2006-2197: DOCTORAL STUDENT CO-FOUNDERS: A CASE STUDY OF ADVANCED LASER MATERIALS, L.L.C.

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Doctoral Student Co-founders: A Case Study of Advanced Laser Materials, LLC

Abstract

In January of 2003, two University of Texas at Austin doctoral engineering students, R. S. Evans and D. L. Vanelli enrolled in a business plan course cross listed in the college of engineering. They chose a University of Texas patent-pending technology to form the basis of their business plan. A State of Texas Technology Development and Transfer grant had been awarded for further development of the technology, but required matching corporate sponsorship. During their coursework the students created a new application for the technology. They then competed in the Idea to Product® competition. During the competition, an angel investor and Entrepreneur in Residence expressed interest in the opportunity identified by the students. That summer the students and a team of angel investors further examined the opportunity, created a new company and began license negotiations with the University of Texas. The new company provided matching funds and Mr. Evans became the lead researcher on the project. From their common interest in entrepreneurship these students were able to leverage many university assets to create a company and become entrepreneurs. Their experiences during the process illustrate both the opportunities and significant challenges associated with integrating commercialization activity into doctoral education. The following year, Mr Vanelli put his doctoral work on hold to focus on his role as president, Mr. Evans, now Dr. Evans, chose to resign and complete his degree, maintaining an advisory role.

From a certain perspective, doctoral students are always entrepreneurial as they lead their own research contributions, sell their vision to their faculty committees and create new knowledge. In their careers, whether they are successful faculty members, involved in business development, work with large companies, perform research or engage in management, there will be elements of entrepreneurship. Related education and a culture of entrepreneurship within engineering education and university involvement in technology commercialization both lead to more opportunities for doctoral students in engineering to be entrepreneurial during their studies. This paper explores the experience of two doctoral engineering students who co-founded a company based, in part, on their research. The case for entrepreneurship within engineering education and the trends in university technology commercialization have been developed in the literature and provide the perspective for examining the experiences of these two students. University assets, community connections, an NCIIA E-team grant, courses and competitions were all connected in support of entrepreneurship education and startup formation. The ultimate goal with regard to entrepreneurship is to create an appropriate culture at the university level, in engineering education and in engineering practice more generally. The story of these students and their company sheds light on the current culture and provides guidance for future development of engineering education.

Entrepreneurship Assets and University Technology Commercialization

For the majority of doctoral students whose careers will be in industry, "even those who work on the bench need to understand what motivates market-driven (as opposed to curiosity-driven) research."[1] The trends within research funding organizations are also moving toward a greater

consideration of the future impact of research activity forcing those in the academy to promote their work in a broader and more application driven light. The careers of engineers often grow to incorporate managerial and strategic responsibilities which are almost impossible without an ability to consider business and legal issues and to communicate effectively to many different audiences. [1, 2, 3, 4] And, as Meier et al., suggest even those who remain squarely within a technical arena, "are being asked to take responsibility for the overall system."[5] One subject that neatly encompasses the concepts of innovation (implying new markets and new products), opportunities, creating networks, management, risk, ownership and the pursuit of value creation is entrepreneurship, despite the absence of a cohesive theory (or unified definition) in the literature.[6] There will continue to be challenges related to the creation of entrepreneurship theory and entrepreneurship education. Even so, it has already been established that, entrepreneurship belongs in engineering education.[7]

At large universities in particular, doctoral engineering students have many assets available to them to explore entrepreneurship. These include courses, competitions, technology transfer offices and business incubators. There are also many different individuals among faculty, alumni, students and business community that can become a part of a personal network. While the many university programs, such as the work of the Murchison Chair of Free Enterprise at The Univeristy of Texas at Austin, the SiTEC center at the University of Southern California or the TI:GER program at the Georgia Institute of Technology have begun to draw these assets together and facilitate the incorporation of them into doctoral education these programs are relatively recent developments. For most doctoral students and at many universities the onus is on them to be, the best word is, entrepreneurial in making entrepreneurship a part of their educational experience.

There is another perspective to consider that is intimately related to both engineering entrepreneurship and to the case study forming the central discussion of this paper. Doctoral engineering students are themselves assets. "The creation and sharing of intellectual property," through student graduation, publication, consulting and technology transfer, "is the core role of a university – the prime asset."[8] Yet, in terms of technology transfer, there is an important gap between technology that exists within a university and technology that facilitates commercial enterprise. To execute a license consummating the legal transfer of technology from university to firm, the university wants to see an organization that can create value, the licensee may need some type of rights to the technology to solicit funding to actually create an appropriate company. A license, of course does not contain all of the knowledge necessary to continue developing the technology as a significant portion may be tacit within the researchers themselves. Within the university there is understanding about the research hurdles, while the licensing firm needs to establish the development hurdles.

In this paper, the experience of two doctoral engineering students allows entrepreneurship to be explored from two important perspectives. First, we may examine the educational experience that comes from connecting a variety of university assets together where there is an emerging culture of entrepreneurship, but not a comprehensive center. Second, doctoral students can be regarded as assets themselves in terms bridging the technical and organization gap that exists between university labs and technology based ventures.

From Coursework to Competition

We may now introduce the cast. In the spring of 2002 Mr. Vanelli and Mr. Evans both enrolled in the Enterprise of Technology Graduate Course. The course is cross-listed in law, business, natural sciences and engineering and focuses on the early stages of technology commercialization, before an actual product would be detailed or a business plan would be prepared. The format of the course is described by Nichols et alia.[9] At the time both were doctoral students in engineering and both had a great interest in entrepreneurship and technology commercialization, but little experience. Vanelli was building his own doctoral studies related to university technology transfer as an electrical engineering student. Evans was creating a project related to the design and manufacture of MEMS devices. They worked on different teams and met more formally at a Technology Entrepreneurship Society meeting later in the year. Mr. Vanelli competed in the Idea to Product® UT Austin Competition (I2P) that semester, a program that is outlined below. Later in the year Vanelli and Evans became involved in the Technology Entrepreneurship Society, a graduate and undergraduate student group that organizes lectures and workshops and helps to make the I2P® competition possible.

In January of the following year Evans enrolled in New Venture Creation, a business plan course cross-listed in engineering as the only engineering student, but wanting to build a business plan around some type of technology. Vanelli was working for the Assistant VP for Research, had ties to the Office of Technology Commercialization and was able to recommend a technology. He was also encouraged by Evans to take the course on an independent study option to participate in the preparation of the business plan.

The technology they began to work on involved the fabrication of ceramic composite parts without the use of molds or special tooling. Parts were instead built using an additive, powder printing technology to create the part shape and post processing to form the final material properties. The advantage was that complex ceramic composite shapes could be made directly from CAD data without expensive molds or special tooling. A Technology Development and Transfer grant had been awarded to the inventors of the technology for further research, but it required matching funding from an interested firm, which had fallen through. The clock was ticking.

Instead of considering semiconductor fabrication equipment they created a match to a new market, metal casting dies. The market was much larger and in the US, in dire need of support to address foreign competition. Vanelli and Evans estimated that a mold for aluminum parts, a die, that typically takes 6-12 weeks to fabricate and has a market value of $25,000 to $30,000 could be made using the new technology for $5,000 in less than 2 weeks. In other words they created an interesting story.

They decided to enter the Idea to Product® UT Austin Competition. The competition deals with the stages of technology commercialization that come before the preparation of a business plan. The description of the related competitions on the I2P® website (www.ideatoproduct.org) follows. “The Idea to Product® Competitions, founded at The University of Texas at Austin, are early-stage technology commercialization plan competitions that aim for unique product ideas with clear market demand that use innovative technologies. The program is particularly interested in matching technologies resulting from a university's fundamental research programs

with potential markets." Evans and Vanelli took second place. One of the judges for the competition, Mr. Bruce Thornton became interested in helping create a venture based on the techno-market match that Evans and Vanelli created. Mr. Thornton was also serving at the time as an entrepreneur-in-residence at UT as a resource for budding entrepreneurs and those interested in technology and a conduit to the community at large.

So far we see that courses, student organizations and competitions can all be leveraged to support doctoral education and also to facilitate the commercialization of university technologies.

Building A Large-enough Team

Entrepreneurship is about networks. In the preceding discussion inventors, other faculty members, students, guest lecturers to the Enterprise of Technology course and Mr. Thornton became part of the network of people that contributed to the project. One of the awards given to Evans and Vanelli at the I2P® competition was legal services donated by a local law firm which was later used for IP development. During the late spring and summer of 2003 Mr. Thornton corralled a group of angel investor contacts while Vanelli helped to create a link to a local powder printing company. Evans and Vanelli sought the counsel of many local entrepreneurs, lawyers, faculty members and university staff to perform the appropriate technical and market-based due diligence and to help to create an appropriate vision for the new company. In addition, an NCIIA e-team grant was awarded to Evans and Vanelli which helped to fund them during their work to create a new company.

With the often significant participation of an appropriately large group of people Evans and Vanelli were able to form a new company, now called Advanced Laser Materials, LLC. They participated in the licensing of university technology to that new company which was coupled to sponsored research that ultimately matched the grant introduced above and allowed further research to continue. Vanelli and Evans co-authored new sponsored research agreements and visiting scientist agreements working with several university offices. During the development of the company and the associated due diligence research, Evans discontinued his research in MEMS design.

Coupling University Research and Commercialization

Through an eventful and educational spring and summer of 2003 Evans and Vanelli had been instrumental in creating an unusual situation. The goal of university research is a thorough, academically rigorous, understanding and the process of creating that understanding is methodical and it is intertwined with the education of graduate students and the timeframes associated with research grants and the completion of dissertations. A technology-based start-up is incredibly different. Technical understanding is necessary, but only in terms of creating a product or service in the least amount of time with the least expenditure of funds. There are also issues related to making sure that the concept of the product or service has sustainable advantages over existing and potential competition and also there will be a large enough number of enthusiastic customers to form a viable market. Universities are large bureaucratic institutions that operate with a deliberate cadence. New companies run fast and change direction faster. It should be clear that having these two types of organizations bound together by sponsored research funding and a license agreement presented some challenges for doctoral students to negotiate. Quipped Evans at a university research meeting, "We are making the

elephant dance with the mouse." Larger companies often sponsor university research. Faculty members frequently consult with companies on a variety of issues. The interconnected nature of this arrangement was more complex. A student on the board of the company providing matching grant funding that was partially paying a professor's salary was also being advised by the professor. Angel investors, faculty members and both Vanelli and Evans all had to work to address the challenges and to try to satisfy both university research and start-up company needs simultaneously.

Despite the challenges of having licensing, research and a start-up connected there were also benefits. Vanelli had wanted to try his hand leading a new company and was able to serve as president of the company. The experience also supported his doctoral work . In addition to Evans, there were four other graduate students that worked on the project at the university. Their perspective of research was expanded greatly with observation and discussion of IP, company formation and product development. The angel investors participating in the project had never dealt with university technology or graduate-level research. The lead professor admitted learning a great deal about commercialization and incorporating what he learned into subsequent proposals. Evans helped to guide the research team while also participating in company strategy, product development and even branding. The State of Texas Technology Development and Transfer Grant allowed the startup company to receive the benefits of many researchers including collaboration with several professors. For each dollar donated several dollars worth of university research was funded. In addition university materials testing and microscopy facilities were available to a company that could not afford to support their use otherwise.

Graduation and Breaking Even

As the research progressed it became clear that there were more substantial technical issues to be ironed out with the technology than originally anticipated. At the same time market research in the rapid prototyping industry identified an opportunity in the development of polymeric materials, which several of the angel investors had experience in. A second initiative was created to pursue what was thought to be an opportunity with a shorter timeframe. Eventually in the summer of 2004, the core focus of the startup shifted to the creation of materials instead of the manufacture of ceramic composite parts – a leap that is not unusual for a startup firm. The original technology was no longer a part of the business plan for the firm.

By the time the focus of the company was shifting to materials development, Evans had nearly completed the research necessary to finish his doctorate. He chose to resign from the company while retaining an advisory role that included support of technical development and intellectual property development. In May of 2005 he graduated with his doctorate and pursued a post doc in technology commercialization at UT. Vanelli by this time had already decided to put a hold on his doctoral work to continue running the company. During the second half of 2005 Advanced Laser Materials was shipping materials to customers in Europe, in the US and in Asia and was set to break even for the first time.

Conclusions

The experience of Evans and Vanelli touches several important points about engineering education and university technology commercialization. Without the courses, competitions, faculty support and dedication of the students themselves this story would not have happened.

No company would have been formed and the research would not have been completed. Instead they were able to leverage these assets to learn about marketing, intellectual property and other legal issues, management and communication to a wide variety of people. Their interest in entrepreneurship gave them the incentive to incorporate each of the elements described in the literature referenced in the introduction section above.

The gap that exists between university research and a commercially viable technology is illustrated in Figure 1 below. The typical vision of the bridge between these two types of organizations is simply the license agreement. In this case that agreement was supported by the students participating as entrepreneurs to build the connections between the university and a company. In addition, the coupling of university research with commercialization allowed a more market driven focus to be incorporated into university research. In essence the technical facilities and expertise of the university was tied to the business development prowess of the company to transition a technology from being a scientific artifact to potentially being something that can create new value.

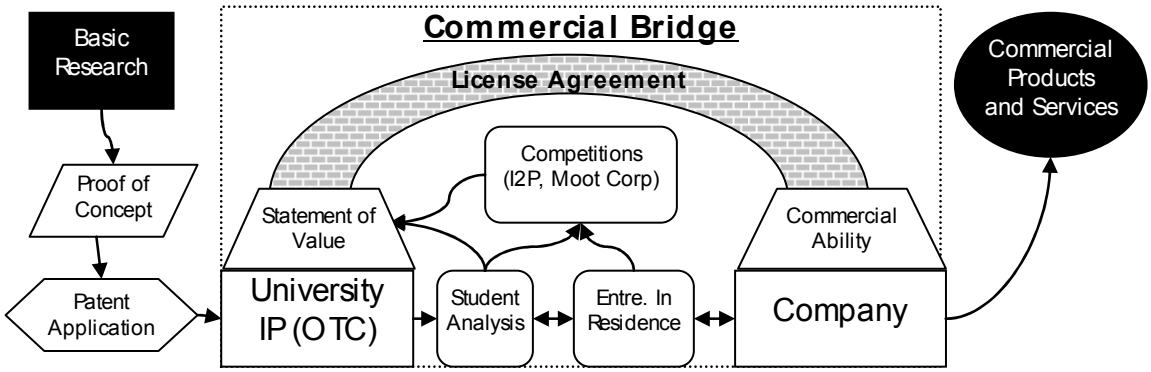

Figure 1: Student Activity Connecting Academia to Company Formation [10]

The discussion also highlights the fact that doctoral students can be thought of as university assets themselves in terms of university technology commercialization. With the support of courses, dedicated faculty members and perhaps competitions students can envision their research in a more application oriented light, without necessarily coloring the academic merit of the work itself. The process integrates topics widely regarded as missing in engineering education and also supports the growing interest among universities to facilitate the commercialization of their technology. This last is appropriate as education is mentioned before commercialization.

There may not be a need for a widespread program to have doctoral students form companies. Forming companies is not easy, it does not match well with the traditional metrics of doctoral study, and it is only when the right combination of a market and the right people converge that it is possible at all. The story above was about connecting many pieces together, which is not necessary to realize significant value. Instead each element, students, faculty, community assets, courses, student organizations, all form the culture of an institution. Perhaps this is simply a case where the value of that culture is easily measured now. When the effect span careers, that is not so easy. As is also illustrated above, there was significant risk associated with this project, both Evans and Vanelli left the projects they were working on in the spring of 2003. When Evans began working as the lead researcher he had no previous experience with powder printing or any

graduate-level instruction in materials science. Despite the great interest that was generated to facilitate the formation of a new company, research actually indicated that there was not an opportunity as close as was originally thought. All of this is a natural part of entrepreneurship and technology commercialization. There will also always be an appropriate difference in the cultures of startups and universities. Drawing them together will continue to present challenges.

In the end, the experience of the students was an incredibly valuable one. It was also valuable for the university and for the angel investors involved. Everyone learned a great deal. It is hard not to encourage other students to pursue similar ends and to encourage universities to facilitate students to learn about entrepreneurship and further, to be entrepreneurs. Issues related to the risks of entrepreneurship and to merging conflicting cultures will provide ample future work in the area.

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