

Introduction

Innovation and entrepreneurship drive the capitalist process, which in turn depends upon individuals willing to take a chance.¹ As Howard Stevenson wrote, entrepreneurs are promoters, focused on opportunity, regardless of the resources controlled.² Innovation can be an uncertain, even irrational act, where entrepreneurs endeavor to enter markets that may not exist with products that may not answer market needs, where traditional analytical tools are not likely to be useful, and where the odds of success are dim. The willingness to take a chance, to innovate and be an entrepreneur, requires two factors: “motivation, defined as market incentives to innovate; and ability, defined as the capability to obtain resources, craft them into products and services, and offer those products and services to customers.”³ Innovation over the long term demands that organizations harness individual creativity and market discipline to the resources they control.⁴ The question confronting educators in entrepreneurship programs is how to help students gain the confidence and skills to actually take a chance.

So how does a student become an innovator and entrepreneur? Is it something that can be learned and taught? Or are entrepreneurs born, and thus in some sense beyond the reach of the educational framework? Robert Hisrich has summarized the current research as follows: “Although there are personal characteristics and skills frequently present in successful entrepreneurs – such as leadership traits, creativity, opportunism, and intuition – so far no unique combination of traits, experiences, and acquired skills differentiates a successful entrepreneur from an unsuccessful one, or even from a manager.”⁵ Nonetheless, successful entrepreneurs are more likely to have had mentors at an early stage in life, more likely to have had work experience, and more likely to have had entrepreneurial experience in prior ventures.⁶ In addition, an overwhelming percentage of ideas for successful new ventures originated in prior work experience.⁷

Rather than focus on the attributes of entrepreneurs, Amar Bhidé in his book *The Origin and Evolution of New Businesses*, distinguishes five types of new ventures based on the nature of the opportunities they pursue, the degree of uncertainty they face, and the strategies they employ: marginal, promising, VC-backed, revolutionary, corporate.⁸ Marginal ventures are niche businesses where the founders “have little prospect of attaining significant size or profitability.”⁹ They are typical of small service opportunities where the business concept is not novel and the return to the proprietors is rarely more than the opportunity cost of their time. By contrast, promising ventures, while similar to marginal ones in their initial small investment and size, are marked by their entry into uncertain markets and the ability of the founders to adapt rapidly to circumstances, to persuade resource providers to take a chance on them, and to quickly generate revenue.¹⁰

Marginal and promising new ventures are likely to be the core of any educational program in the practice of entrepreneurship. While many students will always focus on personal niche businesses, the innovative activities of major research universities should also provide opportunities for *promising* new businesses. Innovation and entrepreneurship are encouraged where there are porous borders among researchers in basic and applied sciences, tech transfer offices, resource providers, and entrepreneurs.¹¹ An entrepreneurship program can take advantage of these porous borders by providing students with opportunities to explore the commercialization of new technologies, thereby gaining both managerial skills and entrepreneurial experiences, all within the mentoring, low-risk environment of a university program. These are the goals we have set for ourselves at Johns Hopkins.

Technology Commercialization and The W.P. Carey Program at Johns Hopkins

The undergraduate business program at Johns Hopkins University is the W.P. Carey Minor in Entrepreneurship and Management. The Carey Program enrolls over 800 students per semester out of a total undergraduate student population of just over 4000, making it the largest minor on campus. Per its web site, the program “offers students a diversified learning experience that emphasizes the concepts, practices, and skills necessary for effective leadership as managers and entrepreneurs in the private and public sectors.”¹² The Carey Program is now part of the Center for Leadership Education (CLE), housed within the university’s Whiting School of Engineering (WSE). The CLE offers a traditional mix of educational programs, including

1. a wide variety of business courses, many using a case approach and requiring sophisticated final projects
2. the Marshall Salant Student Investment Program, which manages a portfolio donated by an alumnus of the same name
3. an annual business plan competition
4. sponsored internships
5. support for campus business and entrepreneurship clubs

In one course, Technology Commercialization, student teams work with the technology transfer offices of the university, the Johns Hopkins School of Public Health (SPH), the Johns Hopkins Applied Physics Laboratory (APL), and the Naval Surface Warfare Center, Indian Head Division (IH). The final project for this successful collaboration requires that student teams define the technology and its applications, review applicable literature, analyze the strength of the provisional patent application (with the assistance of students from the Intellectual Property course), identify technology and market gaps, gauge the interest of potential customers and licensees, define a business model, project the potential returns to licensees, evaluate spin-off possibilities, value the technology from the perspective of its owner(s), and describe next steps. They hold extensive discussions with inventors, intellectual property attorneys, independent experts, outside investors, and potential licensees and customers.

These technology commercialization projects both take advantage of and help create porous borders. The projects support the university’s tech transfer offices by helping them sort through their portfolios of intellectual property assets and identify those technologies with commercial potential.¹³ Not only do they give students the opportunity to acquire good analytical skills and experience, but they expose them first-hand to the challenges of innovation and entrepreneurship.

In response to the high levels of motivation and excitement brought by the student teams, and in order to further enrich the educational experience, APL in the summer of 2004 developed a “Business Opportunity Program” where students who have worked on a specific APL assessment project can exercise a “no-cost option” on that same technology for up to six months in order to

1. complete due diligence
2. work with researchers to close any technology gaps
3. work with patent counsel and tech transfer managers as needed
4. establish a new venture
5. find customers and licensees
6. find investors and partners

If initial milestones are reached, a standard license agreement will be executed; and if they are not met, the technology is simply returned to APL and the students relinquish all rights. The first project for Indian Head was completed in the fall 2004 semester. Because of the enthusiastic response from students to APL’s Business Opportunity Program, the high quality of the work

submitted to IH, and a formal request by a student team to license IH technology, IH is now considering a program similar to APL's.¹⁴

The APL and IH technologies represent a source for “promising” ventures as defined by Bhidé. The key early milestone is to achieve some sort of initial success and thereby reduce the uncertainty of the new venture. Uncertainty is reduced by identifying resource providers, key stakeholders in the broadest sense, and convincing them to take a chance on the new venture. In his book *Commercializing New Technologies*, author Vijay Jolly identifies five sub-processes that build “the value of a new technology.”¹⁵ The key to moving a technology from laboratory to market is to identify the stakeholders necessary at every stage along the way and then garner their support.¹⁶ The table below summarizes Jolly’s stages, their definition, and the key stakeholders at each.¹⁷

Stage	Definition	Stakeholders
Imagining	Where the prospect for a technology is combined with potentially attractive markets	Peers, colleagues, research partners
Incubating	Where paths to commercial viability are defined	Investors, development partners, potential users
Demonstrating	Where a product is built	Potential customers, suppliers of complementary technologies, business partners
Promoting	Where customers adopt the technology	Customers, end-users, opinion leaders
Sustaining	Where the product is improved to meet market requirements	Old and new customers, business partners, management

Despite the clarity of the table, these stages do not necessarily represent a full-proof direct path for moving a technology from imagining to sustaining. Rather, they represent tasks that must be accomplished, whether sequentially, in parallel, or in some combination. Technologies could therefore die at any stage for lack of stakeholders. No matter the details of the commercialization process or model, at some point a product must be built and delivered to a paying customer where it will provide real value; and at some point money must be found, whether from these customers or from investors. The Business Opportunity Program has been designed to give student entrepreneurs the time to find the relevant initial stakeholders, and the practical experience of having to seek their support. Although the technology assessment that originally prompted a student team to exercise an “option” should have identified potential paths to commercial viability, there remains much legwork to find the initial customers and investors. Critical support for these activities will be provided by a student agency.

Student Agencies

Student agencies are profit-motivated businesses managed by undergraduate students with full bottom-line responsibility, and employing other undergraduate students. The majority of schools with student agencies are in the Ivy Leagues, with Princeton reputedly the first in 1911.¹⁸ Agencies are organized in a variety of ways depending on the school, but there are some similarities. Although in the past, most were linked to Financial Aid and Student Employment, now they are generally perceived as vehicles for developing student leaders and for providing opportunities to gain “real” business experience within the protected confines of the university.

Student managers and employees are paid, employees by the hour and managers usually receiving some combination of salary and bonus. While most individual agencies are small service ventures oriented toward the campus community, they are also self-sustaining and not subsidized in any meaningful way by the universities.

Organization and Costs

The Center for Leadership Education at Johns Hopkins University is launching its version of student agencies this year. Students are expected to organize individual agencies by submitting a formal application and business plan. Initially, these will likely include typical service businesses such as moving and storage, late night food delivery, and an on-line exchange for student furniture.

An advisory board for the student agencies is in the process of being composed, primarily of university officers from major functional areas and alumni willing to act as mentors. The board will appoint an undergraduate student as general manager over all the individual agencies to work with CLE supervisory staff. Any student wishing to start an agency, or take over an existing one, must submit a business plan to the board describing the product/service, market, competition, operations, startup costs, plans for growth, and any university hurdles or restrictions. New agencies must be approved by the general manager and the advisory board. Upon approval, the student submitting the plan will become the manager of the specific agency. The immediate goal is to select agencies that have low startup costs and are likely to be profitable quickly. Although the CLE will absorb all initial costs, for both overall infrastructure and the first agencies, it is fully expected that the agencies will operate profitably soon after inception and that part of any surplus will be used to fund the establishment of future agencies.

Technology Commercialization Student Agency

In addition to typical service agencies, the CLE is planning one to do technology assessment projects. A technology commercialization student agency will have two goals:

1. to organize teams to work on technology assessment projects for tech transfer offices and for outside companies
2. to provide a framework where students who exercise a Business Opportunity option can start their efforts

The undergraduate manager of this student agency will be a senior who is enrolled in the Carey Minor, has completed the technology commercialization course, and spent the summer after the junior year working as an intern at Foresight Science and Technology, Inc. (Foresight),¹⁹ a company specializing in tech commercialization (and where several former Johns Hopkins University students are currently employed), or at the tech transfer office at APL.

To accomplish the first goal of working on technology assessments, the CLE and Foresight have developed a cooperative arrangement. The student agency manager will be responsible for forming teams to work on projects recruited from the tech transfer offices of the university, federal labs, and outside companies. Although direct management of the teams will be the responsibility of the student agency, the final work-product will be reviewed by the project managers at Foresight. Because these projects are not classroom assignments, the determination of success and failure will occur in the marketplace. There will be no grade, only the critical response of the customer. Such projects, for which student employees will be paid modest sums, enhance the overall learning experience and, we believe, will distinguish them among candidates seeking employment in companies at the nexus of technology and business.

To accomplish the second goal, the agency will support those students participating in the Business Opportunity Program with resources such as office space, telephones, voice mail, bookkeeping, general business advice from alumni mentors, and assistance from CLE faculty and staff. Given the fairly low probability of success for any student-launched venture, the agency framework is designed to help the venture gain a little traction and then “graduate” into a local incubator. Through the end of the 2004 fall semester (the first full semester in which the Business Opportunity Program was in place), two student teams have prepared requests to exercise an option.

The early objective of the teams will be to reduce the uncertainty of their ventures by convincing key stakeholders to take a chance on them, whether by securing revenue from a first customer or licensee, or by obtaining a small amount of equity funding from an outside investor, governmental development agency, or business plan competition. Achieving a first success will provide a platform from which to attain later ones. The close relationship with the APL tech transfer office is critical here, for as Amar Bhide observed, “promising” new ventures must adapt rapidly to opportunities and to changing circumstances. Student entrepreneurs will act as the conduit between the market opportunities they find and the scientists and engineers developing the technologies.

Conclusion

It needs to be stated clearly that classroom projects in technology assessment and business opportunity programs for undergrads will not solve any university’s tech transfer problems. The goal here is education, specifically education for innovation and entrepreneurship in the broadest sense of the terms. It is also clear that no matter how extensive the classroom training, how complex the business cases addressed, and how sophisticated the projects undertaken, they are still not real. They lack the urgency of actual business because they do not confront actual customers, employees, and investors. In fact, the gap between any classroom and actual business is enormous, and it is questionable whether it can ever be closed. Even when technology assessment projects deal with real technologies and real inventors, they are still, in essence, case studies. Student teams may be able to envision numerous applications for a technology and compile long lists of potential licensees, but there is still a long way to go before a technology is successfully adapted to an application, a tech transfer office negotiates an agreement, a new venture is formed, or an inventor sees any money.

Therefore we have decided to move beyond the classroom. To better prepare students for innovation and entrepreneurship, we have created opportunities for them to acquire actual business experience. We believe that the keys to entrepreneurial success in technology related fields are

1. knowledge of sound business fundamentals
2. porous borders and expanding networks of relationships with inventors and potential stakeholders
3. practice, whether in the framework of student agencies or a business opportunity program
4. mentors, whether through the university or an incubator

Building a robust company from a student run venture would be a happy event and would bring lots of press and recognition to our program, but that is not the expectation. Rather, we believe that the opportunities brought by the W.P. Carey Minor, its student agencies, and the Business Opportunity Program will lead to successful new ventures later, after students have left the university and entered the working world. What we do expect is that students learn not only how

to analyze information, but how to find, organize, and synthesize it into a meaningful course of action. We expect them to learn how to build relationships with employees, customers, inventors, and investors. We expect that in the process of trying to commercialize a technology, students will learn how to find stakeholders and how to balance their competing claims. We further believe that these are the skills that employers are looking for in graduates, and that these are the skills that will enable would-be entrepreneurs to found and build successful new ventures in the future. It is generally accepted that there can be no innovation and entrepreneurship without the prospect of failure. This is the fundamental opportunity that we are trying to give our students, the chance to fail without consequence, and learn the lessons thereof.

We believe that there are lessons from our experience for other schools. To build entrepreneurship and technology commercialization programs for undergraduate students where there is no school of business is a slow process of assembling contacts and building support:

1. Build personal relationships with individual tech transfer officers with the goal of persuading them to share projects
2. Find faculty inventors willing to work with students
3. Supervise student projects closely to ensure high quality
4. Showcase end of semester presentations
5. Place students in internships at tech transfer offices and companies such as Foresight
6. For student agencies, obtain the support (or at least the benign neglect) of university personnel in career counseling, student life, student employment, legal, accounting, purchasing, risk management
7. Invite members of the local business community to become involved as mentors or advisory board members
8. Strengthen relationships with area incubators
9. Show some success wherever you can, for example from increased student participation in entrepreneurial programs, by winning business plan competitions, or by persuading a tech transfer officer to follow up with potential licensees identified by the students and then attest to the fact
10. Keep the Dean informed – you do not want him/her reading about these activities in the newspaper

Networks and porous borders are the ideal conditions for encouraging innovation and entrepreneurship. The Center for Leadership Education at Johns Hopkins University is endeavoring to create these conditions to the extent possible, so that undergraduate students can take advantage of them while still in a supportive environment, and thus gain the knowledge and experience necessary over the long term to establish promising new ventures.

¹ Louis Galambos, Professor of History, Johns Hopkins University, in conversation with the author, November 18, 2004.

² Howard H. Stevenson, "A Perspective on Entrepreneurship," in *New Business Ventures and the Entrepreneur*, 5th ed. Edited by Howard H. Stevenson, Michael J. Roberts, H. Irving Grousbeck, and Amar V. Bhide. New York: Irwin McGraw-Hill, 1999.

³ Clayton M. Christensen, Scott D. Anthony, and Erik A. Roth, *Seeing What's Next* (Boston: Harvard Business School Press, 2004), p.21.

⁴ Louis Galambos, Professor of History, Johns Hopkins University, in conversation with the author, November 18, 2004.

⁵ Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, *Entrepreneurship* (New York: McGraw-Hill Irwin, 2005), p. 75.

⁶ Ibid. pp. 64-67.

⁷ See for example Kathleen R. Allen, *Launching New Ventures* (New York: Houghton Mifflin Company, 2003) and the description of the Inc. 500 in *Inc. Magazine*, Fall 2003 issue.

⁸ Amar Bhidé, *The Origin and Evolution of New Businesses* (New York: Oxford University Press, 2000).

⁹ Ibid. p. 25.

¹⁰ Ibid. p. 31.

¹¹ Louis Galambos, Professor of History, Johns Hopkins University, in conversation with the author, November 18, 2004. See also David C. Mowery, "The Boundaries of the U.S. Firm in R&D," in *Coordination and Information*, ed. Naomi R. Lamoreaux and Daniel M.G. Raff (Chicago: The University of Chicago Press, 1995).

¹² <http://www.mts.jhu.edu/busminor/>

¹³ Lani Hummel, Director of Industrial Relations for the Whiting School of Engineering, in conversation with the author, December 15, 2004.

¹⁴ J. Scott Deiter, Technology Transfer Office, Naval Surface Warfare Center, Indian Head Division, in conversation with the author, December 20, 2004.

¹⁵ Vijay Jolly, *Commercializing New Technologies* (Boston: Harvard Business School Press, 1997), p. 4.

¹⁶ Ibid.

¹⁷ Ibid., p. 18.

¹⁸ <http://mstack.onlyic.org/agencies/history.php>

¹⁹ For more about Foresight, see their website at <http://www.seeport.com/>