Integrating Entrepreneurial Projects into a Successful Multidisciplinary Capstone Design Program at the University of Florida

R. Keith Stanfill, Erik J. Sander, William J. Rossi, H. A. Ingley, E. Dow Whitney, Marc I. Hoit

University of Florida Department of Industrial and Systems Engineering / University of Florida College of Engineering / University of Florida Warrington College of Business Administration / University of Florida Department of Mechanical and Aerospace Engineering / University of Florida Department of Materials Science and Engineering / University of Florida College of Engineering Engineering /

Abstract

The University of Florida Integrated Technology Ventures (ITV) program is designed to provide engineering and business students with an intense, immersive entrepreneurial experience. The ITV program builds upon successful UF industry interaction model programs such as the Integrated Product and Process Design (IPPD) program, where multidisciplinary student teams design and build industry-sponsored products; the Center for Entrepreneurship and Innovation (CEI), the Office of Technology Licensing (OTL), and two university supported technology start-up incubator facilities. The students learn the entrepreneurial process as members of a virtual technology start-up company led by a so called "serial" entrepreneur—a technology venture start-up specialist—who serves as a CEO. The company is composed of the CEO, a business development team of 2 to 5 MBA students (coached by entrepreneurial faculty) and a multidisciplinary technology development team of 6 undergraduate engineers (coached by engineering faculty). The company is supported by a variety of commercialization specialists and local technology incubators. The technology development team participates in the two-semester IPPD course, which has been supplemented with an Entrepreneurship Lecture series. The company is responsible for creating an alpha system prototype and collateral materials such as a business plan and presentation for entry in academic business plan competitions. Three pilot entrepreneurial teams were chartered in the initial offering. The initial virtual companies are centered on patented technologies in the diverse areas of passive ground water contamination flux monitoring, large animal health monitoring, and respiratory muscular system training. Funding for these projects has been secured through the Economic Development Administration, the Lemelson Foundation (via the National Collegiate Inventors and Innovators Alliance), and the University of Florida.

Introduction

The University of Florida (UF) Integrated Technology Ventures (ITV) program provides a unique experiential learning environment for engineering and business students. The ITV program offers undergraduate engineers and MBA students the opportunity to work together within a virtual technology start-up company. Each company is led by an external entrepreneurial Chief Executive Officer (CEO) responsible for delivering a business plan,

marketing study and working prototype system. With support from key engineering and business faculty coaches, the students are key resources to the CEO. The projects are selected from UF technologies ready for commercialization. Program success will be measured in terms of student learning objectives, completed prototypes, business plans, and the spin-off of new ventures. The fall 2003 pilot implementation of ITV occurred less than six months after program conceptualization. This rapid program deployment was possible due to the following factors:

1. strong institutional support
2. a multidisciplinary implementation team from the Colleges of Engineering and Business, and the Office of Technology Licensing
3. the resources of the existing University of Florida Integrated Product and Process Design (IPPD) and Center for Entrepreneurship and Innovation (CEI) programs
4. the generous support of the Economic Development Administration (EDA), the Lemelson Foundation funded National Collegiate Inventors and Innovators Alliance (NCIIA), and MRI Devices Corporation.

The idea of the ITV program is to develop students that have a creative and entrepreneurial mindset. While the creation of spin-off business is a hoped for outcome, the critical aspect of the program is to further the leadership skills of engineering graduates. With the current climate of outsourcing engineering jobs, the best direction for the future of engineering and high-tech business development rests in the universities creating a free-thinking, technically-grounded graduate that can operate in a business environment. We believe that the ITV program is one possible method to cross the typical boundaries between innovative industries and engineering education. Our pilot program features three projects.

Building blocks for success

The ITV program builds upon successful UF industry interaction model programs such as the IPPD program [1,2,3], the CEI [4], the Office of Technology Licensing (OTL) [5], and two university supported technology start-up incubator facilities[6,7]. ITV leverages key elements of the following highly successful programs to provide a new entrepreneurial education experience for engineering and business students. Funding for the UF ITV Program has been provided by the Economic Development Administration (EDA—US Department of Commerce)[8], the National Collegiate Inventors and Innovators Alliance (NCIIA)[9], the UF College of Engineering, and MRI Devices Corporation, a small Gainesville, Florida based company.

NCIIA-sponsored activities

In 2002, the NCIIA provided seed funding to UF's CEI to develop and offer the Technology Venture Sequence (TVS) and Technology Venture Academy (TVA) programs. The TVS is a two-semester, hands-on business planning course. In the first semester, during weekly lectures, the students are taught how to develop a business plan. Then, working in small teams under the guidance of a mentor, teams of three develop a business plan around a real technology idea. Although the class is held weekly, the second semester is unstructured by design to meet the diverse problems encountered by the E-Teams. The E-Teams compete against each other in the annual Howard J. Leonhardt Business Plan Competition hosted by CEI. The TVA provides students, faculty, financiers, and policy makers with an intensive experience in technology commercialization. TVA addresses important issues involved in taking a university-based

technology to market, with lectures, speakers, personal technology evaluations and networking opportunities. Participants learn the process through a team-based commercialization case study.

Integrated Product and Process Design

The Integrated Product and Process Design (IPPD) program is an innovative educational initiative at the UF College of Engineering. Over two semesters (eight months), in weekly classes, students from various engineering and business disciplines are taught how to design products and processes. Then, working in multidisciplinary teams of six under the guidance of faculty coaches and industrial liaison engineers, the students design and build authentic industrial products. The products may include, but are not limited to, the design (or redesign) and manufacture of a new or derivative product, manufacturing process, test apparatus, chemical process, or software system. Since 1995, over 1000 students from more than 10 engineering and business disciplines have participated, and 186 projects have been completed—with a success rate of over 90%. Industry sponsors pay $20,000 per project and own any intellectual property that is developed. College of Engineering Dean Pramod Khargonekar describes IPPD as "the crown jewel of our undergraduate engineering program."

Entrepreneurship for Engineers course

In an effort to promote entrepreneurial thinking among engineering graduate students, a special course, entitled "Entrepreneurship for Engineers" was developed by the CEI and initially offered in spring 2003. The course objectives include exploring the entrepreneurial mindset and culture, examining the entrepreneurial process, experiencing the dynamics of participating on a business team, creating and presenting a business plan, and providing the background and tools to participate in the entrepreneurial process within a large company, in a new venture or as an investor. In addition to individual assignments, class discussions, and a final examination, the students work in teams to develop a venture idea into an early stage business plan and then present that plan to the class and a panel of entrepreneurial reviewers.

Description of the ITV program

The ITV program combines the best of these programs to provide engineering and business students with an educational experience that is as close to a true entrepreneurial environment as one will face in an academic setting through the following major program steps:

- Project Selection: A strategic planning group comprised of university technology commercialization professionals and the ITV Principal Investigators, identifies a faculty-generated invention disclosure ready for marketing and business plan development and alpha prototype creation
- Entrepreneur and Faculty Recruitment: A local, experienced entrepreneur is paid to serve as a CEO of a virtual company comprised of a business team (two to five MBA students) and a technology development team (typically four to six undergraduate engineering students). Part of the selection process is to identify a CEO interested in licensing the UF technology. Since the UF Office of Technology Licensing routinely interacts with local and regional entrepreneurs with such interests, OTL took on the responsibility to find the CEO for each project. In parallel with locating a CEO, the ITV PI identifies a faculty "coach" with needed domain expertise for development of the technology toward a specific market application

- Student Recruitment: The faculty coach, the CEO, the technology inventor, and the ITV PI collaborate to determine the required discipline mix for the undergraduate technology development team. The coach then recruits this multidisciplinary team from the pool of IPPD program applicants while CEI recruits and counsels the MBA students who serve as the business team.
- Experiential Education: The technology development team participates in the IPPD course. Eight supplemental entrepreneurial workshops were developed to educate the technology team on entrepreneurial and business related issues. The business team participates in selected IPPD classes to understand engineering product and process development criteria for alpha prototype development. The business team receives course credit toward their MBA degree.
- Virtual Start-up Company Environment: The company CEO counsels and directs the entire virtual company (Engineering Team, Business Team, Faculty Coach, and Inventor as appropriate) weekly to assure that development of the deliverables, such as the market analysis, the prototype, and the business plan are progressing satisfactorily to fill market applications. At the same time, UF Engineering and CEI coaches meet with their teams individually to discuss specific engineering and business related issues.
- Educational and Entrepreneurial Deliverables: Collaboration among all of the students and the faculty coach and inventor, under the direction of the entrepreneur CEO, will lead to a set of deliverables that includes development by the Technology Team of an alpha prototype that meets the market and business requirements developed by the Business Team. Concurrently, the Business Team will work with the Technology Team to produce collateral information such as a market analysis, business plan, and investor presentation to present in the annual UF Howard J. Leonhardt Business Plan Competition and similar investor forums. The net result of the project is a team of Engineering and Business students working collaboratively with "real world experience" in a truly entrepreneurial environment.

Major pedagogical components

Content and team formation

The IPPD program teaches the student participants the structured, top-down development process through two weekly just-in-time lectures with generic deliverable content, a training manual with generic deliverable requirements definitions, and a weekly coach-led workshop to tailor the deliverable content to the team's project. Students have reading and research assignments, and they work in sub-teams and as individuals to create the project deliverable content. The ITV program follows this same proven methodology. Supplemental lecture content and additional deliverables have been defined for the ITV teams.

Admission to the IPPD program is competitive and the correct number of students by discipline are recruited in aggregate each year to staff all of the project teams (up 180 students and 31 teams). Team formation will be based upon the skill mix required of the ITV team, the qualifications of the students, and the students' preferences.

Entrepreneurial approaches to problem solving

The very nature of the ITV program drives project teams to take an entrepreneurial approach to problem solving. Project teams are structured and act as a virtual start-up company complete

with roles, titles, and responsibilities, an entrepreneurial need to focus limited resources, and appropriate urgency in product development to meet market demands. The teams, through the direction of the entrepreneurial CEOs, engage other resources in the university and entrepreneurial community as necessary to meet milestones. The designed multidisciplinary nature of the course and team require an entrepreneurial approach to orchestrate disparate disciplines (engineering, marketing, production, sales, etc.) in problem solving to meet technology and corporate development milestones.

Learning objectives

The ITV program incorporates unique learning objectives including applying engineering knowledge in an entrepreneurial environment, understanding the entrepreneurial process through experiential learning, understanding and using principles of multidisciplinary team work, understanding and utilizing principles of effective oral and written communications and presentations for audiences ranging from technical specialists (researchers) to generalists (investors), and improving students' abilities to conduct independent research to solve problems utilizing an entrepreneurial approach to problem solving.

Supplemental modules

In addition to the regular IPPD course offerings, entrepreneurial supplement modules have been developed and offered to ITV students approximately every two weeks. The extra classes are open to all IPPD students, but required for the ITV teams. These modules are offered to provide needed information at the appropriate point in the virtual company development and include the following:

1. entrepreneurial idea generation and feasibility analysis
2. entrepreneurship and company formation
3. market analysis and research
4. building and working in a multidisciplinary business team
5. business planning and plans
6. marketing in an entrepreneurial environment
7. financing models (fundraising)
8. financials (income statement, balance sheet, and cash flow statement).

ITV teams

In the pilot offering, three virtual companies were formed. At least two ITV teams will be formed in each subsequent program year. Each ITV team consists of the following:

- a technology development team composed of four to six undergraduate engineering and business students coached by an engineering faculty "coach"
- a two- to five-person market research and business plan development team composed of MBA students coached by a CEI faculty member, the engineering faculty inventor(s)
- an experienced, local entrepreneur to act as a CEO to run the virtual company.

The following paragraphs describe the companies formed for the pilot offering of ITV:

Large Animal Wireless Health Monitoring System

Produce a business plan, an advanced schematic design and a breadboard prototype and associated software for a wireless large animal health monitoring system. The target market is the dairy cattle industry; however, the device could be applied to other large animals such as beef cattle and horses. The technology development team is composed of three electrical engineers, a computer engineer, an engineering sciences (bio-mechanics) major, and an industrial engineer. The business team is composed of three MBA students. The EDA, NCIIA, and College of Engineering provided funds for this company.

Passive Flux Meter

Develop a working prototype and business plan for a start-up company focused on manufacture, installation, and analysis of passive flux meters. The passive flux meter is installed into monitoring wells of contaminated groundwater sites and used to determine cumulative contaminant and fluid flux providing a new method of groundwater remediation analysis. The technology development team is composed of two mechanical engineers, a materials engineer, an environmental engineer, and an industrial engineer. The business team is composed of three MBA students. The EDA, NCIIA, and College of Engineering provided funds for this company.

Respiratory Muscle Strengthening Device

Develop a commercializable respiratory muscle strengthening device for use by musicians, athletes, and others. The technology development team is composed of a mechanical engineer (bio-mechanics minor), a materials engineer, an engineering sciences (bio-mechanics) major, an electrical engineer, and an industrial engineer (English minor). The business team is composed of five MBA students. The MRI Devices Corporation, NCIIA, and the College of Engineering provided funds for this company.

Conclusion

The UF ITV program provides a unique experiential learning environment for engineering and business students. Students learn firsthand how entrepreneurial ventures are formed and operate. Along their educational journey, they also learn many technical and soft skills necessary to be productive professionals. Program success will be measured in terms of student learning objectives and the spin-off of new ventures. We hope this success creates jobs for the local area and a steady stream of trained technology entrepreneurs.

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Biographical Information

R. KEITH STANFILL

Keith Stanfill joined the University of Florida faculty in May 1999 and has been the Director of the Integrated Product and Process Design program since July 2001. Dr. Stanfill has over ten years' industrial experience with United Technologies, including 7 years with Pratt & Whitney and 3 years with Carrier Corporation. As an engineer at Pratt & Whitney, he designed gas turbine hardware for fighter aircraft—most recently the Joint Strike Fighter. At Carrier, he served as a key resource to the New Product Development Council Steering Committee, facilitated Design for X (DFx) workshops internationally, developed business process linkages between new product development and lean manufacturing, and developed and implemented manufacturing systems software. He

received his B.S., M.E., and Ph.D. in 1985, 1991 and 1995, respectively, all from the University of Florida Department of Mechanical Engineering. His interests include technology transfer, product development, entrepreneurship, design education and DFx. He is a registered professional engineer in the state of Florida and is a member of the American Society of Mechanical Engineers and the American Society of Engineering Education.

ERIK J. SANDER

Erik Sander is the Director of Industry Programs for the University of Florida College of Engineering. He served for 10 years in various positions ranging from Project Manager to Senior Engineer analyzing advanced fighter aircraft engines and the Space Shuttle Main Engine for NASA, Lockheed Martin, General Electric, and Pratt & Whitney. From 1994-1995, Erik was a Lead Technology Transfer Officer for Lockheed Martin where he was responsible for all technology transfer activities between the NASA Marshall Space Flight Center, Lockheed Martin and private sector industries. Starting in 1995, Erik served as Director of the University of Florida University Center, a program which assists small companies commercializing university, federal and private sector technology. Since 1998, Erik has served as the Associate Director for Industrial Collaboration and Technology Transfer for the University of Florida Engineering Research Center. From 2001-2002, Erik also assumed the responsibilities of Director of Business Development for Cenetec Ventures, LLC, a private technology accelerator and early stage venture fund. Erik received his Bachelor of Science in Mechanical Engineering from the University of Florida and Master of Science in Management of Technology (Cum Laude) from the University of Alabama in Huntsville. He serves on the Board of Directors for several world class companies and research institutes, is a published technical author, and is a recipient of the NASA Achievement Award and the Martin Marietta Eagle Award.

WILLIAM J. ROSSI

William J. Rossi is Clinical Professor of Entrepreneurship, Associate Director of the Center for Entrepreneurship and Innovation (CEI) and Director of GatorNest in CEI. He began with CEI at the University of Florida in 2001. Mr. Rossi received a B.S. in Mechanical Engineering and in Industrial and Systems Engineering from Ohio University and an M.S. in Operations Research from the University of Massachusetts. Prior to joining CEI Mr. Rossi served in executive, officer-level positions with several companies, both public and private. Senior level responsibilities have encompassed general management, and financial, operations, sales, marketing, and engineering management. Mr. Rossi has been involved as a principal in several start-up and turn-around ventures.

H.A. (SKIP) INGLEY

H. A. (Skip) Ingley is an associate professor of Mechanical and Aerospace Engineering at the University of Florida. Dr. Ingley was Co-Director of the University of Florida's Solar Energy and Energy Conversion Laboratory from 1973 until 1983. Ingley founded Ingley, Campbell, Moses and Associates, Inc. (ICM), a mechanical, electrical, plumbing and fire protection engineering firm in 1983 and served as the chief executive officer and senior engineer for this 35 person firm until 2000. During his tenure at ICM he continued to provide instruction in air conditioning design, energy management and consulting engineering practices. In 2001, Ingley returned full time to the University of Florida and is actively researching alternative energy and conventional energy applications and environmental factors affecting animals. He has authored several technical papers and book chapters and holds one US patent with three patents pending. Prof. Ingley is a 25-year member of the American Society of Mechanical Engineers (ASME) International and the American Society of Heating, Refrigerating, and Air-conditioning Engineers (ASHRAE). Dr. Ingley is a registered professional engineer in the State of Florida and a State Certified Asbestos Surveyor and Management Planner. He has actively supported professional student organizations in the University of Florida's Mechanical and Aerospace Engineering, having served as the ASME and ASHRAE faculty adviser and currently as the ASHRAE design team coach and the faculty adviser for the Mechanical Contractor's Association of America (MCAA).

E. DOW WHITNEY

E. Dow Whitney, a professor in the Department of Materials Science and Engineering at the University of Florida, Gainesville, Florida. He was a NASA/ASEE Summer Faculty Fellow at the Kennedy Space Center, an adjunct professor of ceramic engineering at Clemson University and adjunct professor of physics and chemistry at Memphis State University. Dr. Whitney has numerous fields of interest, some of which include: mining and minerals beneficiation (phosphate ore); thermodynamics and kinetics of high pressure/high temperature phase transformations in solids, including diamond synthesis technology; physical chemistry of hard materials; machining and

manufacturing with advanced ceramic cutting tools and abrasives; chemical tribology in both metal cutting and hybrid ceramic bearings; chemistry of boron hydride and fluorine-based high energy rocket propellants and fractography and failure analysis of glass and ceramics as related to the technical aspects of product liability litigation. His current research deals with the theoretical calculation of ionization potentials and phase stability of high temperature inorganic oxides as related to the development of advanced thorium dioxide/uranium dioxide nuclear fuel elements. He is a SME (Society of Manufacturing Engineers) certified manufacturing engineer (Life) and a professional engineer (State of Florida), a Fellow of the American Ceramic Society and Vice President of Materials Consultants, Inc., Gainesville, Florida, a professional engineering association dealing primarily with product failure analysis and accident reconstruction. He is the editor of a book entitled, Ceramic Cutting Tools; has over one hundred technical publications and holds thirteen patents.

MARC HOIT

Marc Hoit is currently the Associate Dean for Academic Affairs in the College of Engineering at the University of Florida. He received his BS from Purdue University in 1978, his MS in 1980 and PhD in 1984 from University of California, Berkeley. He is a Professor in Civil & Coastal Engineering Department. Dr. Hoit is very active in the research and educational community. His discipline specialty is in the development of Finite Element Analysis software. Dr. Hoit was the faculty advisor for the student chapter of the American Society of Civil Engineers from 1990-2003. During his tenure as advisor, they have won their regional competitions for the past five of the last seven years. He has also help the student steel bridge team place in the top five nationally since 1993. Some of Dr. Hoit's awards include: Distinguished Faculty Award, University of Florida, 2000; Outstanding Student Organization Advisor of the Year, University of Florida, 2000; and Certificate of Commendation, National ASCE, 1999.