Engineering Entrepreneurship Courses Enhance Engineering Management Program at Florida Tech

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Abstract

Innovative Engineering Entrepreneurship courses in the Department of Engineering Systems at Florida Tech have greatly enriched the Engineering Management students' educational experience, broadened their perspectives, served as community outreach forums and integrated holistic experiential learning with academic programs. The four well-balanced and appropriately sequenced courses in Engineering Entrepreneurship, Technical Marketing, High Tech Product Strategy and Technology Commercialization Strategies have been offered successively over four semesters. As part of the course project requirements, students work in E-teams to commercialize innovative product or university/research lab-developed technology. The E-team is not restricted to students in the class - outside technical experts can be included as team members or advisors. The E-teams have to seek funding by completing NCIIA E-team proposals or SBIR/STTR proposals and presenting their business plans at investor-attended colloquiums and competitions.

The "Entrepreneur in the Spotlight" seminar series is another innovative facet of the four-course series. Struggling/successful local technical entrepreneurs visit the class and present their business plan for critique and recommendations by the class. These courses are supplemented by other regional outreach/networking forums organized by Florida Tech and entrepreneur support organizations. The Entrepreneur Club at Florida Tech also organizes seminars, workshops, boot camps, and other grass roots entrepreneurship awareness programs to complement the course offerings.

Students from these courses have excelled at local business plan competitions and a few start-up ventures have been launched. There is a contagious culture of entrepreneurship created on campus and on the Space Coast. This has facilitated cross-campus college collaborations and grant funding. Feedback on these courses has been positive and students have commented on how these courses have broadened their perspectives, made them more versatile and enhanced their career progression. Since most successful entrepreneurs have a holistic systems approach to new ventures, a unique "Systems Engineering Entrepreneurship" program is being pioneered to augment the Engineering Management program at Florida Tech.

Introduction

Over the past seven years, Florida Tech's Engineering Management program has offered pioneering, innovative courses in Engineering Entrepreneurship, Technical Marketing, High Tech Product Strategy, and Technology Commercialization strategies. In these case study courses, students develop real world marketing and business plans for commercializing innovative new products and technologies.[1] Some of the innovative product development and technology commercialization ideas have won accolades at regional business idea pitching competitions.

While meeting the increasing demand for holistic, interdisciplinary education, these innovative courses have greatly enriched the students' educational experience, broadened their perspectives, significantly enhanced their career prospects, served as community outreach/networking forums and integrated experiential learning with academic programs.

This paper reviews the growing popularity of engineering management programs, the impact of entrepreneurship courses on the engineering management curriculum (including a taxonomy of promoters, engineers, managers, engineering managers and engineering entrepreneurs), the debates over teaching of entrepreneurship courses and a new course in Systems Engineering Entrepreneurship that will be a paradigm shift in engineering entrepreneurship education.

The Growing Popularity of Engineering Management Programs

To better prepare themselves, many engineers, scientists and researchers are choosing to pursue their master's degrees. This fact in and of itself is not unusual. What is unusual, however, is the fact that the degree is not in a technical discipline, but in management for engineers. That is where engineering-management programs come into play.

Engineering Management programs combine business and technology courses. The Master of Science in Engineering Management (MSEM) is a graduate degree that combines the strengths of a traditional MBA with a focus on engineering and technology. Courses are geared toward providing students the best of both worlds. Not only do they have an opportunity to refine their technical skills, but it is done in a management context.

These programs include core courses like most MBA programs, such as project management, quality engineering, engineering economics, statistics and organizational behavior, but with a technological stream through each. The idea of engineering-management programs isn't a recent revolution, but the need—and popularity—for such programs is gaining momentum as businesses prepare to compete globally. Between 1994 and 2002, the number of U.S. universities offering master's programs in engineering management increased from 159 to 269.[2] During the last two decades, traditional MBA programs have given way to graduate degrees tailored to the business world's increasing emphasis on technology, global expansion, and the rise in entrepreneurship. At the same time, new MBA programs are striving to accommodate working engineers' need for flexible class schedules and relevant curricula, as more mid career professionals enter managerial positions. The result is an overwhelming array of offerings for

engineers seeking cross-disciplinary skills to better manage product designs and foster technological innovation.

These programs teach engineers how to bring together different disciplines and practice engineering in a team environment.[3] Most of these Engineering Management programs are in the United States although some European schools are beginning to follow suit.

At Florida Tech, some of the MSEM graduates start their own businesses, but mainly, they are in the MSEM program to advance within their company. Although many of Florida Tech's MSEM students hold undergraduate and even graduate degrees in engineering, an increasing number have worked in biotechnology, chemistry, marine and environmental engineering, etc. reflecting the growth of those industries Many come armed with general MBAs but want more specialized engineering management training.

The Florida Tech MSEM program targets working engineers and managers who plan to continue in technology-intensive roles or industries but need to understand strategic issues and develop stronger management skills in technical marketing, product strategy, project engineering, systems engineering, etc.

The courses are designed to help students anticipate and manage emerging science and technologies. As the business world becomes increasingly multinational, Engineering Management degree programs are also taking a more global outlook. Florida Tech Department of Engineering Systems has formed corporate alliances, satellite campuses, and joint and exchange programs with other departments and colleges. There are a number of international students from multinational companies enrolled in the MSEM program. This diversity gives students the experience of tackling complex business and technical concepts in an international setting.

Teaching of Entrepreneurship

Engineers with a Bachelor or Master degree are typically products of a four-year and two year university programs respectively, which vary little from university to university, or even country to country. Engineering Management programs are typically two-year graduate courses leading to the MSEM degree. Entrepreneurial courses however can be found in high schools, undergraduate schools, graduate schools, trade associations, private establishments, short courses, and correspondence courses. Although there is some agreement on the skills and characteristics needed for entrepreneurial behavior, there is no consensus on how best to impart the knowledge.[4]

The field of "Teaching of Entrepreneurship" in business schools (where it has been historically based) has been divided as to whether entrepreneurship can be taught or not.[5] A more appropriate emerging question is "Can Entrepreneurs Learn?"[6] Those who favor Entrepreneurship as an independent academic discipline see it as a distinctive, if not unique component of the free enterprise system. In this respect, it creates wealth, improves the productivity of a region, adds to employment, and offers a more exciting dimension to society. A second consideration is that entrepreneurship contains specific knowledge, concepts and theories that apply in a reasonable and consistent manner across the discipline. The search for an opportunity, the verification or

viability of the opportunity and the language of financing are distinct and particular to entrepreneurship in its own right.[7] Those who do not favor an entrepreneurship discipline are becoming less vocal in their opposition than in the past. Entrepreneurship courses and programs are sprouting up in business and engineering colleges of esteemed universities. What does remain is the lingering argument that much of what is applied in the process of entrepreneurship includes material that overlaps in other courses.

In the early days, a number of large universities claimed that the functions of management – planning, organizing, controlling- are very much evident in entrepreneurship and need not be treated as a uniquely different discipline. The debate did not recognize two critically important features of an entrepreneur: The role of creativity in entrepreneurship, whereby the new concept, invention and innovation that literally takes charge of the entrepreneur. Second, there is the vision that goes along with the new concept. A final argument that the more conservative academics pursued was that, since a new venture cannot really be created in the classroom, the concept of entrepreneurship cannot be taught and that the "concept of starting one's own business" does not require academic treatment. However, teaching entrepreneurship offers the advantage of avoiding those errors and misjudgments made by individuals who ventured before.

The academic propositions in teaching business to young people also apply in the teaching of entrepreneurship. The number of businesses created and the economic impact of entrepreneurship courses and programs at Stanford, MIT, University of Texas-Austin and other leading universities is testimony to the fact that entrepreneurship skills and know-how can be taught and entrepreneurs can be nurtured through supporting programs in university-based incubators, entrepreneur associations and local business networks.[8,9,10]

Environmental Factors Impacting New Venture Creation

Given a satisfactory market opportunity, there are a number of environmental elements that must be in place to support a successful start-up. William B. Gartner[11] lists ten ingredients that are most important to successful venture creation: 1) Suitable financing 2) Availability of a competent workforce 3) Accessibility to helpful suppliers 4) Government support, or at least the absence of obstacles 5) Proximity of Universities to assist in research 6) Availability of land or facilities 7) Access to transportation 8) Support of local population 9) Available support services- secretarial, telecommunications, etc.10) Low entry barriers.

Each of the above factors is important, some of them may be more critical to one venture and not another, but all of them have a considerable role in ensuring new venture success. Proximity to universities is noteworthy in two respects: In high tech start-ups where new inventions or technologies play a dominant role, these institutions can make significant contribution to successful start-ups through research, problem solutions and engineering support. Another benefit of the university is the availability of faculty/researcher consulting services in terms of technology, R&D, marketing, production systems, MIS, accounting , finance, etc.

Benjamin Mokry[12] suggests that in order to create a more receptive environment for entrepreneurship, a number of fundamental societal changes must occur. He supports the major truism that "local communities are the breeding ground of entrepreneurship" and are capable of

creating an environment favorable to it. Mokry has added two factors to Gartner's 10 factors that affect entrepreneurial success: 1) Existence of an entrepreneurial sub-culture. The tremendous success of Silicon Valley, Boston, Austin and San Diego very much support the notion that entrepreneurs feed off each other in a synergistic fashion and create their own dynamic environment. 2) Incubator organizations, many of which are initiated by local universities and governments as enterprise centers

Recent studies[13] have developed a more positive awareness of educating people in entrepreneurship and eventually how to become entrepreneurial. It has been determined that 1) potential entrepreneurs can be encouraged through university-based entrepreneurship programs 2) entrepreneurship within an established definition can be taught and 3) entrepreneurial alumni do succeed and they themselves provide further insights and educational materials for dissemination in the classroom. [14, 15]

Studies by Wolfe, Adkins and Sherman[16] have shown that universities serve as sources of new technologies that might be commercialized by incubator client firms and other regional start-ups. Universities can also provide other valuable services and unique resources to both the incubator, its clients and other regional start-ups such as (1) Faculty / technologist managerial or technical consulting on a pro bono or fee basis (2) Student interns and employees (3) Access to technical labs, facilities and equipment (4) Access to databases and researchers (5) Access to research and development financing through programs such as SBIR – federal grant funding is greatly enhanced when incubator clients submit a joint proposal with a university or federal laboratory (6) Additional services and resources including patent knowledge, alumni who may act as advisors, business contacts and strategic alliance facilitators or investors, access to a far-flung network of laboratories and technical expertise, and access to investment by university foundations.

All the above mentioned research findings and other issues and environmental factors were considered when designing the entrepreneurship programs at the University of Central Florida. Additionally, leading entrepreneurship programs in the country were benchmarked and the best practices were adopted. [17, 18, 19, 20, 21]

Historical Perspective

The Space Coast Region of Central Florida has had most of the ingredients for transforming the area into a hub of high tech entrepreneurial activity – these include a central location, availability of land, communications infrastructure, transportation resources (which even include the NASA-KSC spaceport), trained workforce, high tech companies, state incentives, strong research universities providing the intellectual capital, research parks and incubators. There was not a very strong entrepreneurial sub-culture as in Silicon Valley or Boston and this had to be created through university entrepreneurship programs.

There has been considerable demand for Engineering Management, Engineering Entrepreneurship and Technology Commercialization education on the Space Coast. 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 Melbourne 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 and strategic plans for high tech products and technologies have been taught in graduate Engineering Management program at the Florida Institute of Technology (a.k.a. FIT or Florida Tech) since 1997. In these 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 course offering in "Engineering Entrepreneurship" by 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. The Engineering Management Program is now part of the newly formed Department of Engineering Systems (DES) which offers two graduate Master's degrees: MSSE and MSEM in Systems Engineering and Engineering Management respectively. In just two years, the Department of Engineering Systems is the fastest growing department in the university, with the highest number of graduate students enrolled (nearly 150).

Concurrently, Florida Tech's intensive graduate engineering programs (in ECE, ME, CE, ChE, AE, Environmental and Ocean Engineering) have resulted in a number of outstanding senior design projects and master's and doctoral level research project/theses. There is a coordinated program on "Senior Design Commercialization and Entrepreneurship" that has been initially grant-funded by the NCIIA. Senior undergraduate students can register for the Engineering Entrepreneurship series of graduate courses offered by the Department of Engineering Systems.[23]

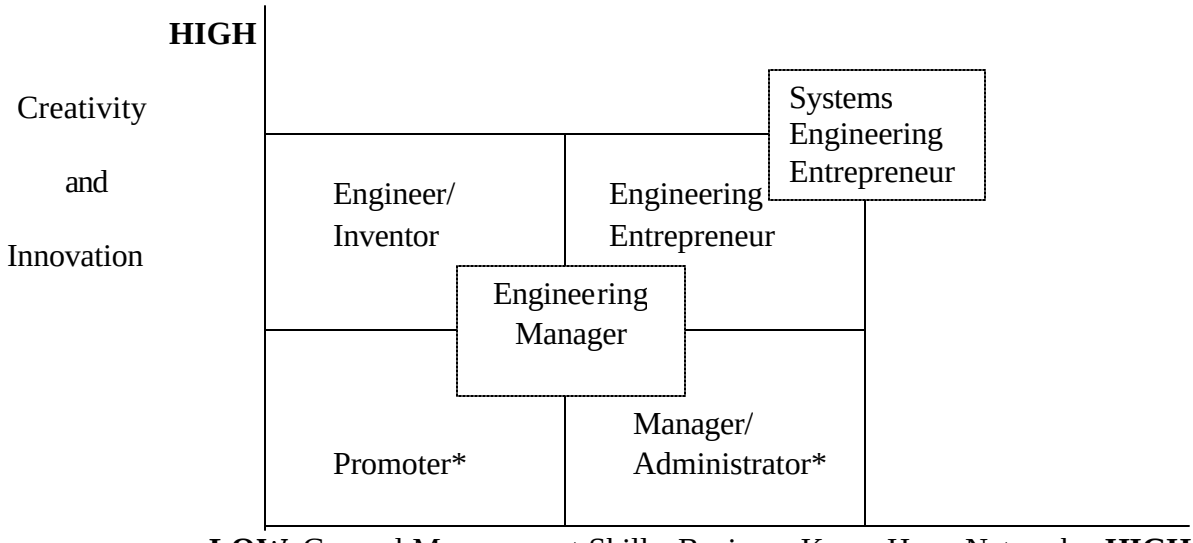
Why Engineering Entrepreneurship ?

Traditionally, engineers in the various disciplines have been trained to solve explicit problems, such as finding the solutions of n-equations with n-unknowns. In such problems all the required information is provided, and the solution requires the application of a specific strategy that will work for all problems of a given type. Unfortunately, the nature of the 21st century economy means that the types of problems that engineers have to solve tend to be more implicit in form. All the information required for the solution is available, but it is fragmented, dispersed and requires highly developed perception skills to extract and use successfully. Traditionally, in large corporations, high levels of creativity and innovative idea generation have not been seen as central to the engineer's role. However, to compete in a changing marketplace fraught with

rapidly changing technology, shorter product life-cycles, downsizing and outsourcing, engineers need to re-invent themselves as independent and entrepreneurial and market their creativity.[24] In many large corporations, entrepreneurially thinking engineers have been observed to show more entrepreneurial initiative and a higher level of productivity, efficiency and cost-consciousness. It is a known fact that engineers who manage their engineering careers as entrepreneurs from the start enjoy a higher probability of advancing within the company.[25] The Systems Engineering and Engineering Management degree program at Florida Tech broaden the typical engineer's perspectives considerably with the traditional well-rounded Engineering Management and Systems Engineering course offerings, as well as complementary innovative courses in Engineering Entrepreneurship, Technical Marketing, High Tech Product Strategy and Technology Commercialization Strategies.

Despite the popularity of these engineering entrepreneurship-related courses, the word "entrepreneur" is often misunderstood by engineers and some employers as it conjures visions of larger than life empire-builders who create high risk business ventures that promise either intoxicating wealth or wretched bankruptcy – and very little in between. Entrepreneurs seem to thrive in chaotic and uncertain realms, far removed from the orderly and methodical world of engineers, where calculations and data are applied to design solutions that eliminate uncertainty and risk. Another misperception is that entrepreneurship courses belong to business schools and are not engineering-related. However, the truth is that Systems Engineering Principles parallel Entrepreneurship Concepts. All employers are engaged in a business to produce a return on investment. An engineer's compensation package is an investment made by the company. Whether one is a CEO in charge of a whole company or an engineer overseeing a single task or project, he or she is responsible for producing a positive return on the investments they are entrusted to. So all engineers engage in entrepreneurship – but only those who deliver the best returns on the investment they manage will be in the best positions for advancement.

Taxonomy of Engineers, Promoters, Managers, Engineering Managers, Engineering Entrepreneurs and Systems Engineering Entrepreneurs
(adapted from Jeffry Timmons: New Venture Creation)[6]



* Typical graduates of Business Schools with BBA or MBA degrees

The above taxonomy illustrates the relative skills and characteristics of Engineers, Promoters, Managers, Engineering Managers, Engineering Entrepreneurs and graduates of Systems Engineering Programs. As a result of the interdisciplinary nature of the Engineering Management program and his/her engineering education and experience, the typical Engineering Management graduate is expected to have higher levels of technical creativity and innovation capabilities than the typical Promoter and Management graduates of Business school BBA/MBA programs. The Engineering Entrepreneur with a broad based entrepreneurially-oriented engineering education rooted heavily in experiential entrepreneurship programs and activities is expected to develop a higher level of skill sets in Creativity and Innovation as well as general management skills, business know-how and networking skills. Armed with a cache of Systems Engineering tool and techniques such as simulation, project engineering, systems integration, Technology Function Deployment, customer requirement engineering, decision and risk analysis, etc that make the entrepreneurial process more deterministic and after going through a broad based entrepreneurially-oriented engineering education rooted heavily in experiential entrepreneurship programs and activities, the Systems Engineering Entrepreneur graduates have demonstrated the highest levels of creativity and innovation and general management skills, business know-how and networking skills..

Florida Tech Systems Engineering Entrepreneurship Course

A common complaint heard from most high tech entrepreneurs is that their entrepreneurial projects always take more than 2X the time, the money and the resources than what they planned for at the outset. The Systems Engineering Entrepreneurship course at Florida Tech is designed to allay the above misperceptions, fears and complaints using proven Systems Engineering body of knowledge in Project Engineering, Systems Integration, Decision and Risk Analysis, Simulation, Systems Life-Cycle Costing, etc. It has been observed that some of the most successful high tech and serial entrepreneurs have a systems engineering approach to their entrepreneurial ventures. This is because of their broad perspective of the competitive environment and a balanced, methodical and systematic approach to capitalize on the opportunities to ensure sustained long term success.

The Florida Tech Systems Engineering course is designed based on the fact that Systems Engineering Principles parallel Entrepreneurship Concepts and Steps, such as, for example:

SE Concept	**Entrepreneurship Concept and Steps**
Technology Function Deployment, Technology Roadmapping	Opportunity Recognition
Requirements Engineering	Understanding Customer and Market Needs
Systems Integration	Putting together the Business Plan

The Systems Engineering Entrepreneurship course is uniquely designed to leverage proven Systems Engineering principles, tools and practices that parallel entrepreneurship concepts and steps for high tech entrepreneurial success such as Requirements Engineering, Competitive

Analysis, Systems Modeling and Simulation, Product Development Process Engineering, Project Engineering, Decision and Risk Analysis, Systems Integration, Performance Assessment, System Launch Considerations, System Life-Cycle Costing, Quality Engineering, etc.

The influence of Systems Engineering (SE) thinking on entrepreneurship has often been overlooked in business-school based technological entrepreneurship programs. The innovation process is significantly improved and made more robust by adopting a SE mindset early in the timeline. If SE concepts that work so well in engineering are applied to the innovation process, the quality of the innovation and likelihood of success are improved by significant orders of magnitude. For example potential investors will look more favorably on a product concept that has a lifecycle design effort put into the initial model. This leads to a more mature product development process that is less likely to run into development troubles. Therefore the investors will see a more desirable opportunity and the entrepreneur significantly improves the probability of entrepreneurial success.

Traditionally, universities have not been the best places for teaching students how to start small businesses, be innovative, and leverage basic science and engineering into new products. It is also a challenge to find people with enough expertise across the necessary areas to teach. For example in a start-up, you need engineering expertise to make a prototype; management expertise to market and sell the product; legal experts to sort out patents, royalties, and product ownership; and people adept at evangelizing and acquiring funding. Florida Tech has overcome these hurdles because the Engineering Systems faculty has considerable industry and entrepreneurial experience and adjunct faculty and guest lecturers are used to augment the engineering entrepreneurship course series.

There's an obvious demand for engineering entrepreneurship programs, as evidenced by the high enrollments for these courses. After taking the engineering entrepreneurship series of courses at Florida Tech such as Systems Engineering Entrepreneurship, Technical Marketing, High Tech Product Strategy and Technology Commercialization Strategies, students not only know the course contents and complete their marketing plans and business plan term projects, but they gain real experience in experiential entrepreneurship by pitching their ideas at business plan competitions and colloquiums and network with experienced professional such as other entrepreneurs, investors and business service providers. They also experience how to create and manage an environment where technological innovation and creativity could be fostered. Though some of the working students know a lot about product development when they enter the program, they typically have learned only the ways their current and previous employers do product development. The Florida Tech Engineering Management program with its engineering entrepreneurship course series, gives them a chance to learn and hands-on integrate ideas methodologies and systems from case studies and other students', entrepreneurs and alumni experiences.

It is anticipated that the pioneering Systems Engineering Entrepreneurship course and program, with its rigorous cutting edge SE tools and techniques especially in Technology Function Deployment, Requirements Engineering, Project Engineering, Decision and Risk Analysis, and Simulation will create new paradigms in entrepreneurship education and will enable the entrepreneurial high tech endeavors of engineers to be more deterministic than stochastic.

4-Course Florida Tech Engineering Entrepreneurship Course Series:

The Engineering Entrepreneurship course series has been combined into a Certificate Program and it consists of one new course module in Systems Engineering Entrepreneurship that is dove-tailed into three existing course modules in Technical Marketing, High Tech Product Strategy and Technology Commercialization Strategies.

Module 1: **Systems Engineering Entrepreneurship** - this module is a comprehensive overview of Systems Engineering Principles as applied to Engineering Entrepreneurship and the students will start integrating the various components to develop their business plan. The risks, rewards and challenges of entrepreneurship, and the system-engineering-based strategies and tactics to increase the chances of success are systematically covered in this module. Each session of this module consists of (1) a lecture and case study based on system engineering principles that parallel an entrepreneurship concept and step and (2) experiential guest lecture/seminar by industry expert or entrepreneur on entrepreneurial opportunities in emerging fields.

Module 2: **Technical Marketing** - This module gives the engineers a strong marketing orientation and shape their innovative high tech idea into the right product for the right customer, to further increase the chances of market success. This is very critical for engineers to develop paradigm pliancy and think in terms of the Whole Product, not just their generic technologies or products.

Module 3: **High Tech Product Strategy** - This state-of-the-art course module addresses the formulation of specific high tech product strategies to increase the probability of market success. These include Product Platform and Product Line Strategies; Differentiation and Price-based Competitive Strategies; Support Strategies based on Time, Cannibalization, and Global Product Development and Growth Strategies based on Innovation, Expansion ad Strategic Alliances.

Module 4: **Technology Commercialization Strategies** - This state-of the-art course is designed to develop the students' ability to apply the engineering and entrepreneurial processes to Technology Commercialization. This innovative, overview course will systematically cover the Technical, Marketing and Business aspects of the Technology Commercialization process in 18 steps through the 3 phases (Concept, Development and Commercial) and six stages (Investigation, Feasibility, Development, Introduction, Growth and maturity)

The Final Business Plan: **Final Business Plan Write up and Presentation**. As part of the Certificate Requirement, the students would be required to write up a professional business plan and present it to the NASA / UCF Incubators and Technology Development / Commercialization Offices and also to Central Florida Investment Corporation and other interested VCs. Teams of two or three students will work on the development of the business plan to market an innovative new product or commercialize a promising technology, throughout the four-course program.

This program is open to graduate students and senior-year undergraduate students. There are no pre-requisites for these courses. The courses are offered in sequence over 4 consecutive semesters.

This state-of-the-art course series and program addresses the formulation of specific strategies to significantly increase the probability of market and technical success. Entrepreneurship concepts and strategies developed empirically from the experiences of high-tech companies are applied. These are more practical than theoretical and are intended to push systems engineering entrepreneurship to the cutting-edge. Through the incisive insights of leading systems engineering experts, entrepreneurs, numerous examples, and case studies / interactive discussions simulating the experiences of technical entrepreneurs, this comprehensive course and program systematically covers almost all the issues aspiring technical 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 systems engineering principles and 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. VC and Angel-investor developed criteria is taken into consideration when selecting recipients for funds. Expected participation in other entrepreneur networking activities on campus and in the community is kept track of, encouraged and rewarded. A number of foreign students from India and China and other foreign countries are enrolled in this program. They are expected to take this systems engineering approach to entrepreneurship back to their countries, and contribute to and empower their emerging high tech industries, where a systems approach is minimal or non-existent.

The "Engineering Entrepreneur in the Spotlight" Experiential Seminar Series

The Systems Engineering Entrepreneurship course and certificate program is complemented by another pioneering innovation in experiential entrepreneurship at Florida Tech – The "Engineering Entrepreneur in Spotlight" seminar series. In these seminars, typically held twice a month, struggling/successful local technical entrepreneurs visit the class and present their business plan for critique and recommendations by the class. Once a month, these "Engineering Entrepreneur in the Spotlight" seminars are open to the public. Over the past three years, these seminars which have got wide pre- and post-event publicity in the local media, have become an increasingly important networking forum for entrepreneurs, inventors investors, business service providers, students and faculty. As a result of these seminars, a number of local business deals and alliances in high tech entrepreneurship have been consummated and Florida Tech students have secured career-enhancing opportunities with established and start-up companies as interns, co-op students, or permanent positions as founders, advisors or technical experts.

Conclusions:

The initial impact of the Engineering Entrepreneurship course series and experiential Entrepreneurship activities on the Engineering Management program at Florida Tech has been remarkable.

Elements of the pioneering Systems Engineering Entrepreneurship course have been prototyped and tested in various formats such as seminars, short courses and as entrepreneurial topics in Systems Engineering courses. The feedback from the students has been very positive.

The "Engineering Entrepreneur in the Spotlight" seminar series featuring local entrepreneurs, innovators, inventors and, their research collaborators and entrepreneur networking / service providers such as Florida/NASA Business Incubation Center (FNBIC), Space Applications Technology Outreach program (SATOP), Technology Research and Development Authority of the State of Florida (TRDA), Florida Tech Start, the Alumni Entrepreneur Alliance, The Space Coast EDC and other local organizations, have seen increasing attendance and have become an increasingly important networking and discussion forum for local entrepreneurs, inventors, business service providers, investors, students and faculty.

Florida Tech has been an active partner of the NSF-funded Partnership for Innovation - Center for Entrepreneurship and Technology Commercialization (CENTECOM) along with UCF, USF and Florida A&M University. The response to these grants has been extremely positive, with 7 of 13 entrepreneurial senior design teams this year intending to launch businesses around their senior projects. Additionally, there were twelve graduate E-teams presenting their business ideas at the Engineering Entrepreneurship Business Idea Pitching competition. A contagious culture of engineering entrepreneurship and high degree of entrepreneurial awareness has been created on campus and in the Space Coast community.

With the Systems Engineering Entrepreneurship course and program enabling aspiring and struggling engineers-turned-entrepreneurs for higher degrees of entrepreneurial success with a deterministic approach (rather than a stochastic approach) it is anticipated that the locus of high tech entrepreneurship education will move from business schools to engineering schools.

At the Engineering Entrepreneur in the Spotlight seminars, students from the Engineering Management program have been able to network with local entrepreneurs, investors, business service providers, high tech executives and make valuable contacts, that have resulted in securing investment capital or internship/career opportunities. Armed with cutting edge Technical Marketing, Product Strategy and Engineering Entrepreneurship skills, graduates of the Florida Tech Engineering Management program have turbo-charged their career advancement prospects into fast-track marketing, general management and executive positions.

Thus the Engineering Entrepreneurship Course series has significantly enhanced the Engineering Management program at Florida Tech.

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Dr. Carmo A. D'Cruz is Associate Professor in the Engineering Systems Department at Florida Tech. A twenty-year veteran of the semiconductor industry, Dr. D'Cruz has concurrently studied and taught at Engineering and Business schools. His industry experience ranges from R&D and engineering to manufacturing, operations, marketing and business development. He has developed pioneering courses in Systems Engineering Entrepreneurship, Technical Marketing, High Tech Product Strategy and Technology Commercialization Strategies.

Dr. Muzaffar A. Shaikh is Professor and Head of the Department of Engineering Systems at Florida Tech. Dr. Shaikh spent nearly nineteen years in industry, before he joined Florida Tech in 1987. He was Associate Dean of the Florida Tech School of Management from 1993 to 1997. He has won teaching excellence awards in the School of Management, College of Engineering and at the University level. Dr. Shaikh is an associate editor of the INCOSE System Engineering Journal and the North American editor of the Business Process Management Journal.

Dr. Wade H. Shaw, P.E. is Professor of Engineering Systems in the Department of Engineering Systems at Florida Tech. For over 5 years he was the coordinator of the Engineering Management Program when it was housed in the School of Management. He is a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) and in 2000 was awarded a Millennium Medal for his contributions to the field of engineering management. He is currently an Editor-in-Chief of the IEEE *Engineering Management Review*.