non-provisional patents and three patents have been or are in the process of being issued. Additionally, the faculty/researchers and students co-authored ~70 product and/or medical-related papers (both peer-reviewed journal and conference papers) and participated in the formation of six new start-up companies/ventures.

## **Conclusions**

Overall, this program was a success as evidenced by a number of key accomplishments: 1) the establishment of two formal workshop series on “Technology Commercialization Workshops for Biomedical Engineers and Medical Researchers” and “Theory-Based Decision Support for

Analyzing the Wealth Creating Potential of Venture Ideas”; 2) the formation of successful partnerships with three new start-up companies which significantly contributed to strengthening their position as a company; 3) creation of six new entrepreneurial ventures by the participants in the NSF-sponsored Partnerships for Innovation program; 4) authoring of 28 new patent disclosures by both students and faculty participating in this program; 5) the program piqued an interest in two engineering students to pursue and complete a Master in Business Administration (MBA) degree; and, 6) participants in the program received national recognition for their work. A total of 34 individuals participated in this program as educators, researchers (14), and students (18) as well as state government representatives (2). This program resulted in the establishment of new biomedical device companies which are helping economic development in the region, as well as nationally.

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