

Lehigh's Entrepreneurial Network (LEN) of Alumni: Resources for Student Entrepreneurs

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Abstract

Entrepreneurship education at Lehigh University has been recently enhanced by substantial institutional investments in new academic programs, the development of a campus center for student entrepreneurs and several grants from federal, state and private organizations. One such grant is from the Kauffman Foundation to build a Lehigh Entrepreneurial Network (LEN) of alumni to assist and advise student entrepreneurs. The effort requires the partnership of several academic programs, such as Lehigh's Integrated Product Development, Integrated Business and Engineering and Design Arts along with several internal organizations including Lehigh's Alumni Association, the Development office and the University's new thrust in innovation, commercialization and entrepreneurship led by the Vice Provost for Research and the Dean of the College of Business and Economics. The LEN is a critical resource to: 1) help guide successful student e-teams through the product design, development, production ramp-up and market introduction phases of new product development, 2) help the students acquire seed funding, and 3) when appropriate be part of the management team in the startup phase of their businesses. The paper will describe *a work in progress* including the design and implementation of the Lehigh Entrepreneurial Network, its vision, goals, program components and evaluation mechanisms as part of the development entrepreneurial environment at Lehigh University.

Introduction

The 1,600 acre campus of Lehigh University is located in Bethlehem, PA, 75 miles west of New York City and 50 miles north of Philadelphia. The university is private, co-educational, non-denomination and serves 4,650 undergraduates and 1,980 graduate students, approximately 60% percent male and 40% female. Students are enrolled in three undergraduate colleges: arts and science (45%), business and economics (25%), engineering and applied science (30%), plus a graduate college of education. Lehigh is considered to be in the class of "highly selective" schools with a with inter-quartile SAT scores from 1210 to 1370. More than 50% of the student body receives scholarships. The student body is from over 20 states and 65 countries, the majority from Pennsylvania, Delaware, New Jersey and New York. There are approximately 420 full-time faculty members with an 11:1 undergraduate student to faculty ratio. The University is a Carnegie class R2 research school with annual research funding of \$35-37M with 24 research centers or research institutes. Lehigh has an active and engaged alumni serving in various capacities, such as industry liaisons, department and program advisors and members of the University Board of Trustees.

Lehigh University offers regular entrepreneurship courses and has both full-time regular faculty and adjunct faculty (Lehigh calls them Professors of Practice) dedicated to teaching entrepreneurship. According to a Cornell University study by Debra Streeter

[Ref 1] Lehigh's entrepreneurship model is classified as a *magnet* program centered in the business school and primarily MBA-oriented. Lehigh has made a substantial commitment to our entrepreneurship-oriented graduate MBA program, including an entrepreneurial option and a Venture series certificate program. Lehigh has consistently ranked in the top 10 nationally among research institutions in the Standard and Poor's survey of Fortune 500 companies in the percentage of Lehigh Alumni in corporate leadership positions.

Not mentioned in the Cornell study, Lehigh has recently invested heavily in several new programs that promote campus-wide teaching, research and outreach in *technical* entrepreneurship at the undergraduate level, including in Marketing and Management, Integrated Business and Engineering, Integrated Computer Science and Business, and a campus-wide, year-long experiential program in Integrated Product Development.

Entrepreneurship teaching – graduate: Historically, entrepreneurship education at Lehigh has focused on the graduate MBA program in the College of Business and Economics. This program has recently implemented an entrepreneurial track led by an experienced and successful entrepreneur. The graduate MBA has been augmented by a combined MBA and Engineering Masters program, where students earn dual degrees in business and engineering. Also at the graduate level, one of the authors, Professor Ochs has offered a new product development course with industry-sponsored projects with globally dispersed development teams [Refs 2 and 3]. As mentioned above the MBA program now offers a certificate program in entrepreneurship called the Venture series. In addition, our Manufacturing System Engineering offers a graduate course for new product development within a corporate framework.

Entrepreneurship teaching – undergraduate: Since the mid 1990's Lehigh has offered an award winning cross-disciplinary program in Integrated Product Development (IPD) for students in engineering, business and the design arts. For the past six years, the program has focused on technical entrepreneurship through new product development, with industry sponsorship of cross-disciplinary student teams [Ref 4]. The IPD program has also engaged local entrepreneurs and student entrepreneurs. Since the inception of the National Collegiate Inventors and Innovators Alliance (NCIIA), for seven consecutive years Lehigh student teams have won national competitions for collegiate innovation and entrepreneurship (see www.NCIIA.org). The IPD program is recognized as a truly unique cross-disciplinary educational experience [Ref 5] and it has grown to support over 200 students per year, working in competing teams of six students each. (See www.lehigh.edu/ipd for program details and list of projects).

In 2000 Lehigh instituted a new Integrated Business and Engineering (IBE) curriculum and in 2002 a new Computer Science and Business (CSB) curriculum. Both new programs have adopted the IPD model for technical entrepreneurship in their capstone projects. Professor Ochs from Mechanical Engineering, Professor Watkins from Economics and Professor Snyder from Design Arts, co-teach the IBE freshman course in new product development and the two-semester capstone projects courses. Based on

previous year's experiences, for the year 2004 capstone project courses we anticipate 15 corporate projects with 30 teams with students from 24 departments from across campus.

Entrepreneurship research: The College of Business and Economics has led the University in Entrepreneurship research through the Musser Center for Entrepreneurial Studies, the Small Business Development Center, and Lehigh's Iacocca Institute for Global Entrepreneurship. Recent research and development in technical entrepreneurship at Lehigh has been funded by NASA/CAPE [Ref 6], the US Department of Education [Refs 7 and 8] and the US Department of Labor [Ref 9]. This funding has resulted in the development of the various curricula and has provided start-up funding for the IPD Program. With the University's substantial commitment to sustained funding (see section below), faculty from Marketing and Management, Computer Science, Mechanical Engineering, Economics, Sociology and Design Arts have formed a team to develop proposals for research in the economic, social and technical aspects of entrepreneurship and the development of enabling technologies that assist globally dispersed product development teams.

Educational outreach: The Integrated Product Development program has teamed with Lehigh's Iacocca Institute for Global Entrepreneurship (www.iacocca-lehigh.org/cap/) to sponsor Career Awareness Programs (CAP) for highly qualified, underrepresented high school students. The focus of these one-week summer programs included business, engineering and design arts, all with a technical entrepreneurship focus [Ref 10]. In 2001 in conjunction with Lehigh's Global Village, the Lehigh team from the Iacocca Institute and the College of Education was awarded a grant for a Pennsylvania Governor's School for Global Entrepreneurship. This eight-week residential program brings over 80 highly qualified high school students to campus and combines them with 60+ entrepreneurs from Europe, Asia, Africa and South America. Finally, with considerable input from Lehigh's IPD program, the Community of Agile Partners in Education (CAPE), a Bethlehem PA based consortium of over 200 schools, received a Pennsylvania grant to develop a network of entrepreneurship educators at the high school, community college and university levels. This planning grant focuses on entrepreneurship education using Lehigh's Integrated Product Development model for technical entrepreneurship.

Community Outreach: Lehigh University houses and supports a Small Business Development Center (SBDC), the Ben Franklin Technology Partners of Northeastern Pennsylvania and the Manufacturers Resource Center. These state-sponsored centers help identify and assist company startups with legal, organizational, managerial and financial assistance, often using Lehigh students through courses such as Lehigh Management Assistance Counseling (LUMAC) and the Marketing Practicum. The Ben Franklin center also provides qualified companies national-award-winning on and off campus incubation centers. The centers have close relationships with the Lehigh Valley Economic Development Council, the Northeast Pennsylvania Angel Network and private investments groups in Northeastern Pennsylvania. For the 2002 project year, the clients for the undergraduate capstone courses mentioned above were individual entrepreneurs from the eastern Pennsylvania region recruited in part through the SBDC and the Ben Franklin center. Funding for this experiment was provided by the Department of Labor

[Ref 9]. In October 2003, the SBDC launched its high school outreach program with video, CD and brochures on entrepreneurship and sponsored their first regional networking conference, the Eastern Pennsylvania Inventor's Consortium (EPIC) for entrepreneurs in the region. For more information, go to www.lehigh.edu/~insbdc/.

Entrepreneurship Sustainability: Within the last year, the Lehigh administration has made a substantial commitment to sustained funding for student entrepreneurial projects through capital improvements, faculty, staff, program support and support of building operations and equipment maintenance and replacement. In January 2002 Gregory Farrington, Lehigh's President, approved the spending of \$4.5M to renovate the Wilbur Powerhouse for student entrepreneurial projects. The entire 17,000 sq. ft. facility is dedicated to support student projects required by the Integrated Product Development, Integrated Business and Engineering, Computer Science and Business and Design Arts programs. The building opened in September of 2003. In turn, the academic Deans and Provost have provided sustained line-item funding for the faculty and staff as well as building operations, equipment maintenance and replacement. Sustained funding exceeds \$1M annually.

Additional one time funding has been received from various sources to seed various entrepreneurship activities including:

Commonwealth of PA Entrepreneurship Grant

In July 2003, Lehigh received a \$1M grant from the Commonwealth of Pennsylvania to develop entrepreneurship curricula and to develop "A Model for Entrepreneurial Innovation" by partnering the University with the Ben Franklin Technology center and the Commonwealth. Quoting from the grant proposal, the first objective is

"to establish a strong program of technology partnership linking Lehigh faculty and students with industry, in the Lehigh Valley region and beyond. The proposed partnership will involve a more deliberate program of interconnecting Lehigh's strengths with the needs of industry, fertilizing Lehigh's technology programs with challenges from industry, and creating an effective program of idea commercialization and technology transfer. We propose to begin with a focus on the areas of Optics and the Life Sciences. Working with the Ben Franklin Partnership, we will establish an initiative within Lehigh that will:

- Serve as a "portal" to university resources including both web presence and staff contacts;
- Pro-actively seek opportunities for commercial applications of university-developed technology through patents, licensing, and start-ups;
- Establish links with technology companies, venture capital firms, and economic development organizations to attract and support regional company growth;
- Provide industry liaison and technology transfer support to the Optics and Life Sciences initiatives at Lehigh and in the region;
- Enhance growing community/university technology-based partnerships to create economic development for the region." [REF 13, p.1]

The second objective is “to increase the rate of idea generation. Our goal is to infuse the Lehigh undergraduate and graduate experience with a spirit of entrepreneurship. The theory is simple: the more new ideas we have, the more candidates we will have for commercialization and the more value our graduates will be to innovative companies.” [REF 13, p. 1]

In addition, the \$1M Commonwealth Grant requires the following outcomes [Ref 13, p. 2]:

1. “Create or retain 150 jobs – this could include new jobs created in startup companies launched with Lehigh technology or assistance, existing jobs retained in existing companies assisted by Lehigh, or jobs from attraction of new companies to the region (working with partners such as LVEDC, Ben Franklin, etc.).
2. Attract \$10 million in Equity Investments – this could include investments in Lehigh- or Ben Franklin-launched companies or investments in companies that are partners in Lehigh centers or institutes, or companies that have funded Lehigh research or technology projects, or investments with companies
3. Create five new companies – this could include jobs directly started by Lehigh faculty, students or staff, or companies assisted by Lehigh.
4. Develop 100 Corporate Partnerships – these could be new partnerships or renewals with Centers and Institutes, as well as corporate-funded research projects.
5. 4:1 leveraging of State funds – Lehigh will leverage 4 dollars of funding for each dollar of State funds from Federal, Private, Foundation or University funding sources.”

These metrics are to be accomplished over a five-year period with the grant money to be spent in the first two years. The University administration believes that: “The success of this effort will depend upon coordination and partnerships with resources on Lehigh’s campus and in the surrounding community. The portal activity in this project will serve as the primary access to centers, institutes and economic programs on campus.” [Ref 13, p. 2] Lehigh will also collaborate with the “regional economic development organizations in developing new companies and attract companies to the region. These include the Lehigh Valley Economic Development Corporation, Lehigh Valley Partnership, and the various County and Municipal agencies dedicated to economic development.” [Ref 13, p. 3]

NSF Grant to establish a Cross-Disciplinary Bioengineering Program with a Technical Entrepreneurship Focus

In October 2003 the National Science Foundation (NSF) awarded Lehigh a \$1.3M grant to establish a bioengineering program with an entrepreneurial focus that meets the rapidly increasing demand from students, transforms engineering education, and positions

Lehigh University at a leadership position for technical entrepreneurship education and research in the 21st Century.

The objectives of this program are to implement an excellent bioengineering education program to provide students with a balance of science, humanities, entrepreneurship and technical foundation through integrated experiential learning activities that include traditional classroom lectures, research, and industry, clinical and business environments. Built on Lehigh's outstanding tradition in undergraduate engineering education and the award-winning Integrated Product Development program, the bioengineering program will base its strength in leading edge biotechnologies and a close relationship with existing engineering departments, and maintain partnership with regional hospitals, medical schools and biotechnology industry. This grant will run from October 2003 through Sept 2006. The first cohort of bioengineering students will participate in the capstone entrepreneurial experiences beginning in Spring 2004.

Kauffman 2003 Grant to develop the Lehigh Entrepreneurial Network (LEN)

In April 2003 the co-authors Professors Ochs and Watkins received a Kauffman 2003 grant to development a Lehigh Entrepreneurial Network of alumni. The grant is anticipated to have an impact on both *curriculum development* and *faculty development*. Our curriculum in technical entrepreneurship through IPD projects follows the process shown in Figure 1 below. In this figure the new product development process is shown in four phases: Phase 1-Opportunity scanning; Phase 2-Conceptual Design & Product Planning; Phase 3-Manufacturing, Product and Marketing Development; and Phase 4-Manufacturing and Market Ramp-up. In our current model, cross-disciplinary teams work on industry projects identified in part by the SBDC and the Ben Franklin center. In Phase 1, Opportunity Scanning, the IPD faculty and professional staff work with the sponsors to find appropriate project. Together we assess the appropriateness of the various projects based on our understanding of the technology, the students' capabilities and the difficulty and scope.

Phase 2 and Phase 3 represent the activities of the two-semester undergraduate IPD capstone courses. In the undergraduate version, Phase 4, Manufacturing and Marketing ramp-up, is the responsibility of the industry sponsor. It is this element that is missing from our approach when we do individual student and faculty entrepreneurial projects.

In order to fill this missing aspect our program, we hope to establish a global network of entrepreneurial alumni. The vision, goals, program components and assessment measures of the proposed LEN are shown in Figure 2.

Under *curriculum development* the proposed initiative will apply our award-winning undergraduate model to graduate entrepreneurial education by developing a technical entrepreneurship curriculum involving MBA students, research faculty and graduate students from across campus and will require the redesign of Phase 1 and new support structure for Phase 4. The approach is to integrate our entrepreneurship-oriented MBA

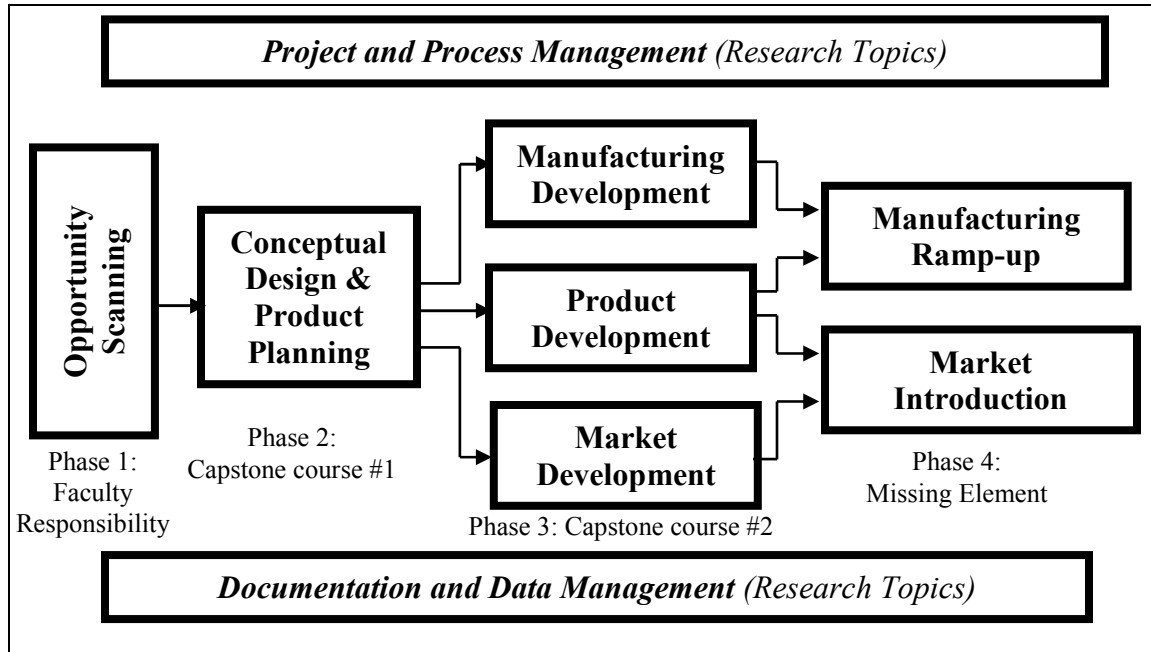


Figure 1. Details of the IPD Process.

students with interested researchers from across campus and entrepreneurial alumni through the required MBA project. This project will engage researchers as clients for new product development and possible company start-ups, and couple them with experienced alumni identified and recruited through the proposed LEN. Lehigh undergraduates who have experienced the capstone IPD courses and who continue on to do graduate work will be encouraged to participate as members of development teams. The methodology for this initiative will require the faculty and alumni development team to investigate and apply the best practices [Refs 11 and 12] to revise our current process (Phases 1-3 in Figure 1). In addition, the faculty-alumni team will also focus on developing mechanisms and programs to bring experienced entrepreneurs to campus to help commercialize university intellectual property. In particular, experience has shown that manufacturing ramp-up and market introduction (Phase 4 as shown in Figure 1) require the greatest financial resources and an experienced management team is required to attract these funds. It is our vision that the LEN will be one source for this experience.

This Kauffman-funded effort is well underway with the publication of a call for interested alumni in the web-based Alumni newsletter and the development of a database of interested alumni. In September, a first gathering (see more below) was held to solicit alumni input to the University's plans to improve innovation, creativity, entrepreneurship and commercialization of University intellectual property. In addition, several of these alumni have already been engaged as mentors to student entrepreneurial teams

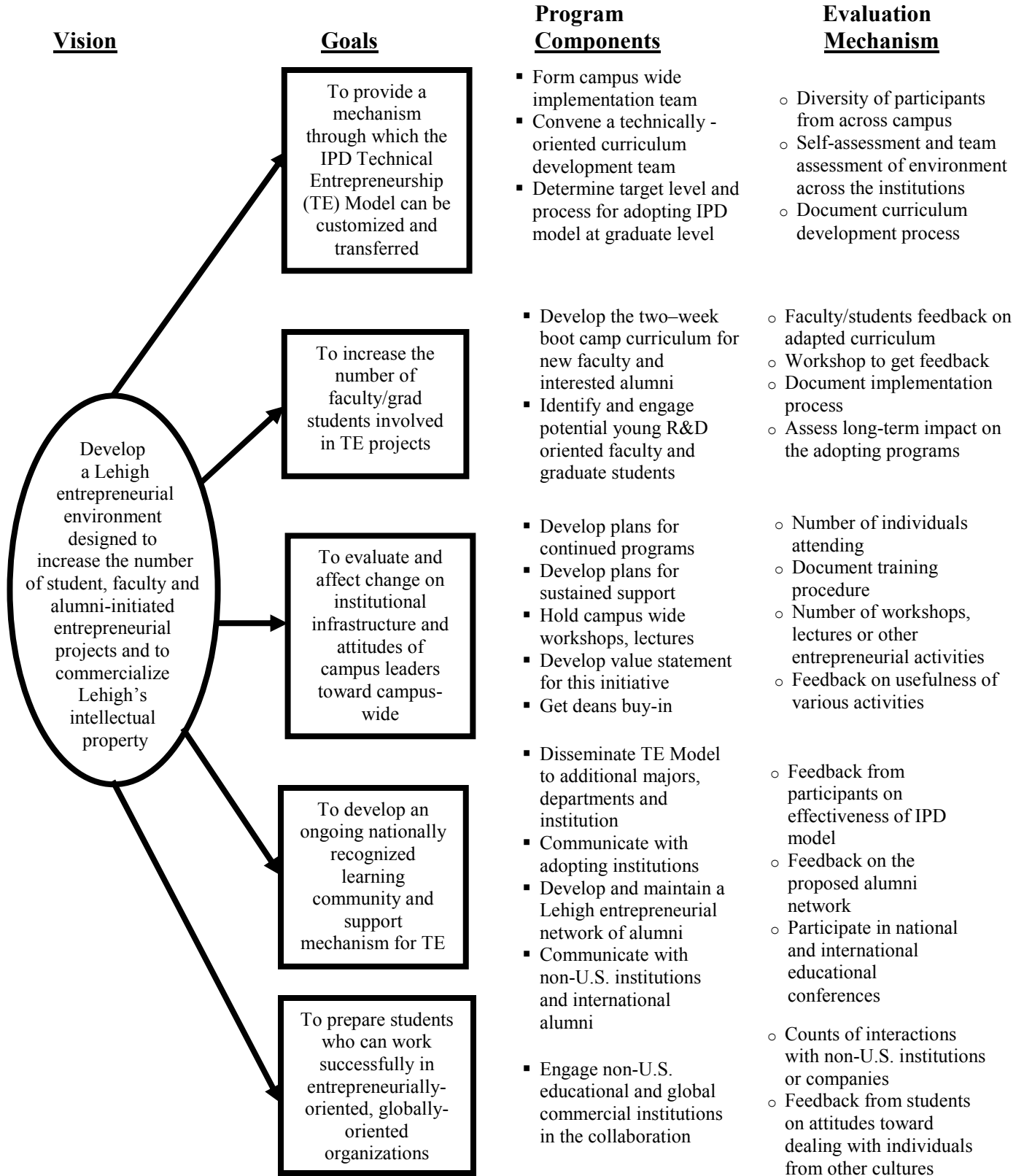


Figure 2. Lehigh Entrepreneurs Network (LEN) Evaluation Plan.

Under **faculty development** the proposed initiative has the goal to engage young research faculty in the entrepreneurial process with the motivation to commercialize their research and in the process hopefully become the next generation of teachers of technical entrepreneurship. Lehigh is in the process of hiring 37 new engineering faculty members in key technical and research-rich areas such as biotechnology, information technology, environmental sciences, photonics and others. As a result of this growth in the number of younger faculty members, faculty development is the primary focus of the academic Deans and Provost. Also under faculty development, we plan to draw on the large numbers of successful entrepreneurial alumni and Lehigh's annual top 20 ranking of alumni support to develop alumni mentors for interested young faculty and provide them an organizational infrastructure to assist with their lack of experience in acquiring start-up funding. We will develop methods of attracting successful entrepreneurial alumni to act as young faculty mentors, developing a national and international network of alumni-entrepreneurs and propose the infrastructure to support this global network. To gain valuable feedback, we plan to offer a summer 2004 workshop in technical entrepreneurship for interested faculty, students and alumni.

A graphic depiction of the vision, goals, program components, and **evaluation mechanisms** can be found in Figure 2. The evaluation will be conducted by an internal professional evaluator, Mary Jean Russo, PhD, a research scientist from Lehigh's Center for Social Research.

The evaluation will answer the following questions:

- Can LEN be adopted at Lehigh?
- Can the undergraduate IPD Model be customized to fit graduate entrepreneurial projects?
- Are the proposed methods for this customization process effective and how might they be improved?
- Can the IPD Model be successfully modified and implemented at the graduate level?
- What are the impacts on programs, faculty and students that adopt the IPD model?
- Is the IPD Model an effective way of producing faculty and graduate students who are team-oriented, entrepreneurial, and comfortable working with individuals from other disciplines?
- What resources are needed to continuously support the proposed entrepreneurial infrastructure with the anticipation of long-term benefits?
- What ongoing support mechanism for the LEN and IPD Model will best promote its adoption by Lehigh and other institutions?
- Will the initiative positively impact alumni, faculty and student participation in entrepreneurship education?
- Will the faculty become more entrepreneurial as a result of this experience?
- What support structures are needed?
- Will alumni participate and under what conditions?
- Can the program and its entrepreneurial ideas attract start-up funding?
- How do we leverage local, state and federal agencies and funding?

- What role do various campus agencies, such as the Technology Transfer Office, play?
- What organizational barriers are there for alumni participation?
- Can this development be translated to other institutions?

Progress to date

In coordination with the PA opportunity grant, a one-day workshop of on creating a model for entrepreneurial innovation and education, intellectual property and technology transfer research was held on September 29, 2003. Nineteen of thirty five alumni invitees attended the workshop along with the University President, three of the four deans, the Vice Provost for Research, selected faculty and representatives from the Ben Franklin Technology Center and the Small Business Development Center. The Alumni in attendance provided feedback to the university plans for developing entrepreneurship across campus including the following:

- 1) Benchmarking leading institutions and developing a Lehigh-specific model for entrepreneurship education and research;
- 2) Development of an entrepreneurship educational programs including a minor for undergraduates, an expansion of the graduate programs in IPD and the MBA Ventures Series and a summer boot campus in entrepreneurship for new faculty and staff;
- 3) Development of a technology transfer office reporting to the Vice Provost for Research, including creating, searching and hiring a Director of Technology Transfer, Entrepreneurial Research and Education. As per the posted job description:

“The Director will be responsible for planning, directing, and coordinating the university-wide technology transfer operation and coordinating this operation with undergraduate and graduate entrepreneurship education programs and in particular, managing and leading the following activities:

 - a. coordination with the Deans and faculty directing entrepreneurship education programs is essential so that a seamless entrepreneurial philosophy is developed across the whole university,
 - b. provide leadership in developing strategies for external partnerships for patenting/licensing, venture creation and establishing startup companies in collaboration with the Ben Franklin Technology Partners of NE PA and other local and Commonwealth agencies,
 - c. create a university-wide system and process for IP development and technology transfer incorporating faculty/staff education,
 - d. serve as spokesperson for Lehigh in matters regarding intellectual property, its commercialization and the economic development impact,
 - e. create strong relationships with faculty/staff, individually and as groups in research centers and institutes and with industrial liaison program directors
 - f. develop these faculty/staff relationships into partnerships with appropriate external constituencies such as licensing/patenting companies
 - g. market LU IP through aggressive corporate outreach

- h. develop and administer policies and procedures, preparing and managing the office budgets, preparing managerial and externally required reports and assuring compliance with state and federal law” [Ref 14]

The result of the workshop was an enthusiastic endorsement for the development of the entrepreneurship environment at Lehigh and for the completion of the two major components of the project: 1) the development of a technology transfer office; and 2) the development of educational programs in entrepreneurship. In particular, the alumni asked to be part of the development process.

As a first step, a faculty team from Engineering, Business, the Office of Research and the Small Business Development Center has developed a proposed undergraduate entrepreneurship minor with 18 credits open to all students across the university. The minor includes 12 credits of background courses and six credits of entrepreneurial projects to be administered through the IPD and IBE programs. Figure 3 shows the details of this minor program.

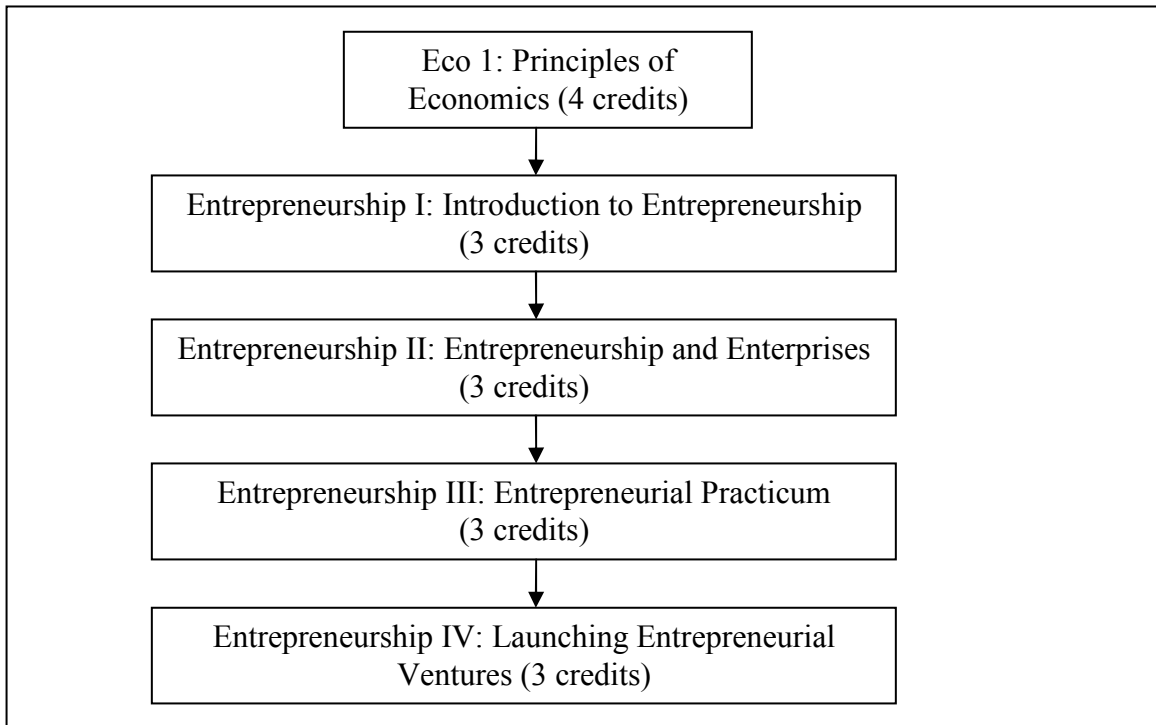


Figure 3. Block diagram of the proposed undergraduate entrepreneurship minor

The program is to be housed in the College of Business and Economics and requires the hiring of at least one full time faculty. This proposal will be reviewed internally and then sent out for external review by the LEN.

Additionally, the faculty team has suggested an organizational structure to implement the LEN, entrepreneurship minor and integrate them with the University’s emerging technology transfer and intellectual property management activities. Figure 4 shows a

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proposed version of the Lehigh University Entrepreneurship and Commercialization Office. The director of this office will report to the vice Provost for research and indirectly to the deans of the four colleges. The director will actively pursue and develop the intellectual property from the various research programs across campus and aggressively market and license University IP. This proposal is currently under review by the University administration.

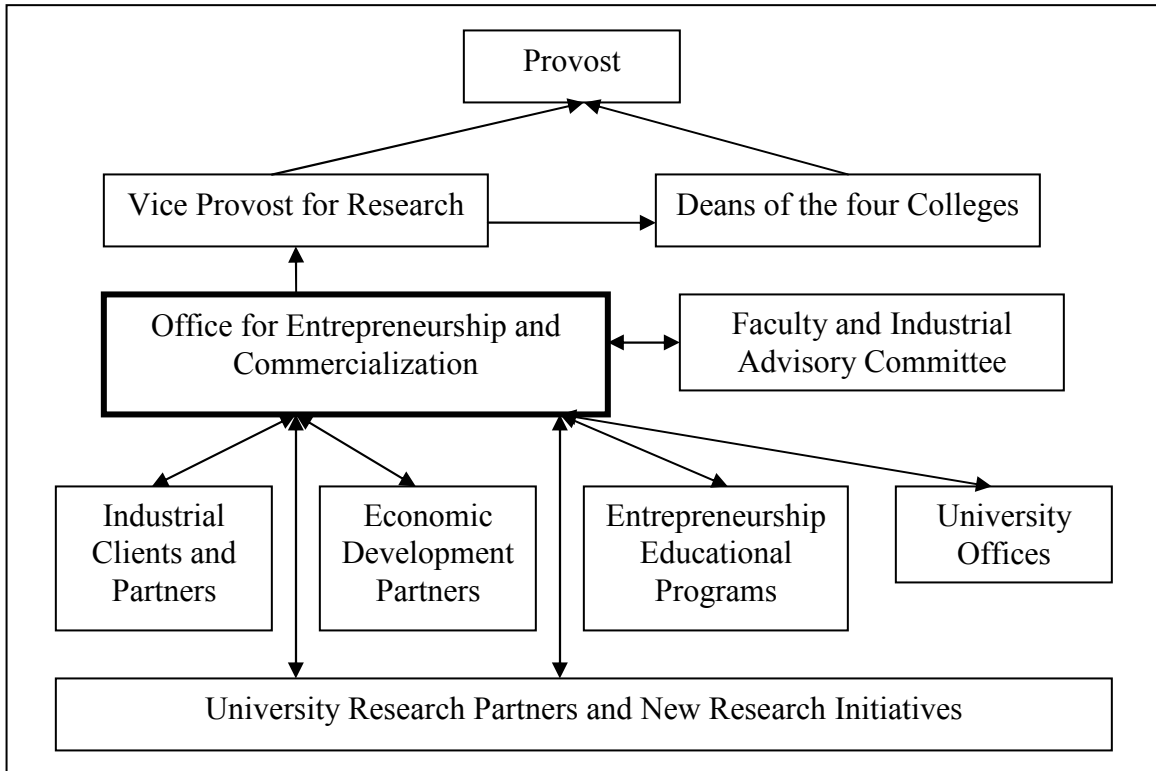


Figure 4. Organization Structure of the Proposed new Office of Entrepreneurship and Commercialization

Next Steps

In the summer of 2004, a boot camp for new faculty and staff is being planned. The initial approach will be to team with the Invitation to Venture (I2V) program established by the National Collegiate Inventors and Innovators (NCIIA). Details of this are being explored.

With the establishment of this office and the hiring of its director, Lehigh should have the infrastructure in place to support the development of new products from research and development across campus, educate interested faculty and students and enhance the entrepreneurship culture in and around the university. The Lehigh Entrepreneurial Network of alumni will play a key role in this development effort and be a key element of its sustainability.

In the near future plans will have to be developed to cultivate a system to create products from university research and tie this to entrepreneurship education at the graduate level. Using graduate students in engineering and science working with MBA students, we plan

to follow the model by Kingon and others at NC State [Ref 11], to develop the “best” possible products for the most appropriate market following the Science-Technologies-Products-Markets (STMP) process of systematic development and review of viable possibilities as shown in general form in Figure 5.

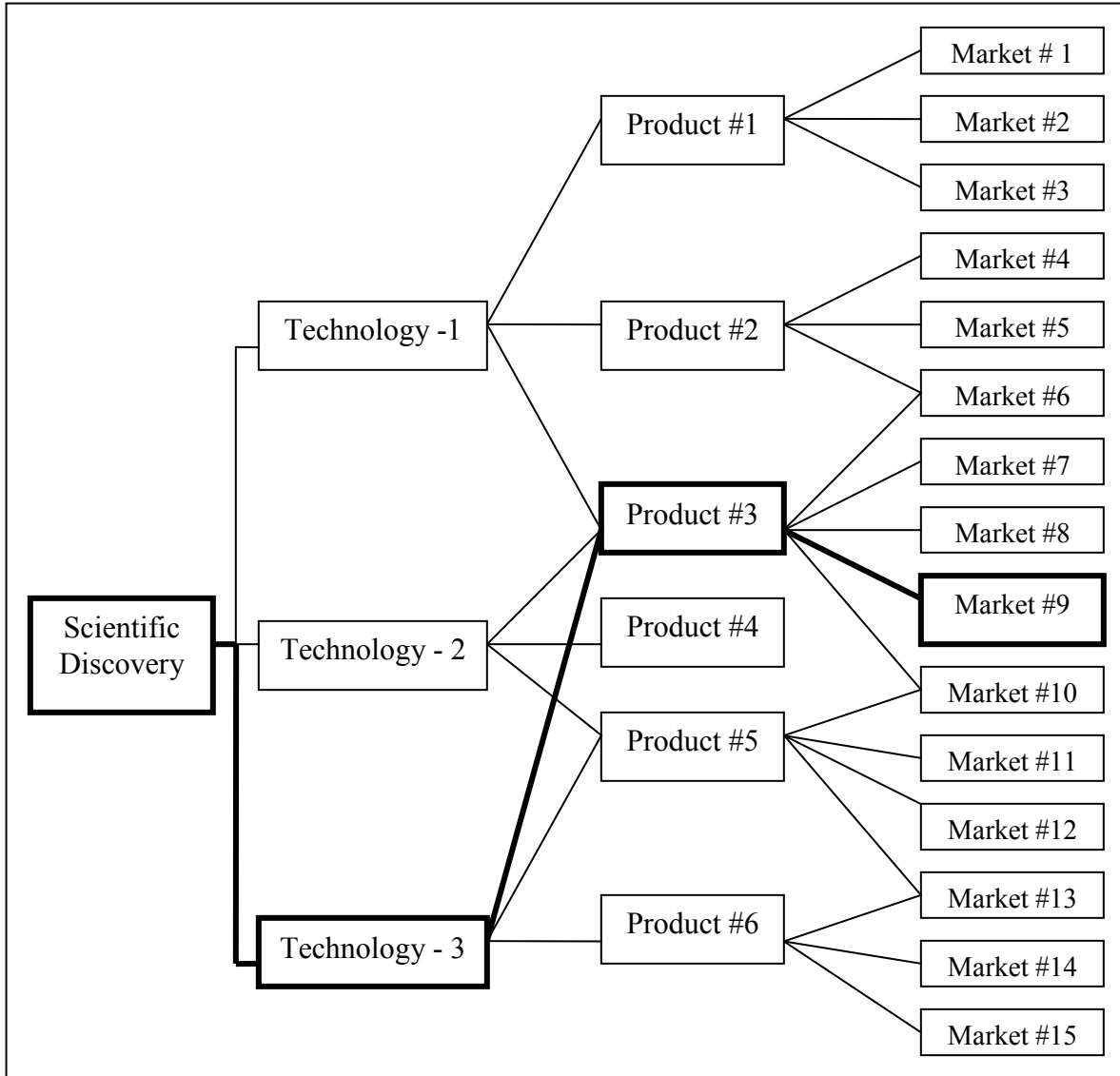


Figure 5. Science-Technology-Product-Market (STPM) Model for the Commercialization of University Intellectual Property (IP)

Each semester, scientific discoveries with commercialization potential will be prioritized and considered by the faculty and students engaged in the graduate program in commercialization and entrepreneurship and the teams will systematically search for the best solutions that might be the combination highlighted in Figure 5. This effort will require both knowledge of the technical area as well as the development of criteria for anticipated successful products.

Finally, this mission, the goals, program components, evaluation mechanisms, organization structure and management philosophy surrounding the Office of Commercialization and Entrepreneurship and the Lehigh Entrepreneurial network are intended to form the various working parts of an economic development engine. As such, these activities are worthy of academic study [Ref 12]. In particular, it is our hope that this collective effort to establish a model entrepreneurial environment can become a focus of economic development and sociology research in the near future.

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John B. Ochs is Professor of Mechanical Engineering at Lehigh and Director of the Integrated Product Development Program (IPD), which he co-founded with Dr. Watkins in 1994. He is current national President of the American Society of Engineering Educators’ Entrepreneurship Division. From 1985-95 Dr. Ochs did extensive industry consulting and was involved in the start up of three companies. In 1996 the pilot courses IPD won the American Society of Mechanical Engineers’ curriculum innovation award and in 1997 IPD won the Newcomen Society award for the promotion of America’s free-enterprise system. Dr. Ochs holds a Ph.D. from Pennsylvania State University.

Todd A. Watkins is Associate Professor in the College of Business and Economics and Director of the Kalmbach Institute for Regional Political Economy at Lehigh. He holds Ph.D. and M.P.P. degrees from Harvard and a B.S. from the University of Rochester. He previously worked in optical design and optic manufacturing engineering at Eastman Kodak. His research and teaching involves the economics of innovation, manufacturing and new product development. From 1999 to 2002, as the Faculty Fellow to the Provost, he was responsible for promoting innovative, inquiry-based curriculum campus wide. For seven consecutive years, teams advised by Dr. Watkins have won start-up grants in national competitions for collegiate technology entrepreneurship.