2002 ASEE Proceedings Paper
Session No:__2213_____

An Engineering Entrepreneurship Course for ChE Seniors

Ramani Narayan (www.msu.edu/user/narayan)

Department of Chemical Engineering & Materials Science
Michigan State University, East Lansing MI 48824

ABSTRACT

Entrepreneurship is the vehicle that fuels economic growth. The goal of this course is to expose ChE seniors to the "entrepreneurial process", and better prepare them to enter the business world with consideration of issues such as the nature of entrepreneurship, opportunity identification, intellectual property creation and strategy, market research, operations, financing, valuation of technology, and cash flow analysis in a technical environment. These are necessary ingredients of all successful technical business ventures, regardless of size.

Student teams of 2-3 will apply their engineering skills and abilities in a business environment to identify innovative product/process opportunity/opportunities, investigate the potential for an entrepreneurial business opportunity, keeping in mind the differences between an "idea" and an "opportunity" and develop a sound business plan for bringing the innovation to commercial reality or not as the case may be. The product/process innovation/idea for commercialization is envisioned to operate through a start-up entrepreneurial venture or by working with a small or medium size business -- *entrepreneurial internship*.

PROGRAM GOALS

Entrepreneurship is the vehicle that fuels economic growth. Nearly 50% of the growth in our economy can be explained by entrepreneurial activity. While Fortune 500 companies have lost 5 million jobs since 1980, the United States has added 34 million new jobs. This increase is due to start-ups and small business growing to large businesses. The purpose of this program is twofold:

1. Expose students to the "entrepreneurial process", with consideration of issues such as the nature of entrepreneurship, opportunity identification, intellectual property creation and strategy, market research, operations, financing, valuation of technology, and cash flow analysis in a technical environment. In the process, they will learn to integrate their engineering skill with business concepts and will be much better prepared to innovate and bring sound innovative, new products to commercial reality.

copyright 2002, American Society for Engineering Education

2. Actively involve the participating small/medium technology business in the "entrepreneurial process" by having the student-company E-teams working on company specific ideas/product opportunities that need to be evaluated and analyzed – development of a *feasibility plan*.

In addition, successful implementation of the program will allow us to retain bright and talented students (primarily, the student interns) trained in both engineering and business concepts in the State working in small/medium size companies thereby ensuing that the talented human capital stays in the State and not lost to out-of-state multinationals and large companies as it now happens.

The program integrates curricula (learning credits) with internship at small/medium size technology based Michigan business and targets company specific ideas that need to be evaluated and analyzed – development of a *feasibility plan* i.e. whether the idea has market potential – whether it is a product/business opportunity. The program explores whether the venture idea has the potential to succeed and the plan for future action. The elements of the feasibility plan can be incorporated into the company's business plans if the idea is deemed feasible.

PROGRAM SPECIFICS

The Department of Chemical Engineering and Materials Science (CHEMS) at Michigan State University offers a three credit engineering elective course (ChE 491) titled "Engineering Entrepreneurship". The course is open to selected undergraduates in their senior year in the CHEMS program and graduate students.

We formed six E-teams of two students with a mix of 10 undergraduates and two graduates. Six small/medium size Michigan companies will host the E-teams and provide for one or two of their motivated entrepreneurial staff to work with the student E-teams. The goal is for each E-team comprising the student and company representatives to come up with an important (key) innovation/idea and develop a business feasibility plan (product business opportunity analysis) focusing on both technology and business aspects. The Kauffmann Foundation's Planning and Growing a Business Venture (a practical hands-on approach to entrepreneurship and leads students through the process of writing either a feasibility plan or a business plan) book along with the Fast Trac "Business Mentor" CD-ROM program, is used in the teaching and supplemented in various areas – specifically intellectual property strategies, patents, valuation of technology and the integration of technology needs with business concepts. Each week, one and half hour of classroom learning is followed by one and half hour of practical work with their company E-representatives to apply the classroom learning to develop step-by-step the feasibility plans for the product/business idea or plan.

After completing their semester course work, six student interns, one from each E-team spends an additional 400 hours of full-time internship to complete their E-team assignments – finalize the *feasibility plan* developed during the semester course work and incorporate detailed technology (engineering) assessment. A postdoctoral fellow assists in the technology assessments for each of the E-teams. He works closely with the Instructor (Narayan), Narayan research group, and the participating companies to conduct the necessary experiments for generating the data for the technology assessment.

copyright 2002, American Society for Engineering Education

Participating Companies

KTM INDUSTRIES (www.ktmindustries.com) (E-TEAM "STARCH") – This Lansing based company is manufacturing a portfolio of starch foam products for use in the arts, crafts and toys market and in the packaging area. Under the trade name of Magic Nuudles, this multi-colored foamed building block's has gained considerable popularity and can be found in major stores such as Target, WalMart, Zany Brainy, Kmart, and in school supply stores. The company is now manufacturing starch foam loosefill and *GREEN CELL™* biodegradable, engineered foam for global packaging applications such as high-value cargo protection, electronic components protection, material handling, defense packaging, and sound/vibration management. The product is naturally biodegradable and combines high performance cushioning properties with environmental safety.

E-team "Starch" comprises the two student interns, MSU postdoctoral fellow and the participating personnel from KTM will develop a feasibility plan for use of the *GREEN CELL™* foam product in insulation applications like coolers.

CENTURY INC.(www.centinc.com) (E-TEAM EXTRUDER). **C**entury Extruders, a division of Century, Inc of Traverse City, Michigan, offers a complete line of **CX** Extruder Series compounders which feature co-rotating, intermeshing, twin-screw extruders in standard sizes from 30mm to 133mm. **C**entury Specialties is the precision manufacturing division of Century, Inc and provides the component parts for the processing section of the **CX** Extruder.

Recently, Century acquired a new extrusion technology – ring extruder (3+ Extruder). Its innovative design is expected to provide economies of scale and product quality not achievable with conventional extrusion. The unique design of the 3+ enables the user to overcome physical and technological limitations of the current twin-screw extruders. The Narayan research group has a cooperative agreement with Century to evaluate applications for this new extruder and establish its utility and value.

E-team "Extruder" comprising two student interns, MSU postdoctoral fellow, and two Century staff engineers develop a *feasibility plan* around a process concept or product idea using the new 3+ extruder.

BioPlastic Polymers & Composites LLC (E-TEAM "BIOPLASTIC"). BioPlastic Polymers is a Michigan company involved with the manufacture of biodegradable polymer resins for film applications like lawn & leaf compost bags, and injection molded products. Eastman Chemical has an agreement with the company to market their resin suitably compounded with starch or other fillers as compost bags for lawn and leaf collection. E-Team "Bioplastic" comprising two student interns, MSU postdoctoral fellow, and two BioPlastic Polymers personnel develop a feasibility plan around biodegradable plastic films for lawn and leaf compost bags and specific injection molded products.

EcoSynthetix Inc. (www.ecosynthetix.com) (E-TEAM "ECOSYNTHETIX"). This Michigan company, founded in 1996, is engaged in the development and commercialization of bio-based technologies as replacement solutions for polymer-based adhesives, inks, and other related product categories. The company secured venture financing of $6 million to date from Tech Inspirations, Inc., a private venture capital firm who provides leadership in strategic investing and consulting for the technology sector (www.techinspirations.com). E-Team "EcoSynthetix" comprising two student interns, MSU postdoctoral fellow, and two company personnel develop a feasibility plan and technology assessment for an application of one of their products.

copyright 2002, American Society for Engineering Education

21st Century Plastics (E-TEAM "PLASTICS"). This is a Michigan company operating in the field of thermoplastic injection molding of automotive, furniture, and general industry products. They have two plants located in Potterville and Eaton Rapids and looking to diversify their business to grow and stay profitable. E-Team "Plastic" comprising student interns, postdoctoral fellow and two company personnel develop a feasibility plan for a new product/business opportunity – in-house manufacturing of the key resins used by the company for their injection molding business.

Zeeland Farm Services (E-TEAM "SOY"). This is a Michigan company involved with the processing of soybeans. They are looking at value-added uses for the soy oil they produce. Narayan research group is looking at new value added uses for the soy oil in urethane plastics, and starch foam products. The company is looking at investing in a plant to produce soy diesel. E-team "Soy" comprising student interns, MSU postdoctoral fellow, and the company representatives develop a feasibility plan for use of the soy oil in various value added applications. In addition, a detailed technology assessment is conducted on the various options for utilizing of the soy oil including the soy diesel.

Kauffman Foundation Involvement.

Kauffman Foundation provided an interim grant to start the engineering entrepreneurship course and contributed the Fast Trac E-learning tools, CD-ROM and work book.

Program Deliverables

1. Students learn the "entrepreneurial process" with consideration of issues such as the nature of entrepreneurship, opportunity identification/idea generation, patents & intellectual property strategies, market analysis, price and profitability, valuation of technology and financial analysis. They will learn to integrate their engineering skill with business concepts and are much better prepared to innovate and bring sound innovative, new products to commercial reality.
2. Small and medium size companies in the program are exposed to the entrepreneurial process and successful implementation of the program results in the company having introduced a new product or business which contributes to the profitability of the company and to the local/State economy. An added benefit is the institutionalizing of this program within the company and continued support for the E-ship course in-kind and financially, resulting in continued, sustainable economic growth for the company.
3. A new model that integrates the entrepreneur internship program with curricula. The course provides student credits, incorporates active company participation during the teaching and focuses on a concept/idea that potentially contributes value/profitability to the company and to the State's economic development.
4. Retain bright and talented students (primarily, the student interns) trained in both engineering and business concepts in the State working in small/medium size companies thereby ensuring that the talented human capital stays in the State
5. Develops new and additional material for entrepreneurial teaching tools like the Fast Trac "Business Mentor" CD-ROM, work book, and other teaching tools. This ensures

copyright 2002, American Society for Engineering Education

continued and improved access to state-of-the-art business and technology analysis and teaching tools.

BIOGRAPHICAL INFORMATION

web address: http://www.msu.edu/user/narayan; http://gaea.bch.msu.edu/~sinas/index.html

Professor of Chemical & Biochemical Engineering. Has72 refereed publications in leading journals, 13 patents, edited two books and one expert dossier in the area of bio-based polymeric materials. His research area encompasses Engineering and Design of Environmentally Compatible Materials -- Material Design for the Environment. Specific research areas are Biodegradable plastics and polymers, reactive extrusion polymerization and processing, studies in polymer biodegradation and composting, Life Cycle Assessment (LCA) studies and protocol development for meeting a product's environmental stewardship, biofiber -reinforced composites using synthetic and natural polymer matrices.

copyright 2002, American Society for Engineering Education