Taking Senior Design Course Projects to Market

Ken Ports, Carmo D'Cruz, Muzaffar Shaikh, Carolyn Fausnaugh
Florida Institute of Technology

Abstract

This paper describes an innovative new program that is a synergistic combination of Florida Tech's technology commercialization-related course offerings in Engineering Management, its Senior Design course curriculum, and its new business accelerator, Florida Tech Start. The program is designed for the subset of senior design course students who desire to leverage their design course experience by commercializing their innovative products and technologies and creating start-up companies.

Florida Tech's engineering management curriculum offers innovative courses in technical marketing, high tech product strategy, fast cycle time product development & launch, and engineering entrepreneurship. In these case study courses, students develop real world marketing and business plans for commercializing innovative new products and technologies. Some of the innovative product development and technology commercialization ideas have won accolades at regional business idea pitching competitions.

Concurrently, Florida Tech's intensive undergraduate engineering programs (in ECE, CS, ME, CE, ChE, AE and Ocean Engineering) have resulted in a number of outstanding crossfunctional Senior Design Projects. The Florida Tech Senior Design program has become highly coordinated across all the engineering departments and structured for improved quality and effectiveness. There is a growing interest by teams in commercializing the project results.

Florida Tech Start has just commenced operations as a business accelerator for high-tech ventures, and provides a networking forum for inventors, corporate sponsors, investors and business service providers. It is designed to facilitate the creation of start-up, technology-based, revenue generating ventures.

Working together, Florida Tech Start, the senior design sequence of courses, and the entrepreneurial curricular thread in engineering management provide a strong foundation and exciting opportunity for undergraduate students seeking to commercialize their student senior projects.

Introduction

There has been a considerable demand for Engineering Entrepreneurship and Technology Commercialization in Brevard County, Florida. This is because of the available high tech talent due to the proximity of NASA / Kennedy Space Center, defense contractors such as Harris Corp., Northrop Grumman, Boeing, Lockheed Martin, and the growing wireless and high tech industry in the Brevard area. There are a number of talented engineers who have the necessary

technical background and innovative ideas, but do not have the knowledge to commercialize and start a business around these ideas. Also, because of the uncertainties over the NASA / Aerospace and Defense budgets and the downturn in the Telecom industry, many engineers are contemplating using some of their innovative ideas to start-up their own entrepreneurial ventures.

Two courses (Technical Marketing and High Tech Product Strategy) that were oriented towards the preparation of marketing plans for high tech products and technologies have been taught in the graduate Engineering Management program at the Florida Institute of Technology (aka FIT or Florida Tech) since 1997. In these case-study courses, the complex strategic factors and emerging cross-functional principles involved in the development, manufacturing and marketing of high-tech products are examined from a Whole Product and holistic perspective, and the experiences of successful and not-so-successful high-tech companies are analyzed. Throughout the courses, students work on the development of a marketing plan or a strategic plan for commercializing a high tech product or technology.

In summer term 2002, an innovative joint course offering in "Engineering Entrepreneurship" by the Electrical and Computer Engineering Department and the Engineering Management program, resulted in considerable entrepreneurial enthusiasm at FIT. Some of the innovative product development/technology commercialization ideas such as Liq-Sens (application of FIT fiber-optic technology for liquid level measurement) and the DietLight Bulb (diode white light bulb) have won accolades at regional business idea pitching competitions.

Concurrently, Florida Tech's intensive undergraduate engineering programs (in Electrical and Computer Engineering, Computer Science, Mechanical Engineering, Civil Engineering, Chemical Engineering, Aerospace Engineering, and Ocean Engineering) have resulted in a number of outstanding Senior Design Projects. Examples include STEMSCOPE (a compact scanning tunneling microscope), Marvin (an autonomous robot with GPS navigation and proximity sensors) and Europa (a flying submarine).

During the past two years, the Florida Tech Senior Design programs have become highly coordinated across Engineering Departments and structured for improved effectiveness. To facilitate increased, sustainable product realization success, the senior design experience for computer engineers, electrical engineers, aerospace engineers and mechanical engineers now begins in the spring semester of the junior year.

The focus of this paper, the Senior Design Commercialization and Entrepreneurship Program, is designed for the subset of senior design course undergraduates who desire to leverage their system design course experience by taking their project/product to market outside of the university. External public/private foundation funds are being used to facilitate the additional experiential activities, for supporting the development of a synchronized entrepreneurial curricular thread and underwriting some entrepreneurial (E-Team) team expenses associated with materials, establishing intellectual property, market research, travel and other up-front investments.

Goals of the Program

The six major goals of the Senior Design Commercialization and Entrepreneurship Program are to:

1. Provide an experiential learning environment to undergraduate engineering students for transforming innovative senior design product/technology ideas into commercializable products and businesses

2. Develop core skills and competencies through a structured, project-management-based product development approach

3. Enable students to experience the process of engineering entrepreneurship by identifying and pursuing business opportunities for a technology / product with a team of motivated peers

4. Facilitate student analysis of the problems encountered in starting up a technology-based venture with very high degrees of technical and market uncertainties

5. Provide a forum for networking with practicing professionals and entrepreneurs to share their experiences, get feedback, and gain valuable insights, practical knowledge and tools for technology commercialization and entrepreneurship

6. Create start-up, technology-based, revenue-generating ventures that will create jobs in Brevard County, Florida

Courses Supporting the Program

Course 1: **Senior Design –** This is the series of three System Design capstone core courses, beginning with Junior Design in the spring of the Junior year, which focus on conceiving, defining, designing, validating and demonstrating innovative new product ideas. System Design I and System Design II are taken in the Fall and Spring terms of the senior year. The students work on cross-functional teams and learn by participating in and delivering results for business planning, new product development, project management, project execution and closure, a little marketing, and the definition and production of launch collateral materials such as articles, patent disclosures and application notes. Each team conceives a new product idea, then defines it, determines its value proposition, designs it, verifies the design, develops and builds it, validates it and prepares for a "whole product" market introduction. The culmination of the course sequence is the Student Design Showcase, set up in the gymnasium as a trade show, open to all faculty and students, the public, local companies, schools, team sponsors and the press, and at which each team demonstrates their project results.

Course 2: **Technology Commercialization Strategies -** This innovative, overview course systematically covers the technical, marketing and business aspects of the technology commercialization process in 18 steps through the 3 phases (concept, development and commercialization) and six stages (investigation, feasibility, development, introduction, growth and maturity)

Course 3: **Technical Marketing** – This course gives the engineers a strong tactical marketing orientation and shapes their innovative high tech idea into the right product for the right customer, to further increase the chances of market success. It is very critical for engineers to develop paradigm pliancy and think in terms of the whole product, not just their generic technologies or products. Technical Marketing is a course in tactical, product line marketing.

Course 4: **High Tech Product Strategy –** This course has a strategic marketing focus and addresses the formulation of specific product strategies using a unique holistic approach to product strategy. Its comprehensive content systematically covers almost all the issues a high growth, entrepreneurial start-up should consider in developing its strategies, including timing, technological change, globalization, product differentiation, and cost-based strategy, as well as expansion and innovation strategies

Course 5: **Engineering Entrepreneurship** - This course is an advanced overview of engineering entrepreneurship, in which the students learn how to structure their high tech start-up business and their business plan. The risks, rewards and challenges of entrepreneurship and the strategies and tactics to increase the chances of success are discussed in this course. This course develops the entrepreneur's skills in marshalling the resources for launching a successful high tech venture: advisory board, employees, strategic partners, lawyers and capital. The fundamentals of business leadership in the early-growth phase of a high tech venture are covered.

The Final Business Plan: **Final Business Plan Write up and Presentation**. Students on teams which follow this entrepreneurial curricular thread and desire to take their idea to the innovation market will be expected to write up a professional business plan and present it at widely attended forums to potential investors, VCs, incubators and technology development / commercialization offices. Throughout the curricular program, teams of typically four to five students will work on the development of the business plan to market an innovative new product or to commercialize a promising technology.

Courses 2 – 5 above are offered in sequence over 4 semesters beginning with **Technology Commercialization Strategies** in the first summer term, followed by **Technical Marketing** in the fall term, **High Tech Product Strategy** in the spring term and **Engineering Entrepreneurship** in second summer term. This timing synchronizes well with the **Senior Design** sequence and positions entrepreneurial teams to go to market with their ideas either after graduation or in graduate school.

In addition to these engineering and engineering management courses, the School of Management at Florida Tech also offers 3 courses relevant to entrepreneurs:
- Managing Small Business
- Entrepreneurial Finance
- New Venture Development

The latter two are graduate level courses. All contain material which complements that delivered by the engineering management course offerings.

The faculty members associated with these courses have extensive product development & launch / high tech marketing / entrepreneurship backgrounds and experience in industry and academia.

The Senior Design Course Approach at Florida Tech

Most of the Departments in the Florida Tech College of Engineering have a sequence of courses generally characterized as "Senior Design". In this course series, students form teams and work on projects, the results of which are displayed near the end of the senior year. The senior design sequence of courses is coordinated across all the departments in the College of Engineering, particularly during Junior Design, which precedes Senior Design and during which the students pick out their projects, form their teams and do feasibility studies, initial planning and preliminary activities for attaining any necessary project funding. These coordination activities are in their second year and already have significantly enhanced the conduct of the individual courses and the coordination of teams which span multiple departments and programs.

Also in its second year is the Student Design Showcase event. Rather than each department or program independently concluding the senior design experience at the end of the Senior year, Florida Tech now has a single, College of Engineering "Student Design Showcase". For this event, the university gymnasium is set up in a trade show configuration to display project results. The College of Engineering invites all students, faculty, the press, project sponsors, local industry, schools, and the general public to attend. In addition to the Seniors demonstrating their projects, the Juniors also participate, exhibiting their Senior Project plans. External sponsors of projects are invited to set up display tables for their organizations, and other external and student organizations and clubs participate as well. In addition, students and faculty of the Florida Tech School of Management participate, both with a display and an activity to identify several Junior Design project plans for case study work by School of Management students in the following year. The Showcase, in just its second year, has already become a significant university event. The Florida Tech Board of Trustees and also the College of Engineering Board of Advisors coordinate their meetings to occur on the day of the showcase, so all members can visit the displays and interact with the students and teams. Last year, venture capitalists from Orlando attended, looking for prospective investments. This year, the event will be held for two days – on a Friday and on the following day at the university's spring Open House, where the projects will be viewed by approximately 2000 prospective students and their families in addition to the students, faculty and public described above.

The Electrical and Computer Engineering (ECE) Department series of senior design courses masquerades as a start-up company, planning to bring a suite of new products to market. In this context, the students learn much about the industrial new product pipeline, project management and team behavior. Teaching the course in this context is particularly useful for students and teams desiring to commercialize their project results, as they are learning and using an industrial-quality new product pipeline process while they do their projects. The ECE department is also in league with its counterpart at the Rose-Hulman Institute of Technology in Terre Haute, Indiana, and, with the support of NCIIA funding, has an experimental senior design team which spans the two colleges. Since many industrial teams span several geographical locations, there is no reason not to provide this experience to students in an academic setting.

Sample of Senior Design Projects for Commercialization from the Program
Over 300 undergraduate students from the various engineering disciplines register for the Senior Design course sequence at Florida Tech. They are divided into teams of 4 to ~8 students each. As a result, there are approximately 60 E-Teams (about 40 in Senior Design and 20 in Junior

Design). Some of the current projects which could lend themselves well to entrepreneurial ventures for commercialization are:

1) A small, portable, scanning tunneling microscope.
2) A system for tracking creatures which live underwater.
3) A system using fiber optics for weighing trucks in motion on the highway.
4) A wireless system for tracking either materials or humans
5) A vehicle multimedia system with music and videos wirelessly downloaded from a PC.
6) A small, controllable hovercraft.
7) An improved wireless system for control of robotics.

Some of the larger and more complex projects may also have entrepreneurial elements:

1) A flying submarine.
2) A small hovercraft
3) A winged rocket for controllable re-entry
4) A formula racecar
5) A vertical take-off and landing aircraft

At this time, three senior design projects are participating directly in the Senior Design Commercialization and Entrepreneurship Program – the scanning tunneling microscope (STEMSCOPE), the marine life tracking system (TAG), and the smart air conditioning system (SMART AC Systems), the latter a project from last year's senior design course. The program is growing, however, as so far for next year, at least four teams, just from the ECE department, have indicated they plan to start companies and go to market with their senior projects.

Support for the Program from Florida Tech*Start*
Florida Tech*Start* is the new business accelerator for the university, opening for business in October, 2003. It was formed as a College of Engineering and School of Management partnership supporting student, university and community entrepreneurs in the area of high technology, and its goal is to develop leaders who can start high tech companies and make them succeed.

Florida Tech*Start* is designed to be the principal portal in and out of the university for all those with high tech entrepreneurial interests. Its deliverables and services include:

- Networking, workshops and seminars
- Synergistic sponsored programs
- Student internship, research and placement support
- Linkage to entrepreneurial senior capstone design projects
- Regional partnerships for networking and leverage
- A professional services referral network
- Linkages to faculty consulting and collaborative proposals
- Access to specialized equipment, laboratories and other university capabilities
- Coordination and offering of curricula, courses and training
- Other special activities

Entrepreneurial teams and students in senior design work directly with Florida Tech*Start* to help facilitate the commercialization of their projects and ideas. In this regard, Florida Tech*Start*'s goal is provide an accelerated opportunity track for any senior design projects and teams which may have market potential for commercial implementation.

In addition to Florida Tech*Start*, Florida Tech has initiated a student entrepreneurial club, the e-club, which meets regularly, has a series of invited speakers covering all aspects of the entrepreneurial life, and provides student support to the operation of Florida TechStart.

Emphasis on Innovative Thinking and Entrepreneurial Approaches
Throughout the curriculum, elements of leading-edge processes like "Breakthrough Thinking" and "Disruptive Technologies" are included in the program to emphasize creative thinking. Creativity in project selection and issue resolution is stressed in the Senior Design sequence. Interaction with serial inventors and sharing of insights into creative inventions/innovations is required. Using the case studies of inventive geniuses, strategic analysis tools, the courses emphasize creative thinking and problem solving.

This program was designed to provide an introduction to the challenges and choices associated with the development of technical ventures. Students learn how to identify technology-based venture opportunities, evaluate technical feasibility and business potential, and develop a plan for successful commercialization. Throughout the program, students are required to provide updates on the progress of their entrepreneurial ventures. This state-of-the-art program addresses the formulation of specific strategies to significantly increase the probability of market and technical success. Through the incisive insights of leading entrepreneurs, numerous examples, and case studies / interactive discussions simulating the experiences of technical entrepreneurs, this comprehensive program systematically covers almost all the issues aspiring entrepreneurs should consider in developing their new ventures, including funding, intellectual property, project management, timing, technological change, globalization, product positioning, and contingency planning, as well as marketing and financial considerations. Class sessions focus on the issues which must be faced in starting a new venture and the options which are available to the technical entrepreneur. Particular emphasis is placed on rigorous assessment of the technical and business merits of selected innovations through individual and group projects.

Using guest lectures from Venture Capitalists, Financial Advisors, Patent Attorneys, Technology Incubator directors, representatives from the NASA Technology Commercialization office and TRDA (Technological Research and Development Authority), and successful / struggling entrepreneurs, the students are encouraged to mold their innovative ideas into realistic products, business plans and commercial ventures. The faculty from the various disciplines of Florida Tech's College of Engineering and the School of Management and the resources of the local organizations such as the Space Coast Economic Development Center and the Small Business Development Center are available to further guide and help the students with their entrepreneurial projects. By meeting and interacting with practicing professionals, students learn from the experiences of seasoned entrepreneurs and financiers, get feedback from professionals, and acquire practicing knowledge and tools.

As an example, guest lecturers for the fall semester of 2003 for Technical Marketing included speakers discussing:

- FASTRAC, a Boeing spin-off in rapid prototyping
- StarHunter Corporation, a micro-satellite start-up
- A new framework for the technology adoption life cycle model
- How to win business plan competitions
- An invention for harnessing power from ocean waves
- A methodology for proliferating space technology for terrestrial applications
- A start-up for fast turnaround cable routing
- The commercialization experience for a swimming pool leaf skimmer invention
- The linkage between CEO personality and corporate performance and valuation

E-teams graduating from the program are presented the opportunity to participate in the activities of the local / regional incubators, and may compete for space in these incubators. Training in applying for and obtaining funding from Federal SBIR/STTR; other national, state and private programs is available to the E-teams. The program will be supported by the local / regional technology incubators, NASA office of technology commercialization and contributions of local high tech firms and the successful companies that were formed as a result of this program. Graduating E-Team members are encouraged to mentor new senior design teams and strike-up collaborative ventures, and to attend, network with investors/high tech firms and present their business plans at widely attended entrepreneurial forums/colloquiums organized by FIT, local organizations and universities.

Senior design teams and individuals participating in the entrepreneurial course sequence are in good company. The networking is important, and also is the breadth and diversity of high technology ideas and e-teams represented in the courses. The scanning tunneling microscope was proposed as an NCIIA e-team through the Technical Marketing course in the fall semester of 2003 (STEMSCOPE). Other proposals and e-teams included:

- Prescription Drug Conflict Resolution
- Pocket Door Hurricane Shutter
- Autonomous Sonar Radar Controlled Robot
- PerimSec Bluetooth Badging System
- SMART AC Systems
- PFT – Polyethylene Fuel Tank for Autos and Aircraft
- Anti-Scale Device for Oil Pipes
- SMART Pipes

One issue relating to teams with international, employer-paid students (such as the two "pipe" projects above) has been with employee contracts and conflict of interest issues. Efforts are ongoing to resolve these issues on a case-by-case basis.

Program Evaluation Plan

The literature contains some guidance as to proper metrics for evaluation of university entrepreneurial programs. For instance, in the reference #17 article, over 300 universities were

analyzed and ranked in this area, with the top seven criteria suggested for ranking entrepreneurship programs were courses offered, faculty publications, impact on community, alumni exploits, innovations, alumni start-ups, and outreach to scholars. The measures we selected looked more within the courses, but generally paralleled these choices.

The following measures / metrics were selected for use to evaluate whether program goals are being achieved:

1. **Senior design course deliverables (feasibility studies, business plans, Gantt charts, PDRs, CDRs, prototypes, demonstrations, launch collateral, etc).**

   In the ABET accreditation sense, these graded deliverables are used to assess the extent to which the objectives of a given course are being successfully delivered. In the product-to-market sense, they represent the documentation generally developed for the principal gates of a traditional stage-gate system, and are relevant to what entrepreneurs must consider, formally or informally, as they bring their new products to market.

   There are two caveats:
       1) The senior design sequence of courses are core courses and must be taken by all undergraduate engineering students, regardless of their career interests or abilities and
       2) Even on entrepreneurial teams, not all team members are intending to follow an entrepreneurial path after graduation

   The authors observe that the teams and individuals which do better in their performance on these deliverables are always a combination of bright, excited and diligent. This also is a fair description of the student entrepreneurs in the classes. They tend to become the project leaders and drive and inspire their teams. We do not see any systematic difference in the grades awarded to entrepreneurial versus standard teams, other than noting that no entrepreneurial teams have yet ended up in the lower part of the grade distribution. Nor do we see any difference in the distribution in the grades within the teams.

   This measure therefore is used in an absolute sense rather than a relative sense, to ensure that the course objectives and program outcomes are well served by the content and delivery of the courses.

2. **Senior design course student feedback on course objectives, quality and effectiveness.**

   Florida Tech routinely surveys the students in every class every semester to assess the course content and delivery from the students' point of view. The responses are assured anonymity, so detailed evaluation of entrepreneurial versus non-entrepreneurial responses can not be done. The students answer several questions relating to the content, delivery, quality and value of the course on a 1 to 5 scale, with a 1 representing an "A" and a "5" representing an "F" (the lower the rating, the better

the result).   The students are not as generous in their grading as they expect their professors to be. Most courses, particularly the larger, required core courses, are rated between a 2.0 and a 2.5. Courses rated above a 3.0 generally result in counseling and/or coaching of the professor. Courses rated below a 2.0 are generally considered the best, highest-value courses in the program. Since the senior design sequence of courses was redesigned to have a more industrial, whole product flavor, to expand the multidisciplinary nature of the teams and to encourage entrepreneurial behavior, the course ratings have improved from 2.09 to 1.68 to 1.65. When the Junior Design course was created and added to the senior design sequence, its first rating was 1.95.

Again, this metric can not be used in a relative sense to determine the analysis of student entrepreneurs, but in an absolute sense, verifying that the overall sequence of courses, with its new, more entrepreneurial emphasis, is being well received by students.

3. **Written feedback from the investors and technology incubator directors on the business plans that are presented to them.**

The experience with this metric is just getting underway. Regarding senior design projects going to market, we are just now getting to the point where the entrepreneurs are beginning to interact with investors and incubator directors. There will be more to report on this metric in the future, as our program matures and continues to expand. In terms of teams taking the engineering management courses but not with projects originating in senior design, the experience has been that the entrepreneurs have done very well in local and regional business plan competitions, but so far, few of the teams have been able to secure e-team funding from foundations.

4. **Feedback from the students on the entrepreneurial course contents and logistics**

At this point, the entries in this area are anecdotal. The students appreciate the practical, hands-on, case-study approach to the course content of the engineering management courses. The "missing" content most in demand by the students is more entrepreneurial finance information and training aimed specifically at non business majors.

This year, for the first time, what could have emerged as a serious issue was avoided. Several entrepreneurial students in the engineering management courses declared themselves hobbled – unable to participate in any meaningful classroom discussion about their projects and issues because of fear of divulging trade secrets or imminent IP information. The professor, one of the authors of this paper, worked with the research and IP office of Florida Tech and developed a suitable non-disclosure agreement, which all participants in the course had to sign as a condition of class attendance.

An ongoing problem concerns conflict of interest. Several international students taking the courses and sponsored by their companies have had their companies claim ownership of any and all ideas developed by their students in the courses. Some of these ideas were in the areas of plastic fuel tanks and for anti-scale pipeline technology. A clear, equitable solution for this issue is still being sought.

5. **Number of commercializable products / technologies emanating from the program**

Two years ago, there were zero entrepreneurial teams in the ECE senior design courses headed for market. One year ago, there was one team, and it did not decide to go to market till after graduation. This year there are two teams, and perhaps a third (a team was working with an existing start-up, which folded, and they are deciding whether to carry on with their product).

For next year, there will be at least five teams going to market, which is a sizable fraction of the approximately 12 teams per year in the ECE course sequence. Factoring out the three to five staple racecar, rocket and airplane projects which generally do not go to market entrepreneurially, and the fraction of the remaining projects which are entrepreneurial becomes even higher.

6. **Grants and capital raised by each of the E-teams**

As the program is fairly new and Florida Tech*Start* was opened just in October, 2003, this will be a metric of increasing significance as time goes on. Florida TechStart is the initial, not-for-profit business accelerator operation for Florida Tech. Plans are already being developed to develop a related, for-profit operation called Florida Tech*Start* Enterprises, which will be able to provide seed money for certain start-up enterprises, on a competitive basis.

In the meantime, without this local source, most of our e-teams are competing on a more national scale for grant funding. The good news is that in 2002, four teams applied for funding. In 2003, 10 teams applied for funding, and in 2004, as many as 20 teams may apply, including several senior design teams. The other news is that so far, few of the teams in general and none of the e-teams in particular have been funded in this way.

7. **Revenues generated by E-team companies and jobs created**

This is another future metric, as none of the senior design teams has made it to this stage at this time.

8. **Peer evaluation of the E-team members based on reliability, effort, creativity, co-operation, analysis and achievement**

This is done in the ECE senior design sequence of courses to help determine individual grades for each course. The results have been as discussed in criteria #2 above, as the teams generally represent a cross section of student intelligence, skills, aspirations and enthusiasm. This is considered a very good result, however, as the entrepreneurial students typically become team leaders, and for many, the interpersonal relationships and "administrative overhead" required of successful leaders comes as an eye-opening experience.

Implementation Notes

Senior design has been taught for many years at many institutions. At Florida Tech, several years ago, the course developed more of a team project than an individual project focus, though not strongly interdisciplinary.

Engineering management courses relating to entrepreneurial skills have been taught at Florida Tech since 1997. School of Management courses in this area have been available even longer.

This was the state of affairs as recently as the Spring of 2002, and at that point there was virtually zero synergism between Engineering, Management, Senior Design and any significant technology commercialization or systematic entrepreneurial focus or results.

Since that time,

- Senior Design became much better organized across the College of Engineering and much more interdisciplinary in nature, with an emphasis on entrepreneurial teams
- Two national grants were obtained to support senior design wireless and entrepreneurial projects
- A Student Design Showcase was established and has become a very significant university event
- The number of e-team grant proposals from engineering management courses has rapidly grown, as has the number of senior design teams with entrepreneurial intent
- The College of Engineering and the School of Management have partnered and set up the first Florida Tech business accelerator
- Florida Tech won participation in an NSF PFI grant
- A campus e-club has been formed
- A first entrepreneurial Boot Camp was held on campus
- More than 10 papers have been written, presented and/or published in the area of entrepreneurial activities

What changed? In our opinion, it was the happenstance joint arrival of two particular faculty members, interacting with a very ready and receptive culture and the receipt of modest funding to provide seed support of many of the activities. One faculty member arrived in the College of Engineering with a strong interest in entrepreneurship, after 25 years in corporate industry. The other faculty member returned to the School of Management with likewise a strong interest in entrepreneurship, after a long academic and entrepreneurial career. They discovered one another by chance and set about building an effective entrepreneurial emphasis for Florida Tech.

It would not have succeeded, however, except for the ready and receptive culture (and the funding!). The School of Management and the College of Engineering have always been on friendly and cooperative terms, even hosting joint Board of Advisors meetings from time to time. The departments within the College of Engineering had long understood the value of being much better organized regarding senior design, but no individual had taken the lead to make it happen. The Deans of Engineering and Management had both seen the value of having a focal point business accelerator for the university, and had tried earlier to start one, but there was not critical mass for success. There was some entrepreneurial interest around the campus, and also some support being given to community entrepreneurs through Florida Tech's laboratory system, and some IP activity by the professors, all of which could benefit from an organized infrastructure to support and coordinate it, but no sufficient momentum or drive or single point leadership to pull something together.

The final component was access to funding. As Florida Tech is relatively small, private, and tuition-driven for revenue, and since many of the activities, particularly those associated with the business accelerator, service the community and not just the students, it was decided early on that none of these activities would be paid for with tuition money, even for seed funding. The availability of some external funding went a long way to facilitate the actual start-up of much of the entrepreneurial infrastructure which has been developed in the past two years. The goal, of course, is to make all of the infrastructure self sustaining, and our current business model shows that we can get to that point with one more round of, for instance, NSF funding.

The right people with the right interests, the right culture and environment, and a little available funding to kick things off – this recipe can be used by any university or organization seeking to establish or recognize an effective entrepreneurial tradition.

Conclusions
The Senior Design Commercialization and Entrepreneurship Program has created considerable entrepreneurial excitement and increased levels of enthusiasm and innovativeness among the participants in the Senior Design courses. Two years ago, there was no systematic link between senior design and entrepreneurial activities. Now these links have been established or created, there is much enthusiasm, at least three senior design projects are in the commercialization process, and several professors have indicated they wish to work with the next generation of senior design teams to commercialize some of their product and technology ideas.

The networking forums in which the student E-teams participated have resulted in increased awareness of Florida Tech programs by the local industry and community, and provided the students with real-world exposure and experience in entrepreneurship and technology commercialization. This has laid the foundation for successful incubation of high tech entrepreneurial ventures which started as senior design projects. Students in Florida Tech's graduate MS program in Engineering Management have also benefited from the unique opportunity by advising, consulting and working with these senior design teams in developing commercialization strategies for their innovative senior design ideas.

Florida Tech's entrepreneurial student teams have won accolades at local Business Plan Pitching Competitions. The National Collegiate Inventors and Innovators Alliance (NCIIA) has awarded

Florida Tech over $50,000 in Course and Program grants for Senior Design Commercialization and Entrepreneurship. Finally, Florida TechStart has been established by the university as a business accelerator to support these and other activities leading to new high technology businesses and the employment and innovations they create.

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Biographical Information

KEN PORTS is a Professor in the Electrical and Computer Engineering Department of the College of Engineering at Florida Tech and an Associate Dean of the College of Engineering. He is also the Co-Director of Florida TechStart, the Florida Institute of Technology's business accelerator. Prior to joining the university, he spent 25 years in the microelectronics industry in technical, management, staff and internal consulting roles.

CARMO D'CRUZ is Director of Strategic Planning and Business Development at Chip Supply, Inc. in Orlando. He is an Adjunct Faculty in the Department of Engineering Systems at Florida Tech. He has also served as adjunct faculty in the Industrial Engineering and Management Systems Department (College of Engineering) and the Management Department (College of Business) at University of Central Florida, Orlando.

MUZAFFAR A. SHAIKH is a Professor and the Head of the Engineering Systems Department of the Florida Institute of Technology. He is an associate editor of the INCOSE System Engineering Journal, the North American editor of the Business Process Management Journal, and an associate editor of Transactions of Simulation for over nine years. Dr. Shaikh was Associate Dean of the Florida Tech School of Management from 1993 to 1997.

CAROLYN J. FAUSNAUGH is an Associate Professor of Strategy and New Ventures in the School of Management at Florida Tech. She is also the Co-Director of Florida TechStart, the Florida Institute of Technology's business accelerator. Prior to joining the university, she was a practicing CPA for 25 years and founder of Carolyn J. Fausnaugh Associates, CPA's. In the early 1990's she was a member of the founding team of InternetU, the first Internet Service Provider in Brevard County, Florida.