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The Idea to Product® Program: An Educational Model Uniting Emerging Technologies, Student Leadership and Societal Applications*

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Universities are increasingly including technology entrepreneurship in engineering education. This follows the increased expansion of the subject of engineering design education in recent decades. The literature describes important justifications for incorporating entrepreneurship education into engineering curricula, and faculty have developed courses and activities to support this approach. The Idea to Product® Competition (I2P®) is an interesting artifact of these developments, and the efforts of students, faculty members and members of the entrepreneurial community at large and the assessment of the program indicate that it is an effective educational program. I2P® represents an extra-curricular program that supplements and draws from the curriculum and traditional coursework. Led in part by student groups, the I2P® program has developed into a component of a larger culture of innovation and technology entrepreneurship at many universities. Drawing from the literature and ABET guidelines for engineering programs, the authors establish a framework for supporting engineering entrepreneurship. That framework establishes a foundation for a discussion about the program and an integrated program assessment project. The final section of the paper provides general conclusions about the program as an educational program and as part of an entrepreneurial culture, followed by an outline for future work.

Keywords: Idea to Product; I2P; international; entrepreneurship; technology commercialization; innovation.

INTRODUCTION

'The Idea to Product® Competitions, founded at The University of Texas at Austin, are early-stage technology commercialization 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.' (lead paragraph from the I2P® program website—www.ideatoproduct.org)

I2P® FOCUSES ON education and encourages student teams to create a match between a technology and a societal (or market) need. I2P® is not a business plan competition. Teams must demonstrate a market and economic sustainability, but the size of the market and the total value of the opportunity are not a part of the competition judging criteria. Another distinction between I2P® and business plan competitions is that the I2P® program allows engineering and other technical students with no previous experience with the technology commercialization process to be competitive. In the words of a recent engineering student participant, 'the competition allowed us to create a real product concept matched to real market needs from what was just an idea and a technology when we started.' This is an especially important distinction, considering the growing prevalence of technology-based entries in business plan competitions. 'During the past few years, [entrepreneur] competitions have begun to tap a new source of ideas—patents in university technology-transfer offices, often gathering dust. At the same time, more [doctoral] students and researchers have begun participating, to develop their business ideas and pick up key contacts in the venture funding world'[5].

A look at several recent winners of the Moot Corp® Competition certainly verifies this trend. The winner of the 2002 Global Moot Corp® Competition, Private Concepts, created a business plan for a new laser-based method for cervical cancer detection. The 2004 winner of the local UT competition, Bigfoot Networks, was working with a computer card upgrade for online gaming, and the 2004 global competition winner from Carnegie Mellon, EANeedle, created a plan around an ultrasonic cancer detection technology. However, these technologies and the research that spawned them are extremely application oriented; they are inherently matched with a needy customer. It is also important to consider that the technologies themselves were highly developed, some the result of decades of research and near commercial application when students began their

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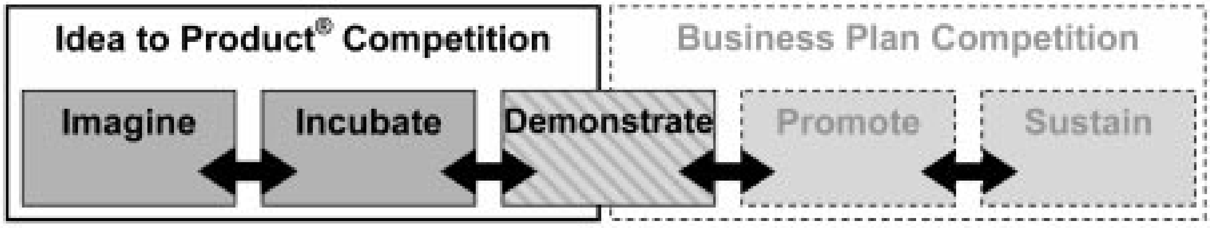

Fig. 1. The Idea to Product® Competition and the Jolly model of technology commercialization.

work to create business plans. The majority of university research, and perhaps emerging technologies in general, is not associated with a particular product or service, and that is a good thing. As Powers [6] argues, there is evidence that basic research 'may even have a greater likelihood for commercialization than applied R&D.' While business plan competitions have begun to be excellent resources for a much broader population of students, for most technologies and for most technical students, making the jump from the lab to a business plan is simply not feasible.

The products and services developed for I2P® are typically not ready for market introduction and are at too early a stage for the detail of information necessary to create a business plan. Fig. 1 illustrates where the competition format fits with the commercialization process model proposed by Jolly [7]. I2P® provides the opportunity for the analysis and technology screening that are required before a formal business plan can be prepared; this early-stage diligence increases the probability of success of new technology products and avoids effort where little opportunity is realizable. Basically, the process supported by the competition allows student teams to examine whether and in what general direction a full business plan might be subsequently prepared. In this way, I2P® is simultaneously an integral part of technology commercialization and an education program about that process of engineering product development and design. It has served as a bridge to business plan competitions and to venture creation.

ENGINEERING AND ENTREPRENEURSHIP

> 'Technological entrepreneurship [exists] at the boundary of academia and practice' [3].

Does entrepreneurship have a place in engineering education? What training and education should engineering students receive? Discussions on this topic have addressed defining engineering itself. Nicolai [8] argues that the most critical desire for engineering graduates is the identification and definition of a problem, development and evaluation of solutions and finally the solution to that problem. Accordingly, engineers create knowledge about both problems and appropriate solutions. There is little debate that 'engineering educators create technical persons.' Steiner [9] argues, however, that, 'innovators[1] . . . are not in the knowledge-making business . . . they are in the money-making business . . . and the money to be made must be made in the public world.' The word 'value' or, with fewer economic implications, the words 'positive change' could be substituted for 'money' in the previous statement and both would be valid. While new knowledge might be needed to create value or positive change, it will be created in society at large.

Academic research, seminars and conferences, cultural shifts within universities and later policy changes reflected in revised ABET requirements all accompanied the re-emergence of design in engineering curricula in recent decades [10]. As universities have integrated entrepreneurship into engineering education during the past decade [1–4], similar academic research and cultural shifts have occurred. The subject of entrepreneurship, however, involves both emerging technology and, ultimately, society at large. It is also important to mention that the concept of 'engineering entrepreneurship', defined below, is easily extended to other scientific fields which also feature technical problem-solvers. By becoming more entrepreneurial, a technical problem-solver becomes a leader of technological change, with implied responsibility for that change.

The following paragraphs develop two central themes. The first is building a general set of guidelines for technology entrepreneurship education for engineers. The second provides insight into the development of the academic culture at UT specifically. Those guidelines consist of three parts: characteristics of engineers, challenges for entrepreneurship programs and central tasks for building entrepreneurship programs. Engineering professors and administrators at UT prepared a series of three key papers—one defining the relationship between engineering and society, the second describing the integration of professional responsibility into design curriculum, the third arguing that entrepreneurship is a part of engineering education—which provide the outline for the following discussion. Several key elements of engineers, challenges and guidelines

[1] The context associated with the term 'innovators' in this citation is limited in some respects to commercial innovation, yet the point is easily generalized. If a practicing engineer is to make some type of positive impact, it will be in the public world.

for entrepreneurship programs form the framework introduced above.

Engineering and society (first paper and related literature)

'The practice of engineering does not exist outside the domain of societal interests' [11].

One of the central arguments developed by Nichols and Weldon [11] is that engineers have a professional responsibility to society. Engineers derive their tasks from the needs of society, and the products, processes and services created by engineers in turn shape society. Meier *et al.* [12] add that technical workers are no longer confined to specific roles but instead 'are being asked to take responsibility for the overall system.' They also list strategic and system thinking, customer contact and orientation and adaptation as central features of successful engineers. As an even broader example, successful technical entrepreneurs must cultivate 'empathy for others' feelings, a desire to influence others' behavior, an ability to delegate and interact . . . and continually read and respond to a broad and complex social context' [9]. Steiner also argues that preparing engineers for the 'realities of the marketplace' requires 'developing in them the characteristics of innovators' instead of relying on disciplinary representations of the world lacking 'the practical complexity . . . of the public world.' Ertas *et al.* [13] use similar language to define a transdisciplinary approach to engineering education: 'looking across the disciplines to find the knowledge and wisdom [engineers need] to succeed.' They also mention the need for education programs to cultivate future leaders. As a final characteristic for Table 1, literature often includes communication as a set of critical skills for engineers. Making connections across disciplines, and any innovation that arises out of teamwork, both require each individual to focus that set of skills in a particular way to develop and maintain networks with other individuals.

Engineering design (second paper and related literature)

'Design is a political act . . . we must be aware of our power' [14].

The next paper in the series [15] describes engineering professional responsibility and the inherent connection to society at large as natural parts of engineering design. The ABET criteria included in this paper suggest both a focus on real-world engineering practice and societal impact as constraints. These concepts are echoed by Coates [16] in his discussion about innovation in engineering education and his argument that the incorporation of a social context into engineering design generates substantial societal benefits. Further, companies often report proficiency with the entire design process as the primary desire for new engineering employees [8, 17].

Table 1. Core characteristics of engineers

- Discipline-Specific Technical Abilities
- Proficiency with the Engineering Method
- Broad Societal Responsibility (Includes Market Orientation)
- Organizational Responsibility (Leadership)
- Strategic Thinking (Broad Timescale)
- Management of Complexity (Across Many Disciplines)
- Rapid Adaptation (Ability to Change Roles/ Expertise)
- Personal Network Development

Societal responsibility, organizational responsibility and complexity are clearly a part of engineering design, but leadership, strategic thinking and the management of complexity are more challenging to support. More importantly, as Ertas *et al.* [13] argue, 'most engineering degree programs focus on solving today's problems with today's technologies.' Similarly, the authors observe that design methodologies in general do not easily support the incorporation of new technologies. In short, universities have made great strides in engineering design education, but the characteristics of engineers listed above are not supported by improvements in design curricula alone. Looking at engineering design, we can identify two related elements for the education of engineers: the use of open-ended, real-world examples to allow students to experience being a practicing engineer, and industrial involvement in engineering education.

Engineering entrepreneurship (third paper and related literature)

'In today's economy, entrepreneurial activity is primarily responsible for job creation and economic growth' [18].

In the third paper of the series, Nichols and Armstrong [10] define the term 'engineering entrepreneur' as 'one who organizes, manages and assumes the risk of an engineering (or technology) business or enterprise.' That definition fits well with careers of engineers that demand integration of leadership, strategic thinking and the management of complexity, tasks that span a variety of academic disciplines. Furthermore, they point out that entrepreneurship programming has an inherent motivation for students. The consideration of entrepreneurship in conjunction with engineering allows students to develop a vision of themselves as leaders and supports the motivation to learn on their own and to adapt to changing situations. Entrepreneurship provides a vehicle for integrating the concept of lifelong learning into engineering curricula. Meier *et al.* [12] emphasize that students must be motivated to seek opportunity, and thought must be given to appropriate incentives for students. To date, entrepreneurship programs for engineering students have had very positive results. Ohland *et al.* [18] report that entrepreneurship programs, especially those that involve undergraduate students, increased both retention rates and GPA. These types of programs offer broader benefits as well: 'Participation in industrial outreach results in positive outcomes for both companies and the mission of the university' [19].

The integration of entrepreneurship into engineering education poses several challenges as well. Meier *et al.* [12] note that '[engineering] faculty members have a difficult time integrating non-technical/engineering concepts into their course materials and student experiences.' Meier *et al.* also mention that educational development does not typically venture far from the scope of accreditation standards. There is an almost unanimous understanding among engineering educators that there is 'a lack of space or time for elective credits in most engineering degree programs' [3]. Making emerging technologies a part of the engineering education process leads to concerns for university technology commercialization in general. As Washburn [20] and others argue, in some instances commercial interests have limited the free exchange of ideas and information. This in turn undermines the purely academic motivation behind academic knowledge and focuses on possible short-term profit rather than the traditional longer-term missions of the university. Further, notable examples from drug research and nanomaterials illustrate that the patenting of early-stage technology—or, as some critics regard it, 'fencing the knowledge commons'—can be a 'process of industry eating the seed corn for a new field' [21]. The point is that entrepreneurship immediately touches many levels of the university and society at large. Wright *et al.* [4] suggest that 'a key policy issue concerns the need to reconcile the objectives of the different levels involved in the broad domain of entrepreneurship.' Wright *et al.* argue further that the development of an appropriate academic culture is central to establishing that alignment, a sentiment echoed widely in the literature: 'The degree of success [of a technology transfer program] depends not only on the nature of the interface between the university and the business community but also on the receptivity in the surrounding community as well as the culture, organization, and incentives within the universities themselves' [1]. Finally, as Wright *et al.* [4] mention, each university culture should be tuned to its own local context. Building on the above discussion, the main challenges are listed in Table 2.

Table 2. Challenges for entrepreneurship in engineering education

- Developing a supporting culture (broad university and community alignment)
- Managing commercialization pitfalls (corporate versus educational goals)
- Degree program barriers (lack of space/credit for new courses)
- Accreditation barriers (limiting educational scope)
- Developing broader faculty expertise

Keys to continuing program development

'The culture in universities is changing. . . . There is greater acceptance of entrepreneurship' [4].

Development of an education program to support engineering entrepreneurship should consider the list of engineer characteristics listed above and should also consider the challenges described in the previous section. Standish-Kuon and Rice [3] describe '5 categories of actions that define entrepreneurship education in general.' These categories make up the first five bullets of Table 3. The final three bullets draw from literature cited above. The final one in particular refers to the educational task that is central to the development of an appropriate entrepreneurial culture.

BUILDING THE IDEA TO PRODUCT® PROGRAM

'There are entrepreneurial universities, rather than isolated entrepreneurial academics.' [4]

The I2P® program began, in part, as a grassroots student-driven effort to address what they saw as a gap in their engineering education. In 2000, a small group of engineering students founded the Technology Entrepreneurship Society (TES). In the spring of 2001, a core group of computer science and engineering students from TES organized the first Idea to Product® UT Austin Competition. UT had developed entrepreneurship programs across several departments, but it was students who planted the first seeds for the competition. The 10 teams who participated in that first competition began with technical ideas of their own. With some direction from mentors, faculty and external collaborators they created 'new understanding' about the commercial potential of their technologies. Each student team presented their concepts to a panel of local entrepreneurs, business leaders and faculty members. Through this first-hand experience, students learned concepts beyond their respective disciplines and related to the creation of societal impact from an emerging technology.

From student initiative and university culture

While the current I2P® program is itself a means of connecting the assets of several university

Table 3. Entrepreneurship program development guidelines

- From Standish-Kuon and Rice, 2002
- Develop intellectual content
  - Institutional acceptance (curricular, structural, fiscal)
  - Engaging students and alumni
  - Relationship with the business community
  - Showcasing success
- From other cited literature
  - Tailor program to local characteristics
  - Incorporate real-world examples
  - Education for students, faculty and members of the community

communities, it is important to consider the environment at the University of Texas at Austin that helped to incubate the competition during its early development. The IC^2 Institute, called a 'think and do tank', serves as a link between the UT and the greater global community. Two other affiliated programs are also relevant to the present discussion. The Austin Technology Incubator (ATI) is a resource for local entrepreneurs, and the Master of Science in Science and Technology Commercialization (MSSTC) offered by the IC^2 Institute is a rare if not unique degree program focused on emerging technology commercialization. One of the developments of the MSSTC program is a 'quicklook' analysis for emerging technologies which connects a technology to a promising market through both primary and secondary research and often results in the creation of new applications for new technologies. More information about IC^2, ATI and MSSTC may be found on the web at www.IC2.org. For more than 20 years, the McCombs School of Business at UT has hosted both local and global Moot Corp® (www.mootcorp.org) competitions. The competitions have been an asset in the preparation of entrepreneurs at UT and at other participating institutions. The Clint W. Murchison Sr. Chair of Free Enterprise at UT (www.engr.utexas.edu/cofe), based in the College of Engineering, has a mission 'to create and nurture a culture of technology innovation, creativity, leadership and enterprise at the University of Texas at Austin and the global community that we serve.'

In the same vein of experience-based technology commercialization education that is now central to I2P®, the College of Engineering, the College of Natural Sciences and the McCombs School of Business at UT Austin introduced a course entitled The Enterprise of Technology in spring 2001. Nichols *et al.* [2] provide a description of the course which has been another vehicle for promoting and examining multi-disciplinary education in technology entrepreneurship, as it is listed in four colleges (engineering, business, natural sciences, and law). The layout of the course provides an opportunity for students to work with student colleagues who have significantly different academic backgrounds (and perspectives) than themselves. It focuses on activities involved in the development and commercialization of technology with an emphasis in commercializing technology from university laboratories. Frequent guest speakers bring broad perspectives and experiences and also maintain close ties between the course and the community at large. The broad range of materials and resources within the course facilitate each team to create a commercialization assessment for a technology, including a basic plan for moving forward.

A walk through the I2P® UT Austin

The two-day competition is supported by a semester-long program of seminars, mentorship and other events that support the generation of initial ideas through to refining the descriptions of well-defined opportunities. The following paragraphs provide a chronological outline of the program's events.

1) Competition promotion and idea generation: TES members continue to be the primary organizers of the I2P® UT Austin Competition, and its associated events and seminars, with support from the staff of the Chair of Free Enterprise. TES begins recruiting for I2P® participation in the fall semester preceding the spring competition. The fall meetings, which feature entrepreneur and technology speakers, are publicized across UT and are aimed at any student interested in technology entrepreneurship. Early in the spring semester, the TES meetings are more focused on arousing interest in and explaining the procedures for competing in I2P®. Speakers on such topics as conducting market research are also invited to the early spring meetings.

The technology ideas presented by teams in the I2P® Competition are generally based on graduate research of team members or other university-developed technologies. In the latter case, the students may select from unlicensed UT patents. The OTC has created a website for students to facilitate this process. The teams' assessments of the technologies add value for the OTC, sometimes revealing applications or markets that neither the OTC nor the inventor had imagined. While this might lead to technology licenses, this is not the most valuable outcome. Offering these idea sources provides a creative springboard for students who wish to participate in I2P® but do not have an original technology, thus allowing for broader participation. Early in the spring semester, a representative from the OTC speaks at a TES weekly meeting to promote and facilitate the use of OTC technologies as foundations for I2P® entries. Student teams are encouraged to examine the functions provided by a technology and the functions needed by a market. The teams then map the common functions into an appropriate product or service concept.

2) Initial project summary: At approximately the midpoint of the spring semester, the teams submit a one-page description of their idea. In this write-up, the teams must describe the product and its underlying technology; explain how it is innovative and unique; describe the target customer group and provide a general market size; explain the need that the product fulfills in the market; and provide a basic overview of any intellectual property (IP) protection. TES holds a review session shortly before the submission deadline to offer feedback to the teams on their entries. A panel of judges, consisting primarily of UT faculty familiar with the competition, selects the semifinalists from among the submissions. The most promising applicants are chosen based on identification and communication of market need, market opportunity, and the uniqueness and innovativeness of the product and the underlying technology. Depending on the number and quality of the submissions, 15–18 semifinalists are typically selected.

3) Mentorship and further development: After the semifinalist teams are announced, TES holds additional seminars to help the teams refine their final entries. For instance, an IP attorney from a local firm may be invited to speak, or a presentation-skills seminar may be held. To supplement the business and presentation experience of the teams, TES matches each semifinalist team with one or more mentors. Mentors are drawn from current students and alumni of IC^2's MSSTC degree program, MBA students, the Chair of Free Enterprise Entrepreneurs in Residence Program, and other friends and supporters of the I2P® program. Mentors are matched with an appropriate student team based on their experience, domain of knowledge, and interest. Workshops with guest lectures on other entrepreneurship topics are also offered during this time.

4) The project summary and practice presentation: The week prior to the competition, semifinalist teams submit a technology summary that expands on the information in the initial one-page submission. This summary is not considered in the judging, but it is provided to them to help the judges prepare for the presentations. The summary is also a valuable exercise for the teams, as it contains the major points that should be included in the presentation. Shortly before the competition, teams are required to present to a panel of faculty and I2P® organizers. This is an opportunity to gain helpful feedback on presentation style, format, and content. The practice presentations are a fundamental educational element of the competition that has been shown to result in significant improvements in participants' presentations.

5) The competition: The semifinal and final rounds of the competition are typically held on two consecutive days (Friday and Saturday) near the end of the spring semester, with the top finishers of the semifinal rounds on Friday advancing to the Saturday finals. For the competitions, each team prepares a ten-minute presentation addressing many of the topics found in a 'quicklook' assessment, including the current state of the technology and the feasibility of developing it for the suggested application, potential market barriers, competitive advantage, and whether there is a window of opportunity in the market for the success of the idea. The teams field 10–15 minutes of questions from the entrepreneurs, venture capitalists, engineers, and intellectual property attorneys assembled for the judging panels. In the finals, cash prizes are awarded, and one team is selected to represent UT at the I2P® International Competition.

EXPANDING THE REACH OF I2P®

Since its founding, over 400 UT students have participated in the competition. The early development of the program within the College of Engineering was quickly met with champions across campus while retaining some emphasis toward the support of technical students. Similarly, the TES leadership and the competition itself have evolved to include both undergraduate and graduate students from across the campus. Teams in the 2003–2004 competitions featured students from five colleges and 13 different departments. More importantly, the competition has evolved into a powerful educational program for students, faculty and members of the larger community. It has helped to promote an evolving culture of technology commercialization, innovation and creativity at the University of Texas at Austin.

Based on the success of the UT competition, the program has expanded to include international competitions. The first I2P® International Competition was initiated in 2003 and has developed into an annual event hosted each year by UT that includes universities from Europe, Asia and North America. The participants for the 2005

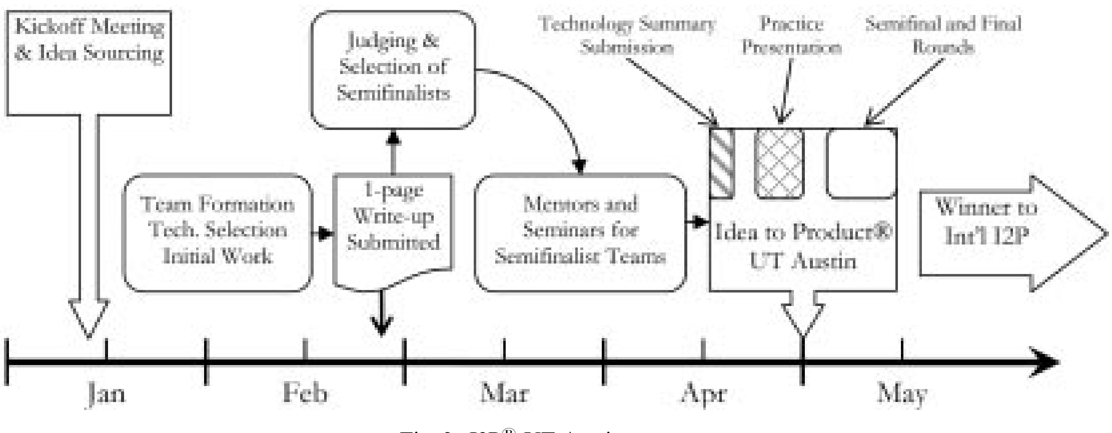

Fig. 2. I2P® UT Austin program.

Table 4. Idea to Product® international participants, 2005

• Georgia Tech	• Stanford University
• Emory School of Law	• Texas A&M University
• Imperial College, London	• Trinity College, Dublin
• Keio University	• Tsinghua University
• National University of Singapore	• University of Georgia
• Penn State University	• University of New Hampshire
• Purdue University	• University of Texas at Austin
• RWTH—Aachen	

competition are listed in the table below. This evolution of the program validates the need for educational support of emerging technology commercialization as well as the portability of the program concept. It also serves to underline that the elements of engineering entrepreneurship education supported by the program are common to academic institutions around the world. What remains to be seen is the development of synergy across campuses; in other words, it is possible that the I2P® program will facilitate leveraging the assets of one community in the commercialization effort of a technology from another.

Each participating university chooses its representative team through a local entrepreneurial competition or course. UT maintains trademark ownership of the Idea to Product® name but is open to local variations on the model that will continue to happen at these universities. For instance, the Engineering Projects in Community Service (EPICS) program at Purdue University provided teams to the international event for each of the first three years of the competition. The EPICS program also highlights an important effect of not considering market or opportunity size in the competition; socially driven entries can compete. The I2P® program model has also been adopted on a regional level in Asia, where the National University of Singapore hosted twelve teams at I2P® Asia in September 2005; similarly, Imperial College London will host the first I2P® Europe in summer 2006. The evolution of the program is shown in Fig. 3. The adoption of the program by several different universities in different regions of the world is one measure of the success of the program. As of the time of writing, discussions have begun related to the formation of several national competitions and also, further in the future, the possibility of discipline-specific and undergraduate-only programs.

EVALUATION AND ASSESSMENT

The Idea to Product® program has supported the integration of entrepreneurship into the engineering education experience through students' hands-on participation in the technology commercialization process. At the same time, the program is allied with and involves students and faculty from colleges across UT, providing an excellent opportunity for additional multidisciplinary collaboration. The network that provides judges, mentors, and speakers for the program is also the same network that is required for technology transfer, and this spurs the creation of companies based on I2P® projects. All of these players—students, faculty, and the community at large—are educated about the process in the iterative exchange of ideas that is played out through the competition and larger program. Further, the multi-university, international reach of the competition demonstrates the portability of the I2P® model to institutions with different research specialties and regions with varied technology concentrations. Briefly, the program resonates well with the characteristics of engineers and guidelines for entrepreneurial education outlined in the first section of the paper while also addressing the challenges presented in the same section. This is a step in the right direction, but seeing a match between features of the program and the framework outlined in the opening section of the paper is neither enough to fully understand its impact nor to provide complete guidance in developing it further. To do this it is important

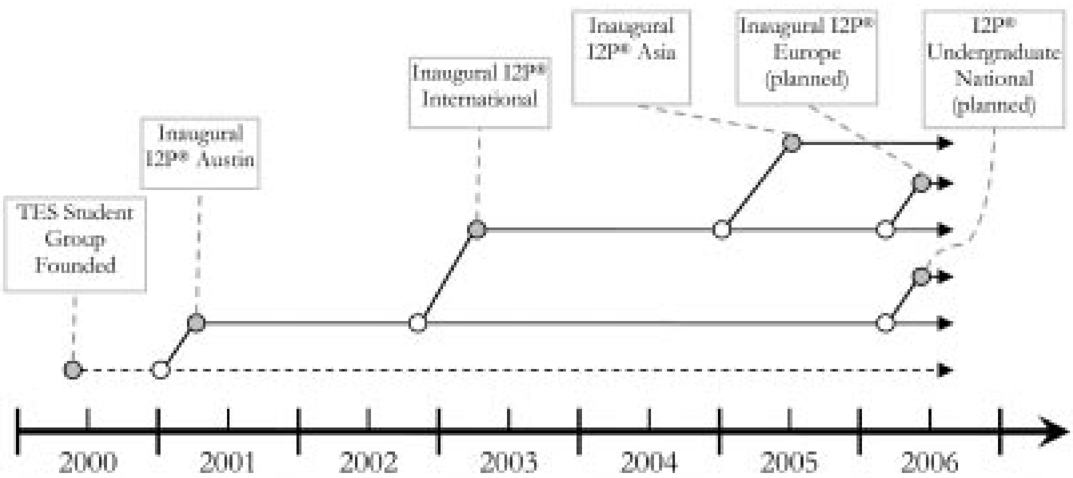

Fig. 3. The evolving Idea to Product® program.

to consider the primary goal of the program: education.

The assessment strategy for the I2P® competition has three main elements that build upon one another and address three key questions about the educational experience. First, does the program have the appropriate structure and support material? An examination at a system and structural level which is expressed in the previous paragraph addresses this first question. Next, what positive effects on students, faculty and members of the community does this competition have? This question has been explored by using the more successful entries as examples and also highlights the effect on the commercialization of real technologies. The final question addresses the more detailed program assessment necessary for program guidance: What are the ranges of experiences that students have during and as a result of the I2P® competition? The initial effort to answer this question resulted in a series of surveys administered during the Third Annual Idea to Product® International Competition in November of 2005. The following paragraphs address two elements of the program assessment.

The team that was placed second in the 2003 I2P® UT Austin finals presented an idea based on a UT patent that enables the cost-effective rapid manufacture of silicon carbide parts. Application of the technology had been lacking forward momentum for some time, and the team developed a new product idea with a clear market demand. One of the competition judges, a UT alumnus, had experience in the area and recognized the value of the idea and the commitment of the team. What followed was the type of positive momentum that can marshal resources and stakeholders to help move an idea forward. The students have incorporated, and have received angel funding, and obtained a license from UT. The two team members, both doctoral engineering students, reported that the competition was an introduction to real technology entrepreneurship. Among the most important things that they learned they cited leveraging communication, leadership and integrating market-based needs into the development of technology. They also described feeling that they had begun to understand what they did not know. In other words, they began to know when to seek advice. Said one of the students: 'entrepreneurship is about collaboration; you actually need lots of help from many types of people.' The lead professor on the project reported having gained a much richer understanding of technology commercialization and, most importantly, of how commercialization issues can be considered within university research.

In another example from the 2003 I2P® UT Austin finals, a doctoral candidate in Botany presented a unique product idea using betalain, a natural antioxidant made by many plants that changes color in the presence of the free-radical changes. The student proposed the incorporation of betalain into foods, cosmetics, or pharmaceuticals as a freshness indicator. Since the competition, the student and his faculty adviser have worked with OTC to patent this new application. A new company, Botanical Scientific, LLC, was formed, which licensed the technology from UT.

More recently, the first place team from the 2005 I2P® UT Austin finals has been accepted to the Clean Energy Incubator (CEI) at ATI. Their human-powered battery charger was developed independently by the students. A judge from the team's semifinal round who is on the CEI's Success Committee was enthusiastic about their project, as was the director of IC^2, who sat on the finals judging panel. This network that the team began to establish at the I2P® Competition has been invaluable in moving the venture forward. An engineering student reported that the framework for the competition and, in particular, the fact that he was working with his own real technology drove him to learn about marketing, financing new ventures and intellectual property development. The resources of community mentors and videos of previous competitions were also cited as having a strong influence. The most important thing that the team learned was communication skills, including making a pitch, despite also describing the value of developing an actual product from an idea as a result of the competition.

The feedback from these teams is instructive. Of particular interest, most of the feedback received was from teams who won some type of monetary prize, but prizes were very rarely mentioned as an incentive. The feedback also highlighted further questions about the students in particular. Were these experiences limited to those who participated on winning local teams? Were the repeated elements of learning about the technology commercialization process, communication, student leadership and networking common to all students? Finally, are the experiences different for students that have different backgrounds and future goals? The aim in developing the survey for the I2P® International Competition was to capture the educational transfer functions for the variety of students participating. Three surveys were administered: one before the competition, one after the practice feedback rounds and a final on-line survey after the competition ended. The questions in the surveys probed preparation materials, student backgrounds and goals and also asked more open questions about why students chose to participate, what elements of the program were the most valuable and the most important things they learned during the competition.

Undergraduate and graduate students from the US, Europe and Asia representing engineering, law, business, computer science and natural science students were a part of the survey. The reasons students reported for participating in the competition included seeking feedback for their ideas, networking, project improvement and the educational experience in general. Similar to the feedback from local teams, little was said about the prize money. This is not to say that the prizes are not important motivators, but it does show that students are being driven to participate in the competition by a rich set of incentives. From the follow-up survey, many students described learning about product development, the commercialization process and critical thinking. Similar to interviews with local teams, communication was listed most often and almost always as the most important part of what was learned during the competition. The value of the feedback from judges was also widely cited. Students reported spending an average of nearly five and a half hours reworking their presentation after the practice rounds on the first day of the competition. One of the interesting suggestions described organizing specialty semifinal rounds, so that, for example, one semifinal would feature all biomedical entries. Several students from Asia and Europe also described seeking and learning about international perspectives on their projects, related to technology commercialization in general.

GENERAL CONCLUSIONS AND FUTURE WORK

The above discussion highlights the establishment of an appropriate environment at UT in which the I2P® Competition was able to flourish and spread to other institutions and demonstrates some evidence of success. The Idea to Product® Competition is an educational model that has been assessed in a variety of ways, highlighting both the program outcomes and a model for assessing entrepreneurship education in general. To further assess the program's impact and areas for future development, we are developing a multi-faceted evaluation based on surveys of the program's key players—namely students, judges, faculty, competition attendees, and peer university participants. Based on our experience with the competition thus far, we expect this assessment to continue to reveal interesting learning outcomes and possible areas for improvement, and we remain open to other innovations and unknown directions that will result from the assessment.

There are several areas of improvement being actively considered. First, the addition of I2P® Specialty Competitions; fields such as biomedical engineering, electrical engineering, computer sciences, and social entrepreneurship each pose unique challenges and require a specialized network for commercialization. Establishing specialty competitions in these areas would allow for more relevant feedback and support for the participants, for instance by selecting judges and mentors with applicable technical or industry experience. Next, getting more students involved could be supported by team-building exercises as part of I2P® activities; providing a mechanism for graduate researchers or other students with technical ideas to build teams with students from law, business, or other disciplines would encourage the formation of more multidisciplinary teams. For instance, many of the engineering graduate students that participate in the I2P® Competition do so without team members from outside their own discipline and would likely have a richer experience if their team represented a broader set of skills and perspectives. Clearly the current momentum of the program indicates an opportunity to transfer the I2P® model to additional universities. I2P® developed in the favorable entrepreneurial atmosphere at UT, and the establishment of regional competitions reveals a question about the possibility of the reverse phenomenon: that is, can the I2P® Competition be used to lead a university toward a more entrepreneurial culture?

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