Development of E-Team to Commercialize Engineering Research

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Abstract

An E-Team of biosystems engineering graduate students was formed at Michigan State University for the purpose of exploring the commercialization potential of a biosensor that can be used for rapid detection of foodborne pathogens. The paper presents the benefits and challenges the students encountered throughout the process of implementing the E-Team’s objectives. Developing and maintaining a business plan, performing a market analysis, partnering with government and industry, dealing with conflicts of interest in an educational environment, managing product development, searching for funding sources and securing intellectual property were all challenges encountered in the process. The E-Team was successful in putting together a business plan, developing a prototype and securing a small amount of start up funds through competitive grants and competitions. However, the E-Team was unable to secure the intellectual property rights. Overall, the process of commercialization was an excellent educational experience for all members of the E-Team. Although commercialization did not materialize, the learning benefits were tremendous and invaluable.

Introduction

A growing trend in engineering education has been to teach students the importance of entrepreneurship as it relates to commercializing research. Engineering research and entrepreneurial skills are essential ingredients in the commercialization of technology for its rapid deployment into the marketplace. While typical engineering skills favor a conservative, calculating, risk-averse approach to technological feasibility, entrepreneurship demands vision, optimism, risk taking and good communication skills (Whittaker, 2001). As the workplace becomes more entrepreneurial, employment demands among engineering graduates require skills other than the traditional roles of research, product development and technical education (Dooley, 1994). Universities are required to be more entrepreneurial and focused on innovation in order to adapt to the changing needs of society (Trevor, 1994; Etzkowitz, 2001). In doing so, universities
have adopted curriculums to support the development of entrepreneurial skills in engineering education (Jacoby, 2003).

One way of developing entrepreneurial skills in students is to expose them to the commercialization process. Commercialization encompasses many fields, including product development, finance, marketing, intellectual property law and management. Engineering students are uniquely positioned to make significant contributions in leading a product to the marketplace.

Such a task was given to three biosystems engineering graduate students at Michigan State University in the form of an E-Team. The E-Team, intent on commercializing a biosensor developed at MSU, worked across disciplines to set up a business plan, a market analysis, intellectual property protection and licensing, securing funding sources and developing a workable prototype biosensor. The E-Team followed the process illustrated in Figure 1, conducting project selection, team formation, market analysis, intellectual property protection, product feasibility, and business plan development. Startup funds were secured for initial product development. A summary of their experiences, including successful strategies and frustrating obstacles, is discussed.

![Figure 1. Process undertaken to commercialize research](image)

**Project Selection**

Many factors must be considered when selecting an idea for a new business venture. Among them, the idea must solve an existing problem in society or have a unique market niche that is specialized over its competitors in the marketplace. The idea should also be unique, capable of being protected by intellectual property laws and complement the existing knowledge base of the team.

The E-Team had a natural reason to select the development of a biosensor that may be used for the detection of foodborne pathogens. The students involved were all graduate students conducting research on biosensors. Furthermore, the MSU Office of Intellectual
Property (OIP) had already completed a provisional patent application protecting the technology. The selection of the biosensor was a good starting point since the E-Team was comfortable about the technology.

After project selection, business research was completed to determine if the idea was viable in the marketplace. Activities, such as conducting the market analysis, writing the business plan, licensing the technology and forming the appropriate management team all provided constant feedback in an iterative manner to transform the project into a viable business opportunity. Project selection was done in an iterative process, thus refining the project focus every step of the way.

**Team Formation**

The purpose of the E-Team was to realistically bring a product to market through the formation of a startup company. The knowledge the students gained through this experience was best accomplished by including experts in the E-Team. The students contacted two business development specialists from the Michigan Economic Development Corporation (MEDC) who were willing to take an active role in mentoring the students in all aspects of business development. These two team members were essential in gathering resources to write the business plan, develop a marketing strategy, conduct a market analysis, and negotiate with the university’s OIP. The E-Team also included their major professor as a technical consultant to add scientific legitimacy to the product.

In addition to the six founding members, the E-Team also recruited a board of directors and a scientific advisory board, for inclusion in the business plan, to guide the company in the later stages. The board of directors consisted of leaders in the food processing industry capable of providing influence and strategic direction for the company. The scientific advisory board included leading scientists specializing in food engineering and the detection of foodborne pathogens to provide guidance in product development.

**Market Analysis**

A complete market analysis was needed to prove the merits of the business idea. Market research includes many activities all of which lead to determining whether there is a large enough market for the product and whether potential customers would buy from us as opposed to the competitors. To conduct a market analysis, research must be carried out regarding the number of industry customers, the size of the market and the number of competitors. This is best accomplished through gathering data on industry statistics, reports on economic forecasting, attending trade shows and networking with industry leaders and potential customers.

All aspects of a potential startup company depend on market size, market competition and market growth. The E-Team set out to complete a “10-page” market analysis, which also served as the building block for writing the business plan. The results of the market
analysis were also used to create an industry review of the foodborne pathogen testing market, which also became a peer review publication (Alocilja and Radke, 2003).

The E-Team built the market analysis from data obtained regarding the number of pathogen tests conducted across a range of industries including food processing companies, environmental monitoring agencies, healthcare industries and the military. The food processing industry was further segmented into the type of food product (meat, dairy, fruit, vegetables, processed foods) and the target pathogen (E. coli, yeasts, molds, other pathogens) to get an idea of the market demand for the biosensor. Data was also obtained regarding the forecasted growth rates for pathogen testing in the food industry. All of the market data was put together to obtain a market size for the pathogen testing in food products. The market size, and the number of tests conducted each year per industry, formed the basis of the company’s business plan. It should be noted that although data and forecasts were subject to change, the market analysis provided both the starting point and the foundation of the business model.

The results of market analysis are summarized here but more detailed information can be found in the paper referenced above. The potential markets for pathogen detecting biosensors are segmented into the medical, military, food and environmental industries. Combined, the total market size for pathogen detecting biosensors is $563 million dollars and is growing at a compounded annual growth rate (CAGR) of 4.5%. Since the E-Team had expertise with detecting food pathogens the decision was made to concentrate on the food products testing industry. Specifically, the food pathogen testing market, which is expected to grow to $192 million and 34 million test units by 2005.

After meeting with venture capitalists and attending various entrepreneurial networking events, it was evident that venture capital firms have little interest in market sizes of less than $1 billion. The E-Team realized that a total market size of $565 million was on the low end but decided to press on for a variety of reasons. One reason is that pathogen detecting biosensors are a disruptive technology and tend to create their own markets. If a low cost and reliable product hit the market it is possible that the net number of pathogen tests would increase simply because the technology was available. Food companies would perform more frequent product testing and new segments would also open up as restaurants and consumers seek to verify the safety of the food they eat. A second reason is that there are other ways to find seed money for a new business other than venture capital. A market size of $565 million, though small by VC standards, does present a certain appeal to angel investors and government initiatives such as SBIR/STTR.

**Intellectual Property**

When starting a high technology company based on proprietary technology, protecting intellectual property is of paramount importance. Technology or specialized knowledge is best protected in the form of a US Patent (and international patents if foreign sales are anticipated). Entrepreneurs must be careful of disclosing sensitive information during networking events, product development meetings and journal publications until a patent
has been filed. Even if all precautions are taken, it is impossible to gain total protection of any proprietary technology.

In the case of the E-Team, MSU had already filed a provisional US patent application as indicated earlier. The challenge was how to license the technology from the university. This could occur in several ways from exclusive licensing to non-exclusive licensing. An exclusive license is when the company is given sole rights to the technology while a non-exclusive license gives the company the license to use the technology while retaining the university’s right to license the technology to a third party. To license the technology, the company can pay a fee to the university, issue company shares to the university, give the university a percentage of company profits or agree to a combination of arrangements. Unfortunately, the E-Team was not able to reach a licensing agreement with the university. Without intellectual property protection in the form of a university license agreement, the company could not realistically obtain serious funding from outside sources and the E-Team decided to put the company eventually on hold.

Since the E-Team's inability to license the technology is the failure point of the project, and as a consequence the lesson to be learned from this paper, the specifics of the failure will be discussed. Failure occurred for two main reasons, conflicts of interest between the founding members and failure to establish a viable business opportunity for the university. With respect to conflicts of interest, it was deemed inappropriate for graduate students funded/employed by the university to start a company based on technology licensed from said university. Also, by having the major professor (also a university employee) serve as a founding member in the venture, the students would be caught in both an academic and business relationship with their immediate supervisor.

Furthermore, the business development specialists from the MEDC (discussed in the Team Formation section) would have conflicts of interest as founding members in the company since MEDC regularly funds technology grants to the university. As for the university, capital and management constraints for the startup company presented a high degree of risk and proved not strong enough to convince the MSU IP office to grant the technology license. Indeed, there are many risks associated with licensing technology to a startup company, especially when the founding members are university employees or are responsible for administrating funding granted to the university.

**Business Plan**

A new business seeking funding must always have a business plan. The business plan is intended to provide direction of the company, forecast its progress both in the near and long term future and sell the idea to potential investors. A living document, the business plan should be updated periodically as company milestones are reached and new market information becomes available.

The E-Team completed a business plan for a company that markets and sells disposable biosensors for food pathogen detection. The 25-page business plan was a five-year outline for financing the company, developing and marketing the product, and dealing with risk. The plan included chapters on product development, market analysis,
competitive analysis, marketing strategy, sales plan, management team, growth plan, risk and countermeasures, future growth prospects, financial planning and financing the first five years of operation. Each chapter in the business plan could be the subject of a course for business students.

**Startup Funds**

Startup funds are needed to develop any idea into a viable business. Funding a new business venture can come in a variety of ways from personal savings, angel investors, loans, venture capital and government sponsored grants. For a high technology company, a substantial amount of funding is required to establish a viable business. For this reason, securing the intellectual property license, conducting a market analysis and writing the business plan must first be completed before seeking funding. Sources of funds include competitive grants and the government backed SBIR/STTR program.

The E-Team attempted to acquire funding through a variety of sources. One such source was the business plan competition geared towards nascent high technology companies in the state of Michigan called the Great Lakes Entrepreneurs Quest (GLEQ). The E-Team was awarded first place for the north region and received an amount of $10,000. This GLEQ money was a great help both in developing the strength of the business plan and providing funding for startup costs of the company. The E-Team was also successful in securing $12,750 from the National Collegiate Inventors and Innovators Alliance (NCIIA) to continue the prototype development. However, without a license agreement, from MSU, the company could not sustain its efforts of securing more startup capital.

**Product Development**

Developing the product can mean different things to different companies. Some companies not only have a product completed but it is already being sold/used by customers. These companies are seeking product development funding for increased sales and marketing efforts or increased manufacturing capacity. Other companies have completed final engineering and testing and are seeking funds to manufacture a final product and begin sales and marketing. Still other companies have only built a working prototype but need additional engineering and test before a final product can be manufactured, sold and marketed. The closer the final product is to completion the easier it is to secure product development funding. Investors prefer funds go directly into manufacturing, sales and marketing than into product engineering and test (Rich and Gumpert, 1987).

The E-Team fit somewhere between the second and third category by having a working prototype but also plans to manufacture a final product. The final manufactured product would have to be tested and reevaluated to ensure that its operation was consistent with the working prototype. Unfortunately, plans for a final product was as far as the E-Team would go in developing the product. The failure to license the technology from the university prevented the E-Team from securing the funds needed to manufacture the product and execute a successful sales and marketing plan.
Overall, the process of commercialization was an excellent educational experience for all members of the E-Team. Although commercialization did not materialize, the learning benefits were tremendous and invaluable.

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Bibliography


Biographies

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