

The EPICS Entrepreneurship Initiative: Combining Engineering and Management to Improve Entrepreneurship Education and Practice

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Abstract

The Engineering Projects in Community Service (EPICS) Program at Purdue, working in partnership with Purdue's Discovery Park and Krannert School of Management, has launched the EPICS Entrepreneurship Initiative. The initiative provides opportunities for the more than 300 students currently enrolled in EPICS to: (1) Learn about entrepreneurship and the management of intellectual property in the context of the products they develop at the request of service and education organizations in the local community; (2) Obtain assistance from programs within Purdue's Krannert School of Management if they are considering the commercialization of the products they have developed. As one step in the evaluation of the commercial potential of the products they have designed and developed, the EPICS teams are encouraged to participate in entrepreneurship competitions, including Purdue's annual \$100K Burton Morgan Entrepreneurship Competition. The EPICS Entrepreneurship Initiative at Purdue is a model for similar initiatives that could be created at the 9 other universities that also have EPICS programs.

1. Introduction

By any measure, the EPICS program is a very large, very multidisciplinary and outstandingly successful engineering design program. This Fall, there are more than 300 students from more than 20 different disciplines enrolled in 24 EPICS teams -- an average of 12 students per team. All students on these teams earn academic credit as they work closely with a project partner in the community to define, design, build, test and deploy systems that provide their partner with new capabilities to serve the community¹⁻⁷. Full information about the EPICS program is available on-line at <http://epics.ecn.purdue.edu>. All publications related to the EPICS program are available at <http://epics.ecn.purdue.edu/papers/Default.htm> and an index of the student teams' web pages resides at http://epics.ecn.purdue.edu/projects/teams_nationwide.htm.

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Since EPICS was launched at Purdue in 1995, more than 1500 students, more than 50 team advisors from the Purdue faculty and local industry, and more than 30 organizations in the community have participated in the program. The most significant measure of size and success is the more than 150 products that EPICS teams have delivered to their partners in the community.

The range of real-world products and systems that EPICS teams have designed, built, delivered and disclosed to the public includes: an artificial wetland that removes agriculture-related chemicals from streams; remote controls and associated mechanisms to unlock/lock and open/close a bank of school lockers for middle school and high school students who lack fine motor skills; custom kiosks with software that enables users to quickly determine how to obtain the social services they need; and sophisticated electro-mechanical play environments for very young children that are physically disabled.

Many of the products the teams have developed, some of which have not been publicly disclosed, clearly have the potential to be developed into commercial products. Verification of this fact is provided by a first-place finish in 1997 and a fourth-place finish in 2000 of two EPICS projects that entered Purdue's Burton Morgan Entrepreneurial Competition here at Purdue. One of these teams had purchase orders in hand for the product that they had developed.

In recognition of this potential to commercialize EPICS products, and in an effort to create an environment in which EPICS students can learn about entrepreneurship and even become entrepreneurs, we have launched the EPICS Entrepreneurship Initiative. Funding totaling \$600K to launch the Initiative has been provided as part of the Lilly Endowment grant that has created Discovery Park at Purdue. A new building, the Burton C. Morgan Center for Entrepreneurship will open in March 2004 and will house entrepreneurship programs from around campus, including the EPICS Entrepreneurship Initiative. The EPICS Initiative will occupy more than 1800 sq.ft. of space in this new building.

2. Goals of the EPICS Entrepreneurship Initiative – Cross-Campus Collaboration

The EPICS Entrepreneurship Initiative is a partnership between EPICS and several entrepreneurship programs within Purdue's Krannert School of Management. The goals of this partnership include:

- Spreading the benefits of products developed by EPICS teams at Purdue to other communities around the country, and to the entire U.S. market, through commercial development of those products.
- Creating an opportunity for EPICS students at Purdue to learn about entrepreneurship and directly experience the process of both developing products for the commercial market and creating a company to manufacture and market them.
- Enabling EPICS teams and their project partners in the community to identify, protect, develop and benefit financially from the intellectual property embodied in the products they create while working together.
- Developing and refining a model for entrepreneurship that can be emulated by any of the 9 other EPICS sites wishing to explore the commercialization of the products developed by

their EPICS teams. These other EPICS sites are: Butler University; Case Western; Georgia Tech; Iowa State; Notre Dame; Penn State; Univ. of Puerto Rico at Mayaguez; Univ. of Illinois at Urbana-Champaign; Univ. of Wisconsin-Madison.

3. Creating a Commercialization Process for EPICS Products

The process by which EPICS project teams will learn about entrepreneurship and explore the commercial potential of their products will be organized into four stages that will be executed each academic year.

STAGE 1 -- Early Fall of Each Academic Year: Faculty from EPICS, faculty and staff from the Krannert School of Management, and MBA/PhD students in the Innovation Realization Laboratory (IRL) in the Krannert School of Management will work closely with selected EPICS teams to estimate the commercial potential of products they have designed and developed. There is a backlog of more than 150 products that EPICS teams have designed, built and delivered to their community partners during the seven years that EPICS has been in operation. The goal for the first few years of the Initiative will be to rank a mix of these existing products and some current projects and make recommendations in the areas of intellectual property protection, potential markets, competing products/systems, and alternative markets and applications. Any EPICS team with products estimated to have significant commercial potential will be encouraged to participate in the Burton D. Morgan Entrepreneurship Competition.

STAGE 2 -- Late Fall of Each Academic Year: IRL students and MBA students that work with the Burton Morgan Entrepreneurship competition will be matched with the EPICS teams that have produced products that were judged by the IRL teams in Stage 1 to have significant commercial potential. They will work with these teams to understand the product in several dimensions: the intellectual property represented by the product; the best approach to protecting that intellectual property; and, characterization of the potential market for the product. A unique educational opportunity will be offered to the EPICS teams participating in this stage of the process; namely, participation in the series of 10 workshops on all aspects of starting a business that has been organized by Dr. Shailendra Mehta, the Director of the Burton Morgan Entrepreneurship Competition (BMEC). The EPICS/MBA or EPICS/IRL partnerships that reach this stage may elect to submit a business mini-plan to the BMEC.

STAGE 3 -- Early Spring of Each Academic Year: The EPICS/MBA or EPICS/IRL teams that submitted business mini-plans that are selected for further development in the first round of the BMEC will decide whether to develop a full business plan for the final competition in March. If they choose to do so, the teams will prepare a full business plan and begin the design of a commercial-grade prototype of the EPICS project. EPICS teams wishing to work on the development of commercial-grade prototypes will be provided with space in current EPICS facilities for this activity. Once the Burton Morgan Center for Entrepreneurship opens its doors in the Spring of 2004, it will offer unique facilities to support this activity.

STAGE 4 -- Those EPICS/MBA teams that do well in the Burton Morgan Competition will be encouraged to pursue the commercialization of their product. Their success in the competition

should ensure that they receive the attention and assistance of the people involved in judging the competition, of the Venture Capitalists that attend, and of people throughout the university. The teams can continue to use the EPICS resources in the Morgan Center for the refining of their prototype and their business plan. This can include meeting with venture capitalists, pursuit of IP protection/development, etc., as appropriate. The culmination of this stage could be the start-up of a company in an incubator in the Purdue Research Park.

As we gain experience with this process, which is currently in Stage 3 for the 2002-03 academic year, there will undoubtedly be refinements and branches that are identified and implemented.

4. Outcomes to Date and Innovations for Next Year

In its first half year of full operation, the response of the students to the entrepreneurship initiative and their participation in its activities has been substantial:

- Three IRL MBA/PhD teams were teamed with 6 EPICS teams to help them with the evaluation of their products. The EPICS teams were: the Classroom Communication and Academic Resource Technology team; the Habitat for Humanity team; the Office of the Dean of Students Team; the Speech Language and Audiology Clinic team; the Wabash Center ECE team; the Wabash Center Greenbush Industries team. Reports on the status of one or more products were produced for each of these teams. While, as expected, some products would likely have very small markets – satisfying only the needs of the local organization that requested them – others were found to be unique or to only recently have any competition in the marketplace.
- Of the 62 entrepreneurship teams from around the Purdue campus that filed business miniplans in the first stage of the Burton Morgan Entrepreneurship Competition, 7 were composed of EPICS students or former EPICS students using their team's technology as the basis for their plan.
- Two of the seven EPICS teams that entered the Burton Morgan Entrepreneurship competition were selected to proceed to the second round of the competition. They have completed and submitted their full business plans and are awaiting the outcome of the judging of the second round of the competition.

Thus, students from at least 10 of the current 24 EPICS teams are learning about entrepreneurship by directly experiencing and participating in the process, by being paired with MBA/PhD IRL teams, by participating in the Burton Morgan Entrepreneurship Competition, and/or by participating in formal workshops on creating a business. This voluntary response from the EPICS students and their teams has thus been very significant and holds great promise for the success of the Initiative.

Based on the experiences gained this year, the following improvements have been put in place for the 2003-2004 academic year:

- For the Fall of 2003, a new course, *MGMT 490S: EPICS Product Commercialization*, will be available for EPICS students that work with IRL teams on commercialization plans and enter

the Burton C. Morgan competition. They will receive 1 credit and be graded on the quality of the business plans they submit to the Burton Morgan Entrepreneurship Competition.

- The *EPICS Entrepreneurship Competition* will be launched in the Fall of 2003. EPICS teams from all EPICS sites around the country will be eligible to enter. Prize funds of \$25K are expected to be available; funding to run the competition is already in place. The winning EPICS team will be provided with travel funds to enable them to participate in the National Social Venture Competition: <http://www.socialvc.net/index.cfm>

5. Krannert School of Management Programs participating in the EPICS Entrepreneurship Initiative

Innovation Realization Lab

The Innovation Realization Lab (IRL) is designed to provide real world business and technology management experience for PhD students in Purdue University's doctoral programs in Agriculture, Engineering, or Science and MBA students in the Krannert Graduate School of Management. Student teams are created to study the commercial viability of each doctoral student's research over a two year period. The MBA/PhD teams participate together in a series of courses designed to guide them through the issues relevant to commercializing new technologies, including intellectual property rights, market, competitor, and valuation analysis. Outside speakers with relevant business experience are utilized as an integral part of the program.

Entering its third year, the IRL has thirty students enrolled, including sixteen PhD students representing Biochemistry/Plant Biology, Aeronautical & Astronautical Engineering, Chemistry, Chemical Engineering, Electrical & Computer Engineering, Industrial Engineering, Mechanical Engineering, and Nuclear Engineering.

IRL Background and Rationale

The concept for developing the IRL came out of discussions between Professor Marie C. Thursby and Alan Peterson, chairman of litigation support consultancy and CEO for Tucker Alan Inc., and the founding benefactor of Purdue University's Technology Transfer Initiative (TTI). At the time, Thursby held the Burton D. Morgan Chair of International Policy and Management in the Economics Department in Purdue University's Krannert School of Management. Thursby is currently the Hal and John Smith Chair of Entrepreneurship at Georgia Institute of Technology's DuPree College of Management. The Technology Transfer Initiative served as the pilot program for the IRL.

Initially Thursby was responding to engineering and science faculty's interest in commercializing their research, as well as the need for MBA students to have internship experience related to research and development. This response consisted of providing ad hoc assistance in the form of MBA students analyzing potential markets and doing some pro forma financial analysis. This activity developed into a formalized pilot program consisting of two PhD students working together with two MBA students, with substantial involvement from Thursby and the PhD students' advisor.

Demand for TTI's services grew annually. This is hardly surprising as the need for engineers to

understand business principles is well documented in yearly surveys of the Industrial Research Institute (IRI). The top five problems listed by industry R&D managers all relate to managing the R&D endeavor as opposed to dealing with technical issues. Data gathered in this process revealed that the top five problems listed by industry R&D managers all related to managing the R&D endeavor as opposed to dealing with technical issues. Furthermore, R&D manager's comments regarding new PhD hires from the university indicated a need for training and experience in team work, market and business related issues, and formulating problems in a manner relevant to the metrics of a market driven enterprise.

The process culminated in a successful \$2.5 million National Science Foundation (NSF) Integrative Graduate Education and Research Traineeship (IGERT) grant proposal by Thursby as the PI, and Professors Warren H. Stevenson (Purdue Mechanical Engineering) Louis A. Sherman (Purdue Department of Biology), William R. Woodson (Purdue School of Agriculture) as Co-PIs. The key parameter for the program's design was that it truly "add-on" to the PhD and MBA students' educational experiences, without impacting their graduation dates. For the PhD students, the primary objective is to develop basic business skills in the area of market, competitor, and financial analysis, with some exposure to business strategy issues. For the MBA students, the primary objectives are to provide exposure to project management in a research environment, and to offer a real world case in which to apply their MBA classroom learning. For both groups, exposure to the culture of the other is a critical element of the program, one that is achieved by creating an environment that requires teamwork to respond to program assignments. Finally, both groups receive instruction from practicing attorneys on patent, copyright, trademark law, trade secrets, and the management of intellectual property assets.

IRL First Cohort Results/Development of IRL/EPICS Interaction

Purdue's IRL "graduated" its first cohort of eleven students (5 PhD and 6 MBA; one PhD resigned after one year) in May, 2002. While the MBAs also graduated from Purdue, all PhDs continued in their programs, as expected. One PhD student has since graduated and accepted a position on industry in a research unit of a major company.

Among the items revealed by an independent, external assessment of the IRL program was that the second year of the program needed more depth and structure. Some interest was expressed in a real world based "practicum" in which the IRL teams could apply the commercialization analysis skills they had learned, and exercise their team skills as well.

Purdue's EPICS program offered an excellent opportunity to develop a real-world case analysis, with the added benefits of introducing undergraduate engineering students to basic market analysis concepts, and possibly identifying products with significant commercial potential that would otherwise be left dormant.

6. Resources under Development

The design of the EPICS Entrepreneurship Initiative's 1800 sq.ft. of space in the Burton Morgan Center for the EPICS Entrepreneurship Initiative is complete and the building will open in March of 2004. EPICS' space includes a workroom and a software development lab for the "polishing"

of EPICS products into commercial-grade prototypes. This building will also enable the EPICS program to:

- Place EPICS students immediately next to the MBA students that they will work with to develop business plans for their products.
- Provide facilities and opportunities for the EPICS teams to work with experts in the areas of design for manufacturability, safety, and reliability. This will ensure that the students learn the importance of these issues and can experience them in the very real context of their own product.
- Provide opportunities for EPICS teams to participate in, and feel a part of, a culture of entrepreneurship, thus ensuring that they come to understand the business as well as engineering aspects of their products.

7. The Unique Role of EPICS in Entrepreneurship

The EPICS program is unique amongst entrepreneurship programs in a university environment because it is built on products that have been developed for a ‘real’ customer. These customers, known as the ‘project partners’ of EPICS teams, request that EPICS teams pursue the design and development of products that help them provide better services to the community. This ensures that at least one verifiable need, or market, exists for each EPICS product. The question for entrepreneurship then becomes the degree to which this market can be expanded and the level of revenue that can be generated.

8. References

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9. Author Biographies:

EDWARD J. COYLE is an Assistant Vice Provost for Research at Purdue University, where he is also a co-founder of the EPICS Program and the Director of the EPICS Entrepreneurship Initiative. He is a co-recipient of the American Society for Engineering Education 1997 Chester F. Carlson Award for Innovation in Engineering Education and a Fellow of the IEEE. His areas of interest include computer networks, digital signal processing, engineering education and entrepreneurship.

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DONALD A. BLEWETT is the Associate Director of the Burton D Morgan Center for Entrepreneurship and Director of the New Ventures Laboratory within the BDM Center for Entrepreneurship. The Center is challenged to provide learning opportunities in the field of entrepreneurship for students and faculty of Purdue University through seminars, speaker presentations, workshops and experiential based coursework. His background spans 30 years in private industry in a variety of marketing and management positions including founder, President and CEO of Precision Cutoff of Toledo.

MARIE C. THURSBY is a Professor of Strategic Management and Hal and John Smith Chair in Entrepreneurship at the Dupree College of Management at Georgia Tech. She has developed and directed four major multidisciplinary programs for research and curriculum development, including Purdue's Center for International Business Education and Research; the Technology Transfer Initiative; and the Innovation Realization Lab, which teams Ph.D. students in science and engineering with MBA students to focus on the interface of technical, management, and economic issues involved in moving fundamental research into the marketplace. The fourth program is a similar program for Technological Innovation: Generating Economic Results at Georgia Institute of Technology and Emory University which is also funded as an NSF IGERT.