

BROWN UNIVERSITY COURSE IN ENTREPRENEURSHIP: Project Report on the First Academic Year

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Abstract

This paper describes a course on technology -based entrepreneurship, funded through the National Science Foundation's Action Agenda for Systemic Engineering Education Reform. Brown University's Division of Engineering has created a two -semester course sequence designed to provide students a hands -on exposure to entrepreneurship through a unique merger of academics and industry. "Parent Companies" provide seed ideas or concepts to the students, who then use skills learned in the classroom (both in this course as well as previous training) to develop the company's idea and turn it into a marketable business. The environment is a simulated spin -off or startup company. The parent companies serve a role as a potential customer for products, as well as a potential source of startup capital. The course faculty carefully manages the student - company interface.

I. Introduction

A. Background

We live in a dynamic time. The pace of technological development in the 1980s and 1990s has been and will be heralded as a veritable revolution, whether this is microelectronics, biotechnology, materials science, computer science, medicine, or other high technology disciplines. The boundaries between engineering disciplines are essentially disappearing, and the practice of engineering is becoming inherently more multidisciplinary, combining basic principles from the traditional chemical, electrical, mechanical, biomedical, materials, and civil engineering areas in order to solve complex problems. In the next decade, the environment for engineering practice will also be undergoing a radical metamorphosis, driven by fierce international competition in high -tech markets, the globalization of manufacturing and services, the impact of exploding information technology on society, the shift from large -scale defense to commercial engineering employment, the cross -fertilization between traditional engineering disciplines, and the complicated issues associated with environmental protection and sustainable development. Employers increasingly emphasize that success as an engineer requires an entirely new skill -set, above and beyond the traditional basic science and technical background. Engineers in today's workplace must be effective communicators and team players, with a knack for understanding the non -technical and human factors issues that profoundly affect engineering decisions.

Beginning in the middle 1980's large corporations have responded to technological change and global competition by downsizing, consolidation, mergers with other companies, acquisitions of small companies and startups, compacting middle technical management, and spinning -off highly focused core business units or subsidiaries. These smaller engineering core business units have also been a response of industry to speed up time -to-market by focusing small teams of personnel on a single product line. Over the past several years the diversity, variety, and complexity of new product introduction have grown manifolds from very simple to very complex, while concurrently, the short time -to-market has decreased significantly.

The convergence of product complexity and time -to-market has greatly impacted engineering research and development and the role of the engineer. The response of Corporate America has initiated a significant shift in employment opportunities for young engineers. More than 200,000 engineering and science college/university students graduate each year and many of them will find employment in small business and startup environments. This type of environment needs a new type of engineer, an *entrepreneurial engineer*, who must possess a broader range of skills and knowledge, above and beyond a strong science and engineering background. Today's engineering entrepreneurs will find themselves working with small, highly focused multidisciplinary teams, composed not only of engineers, but also including individuals with backgrounds in business, marketing, the humanities, and law. It is the environment for which our program seeks to prepare our students. Our program is referred to as ENTERPRISE, the Entrepreneurial Engineering Reform Program: an Innovative Incubator Seed, a unique educational program carried out in partnership with industry.

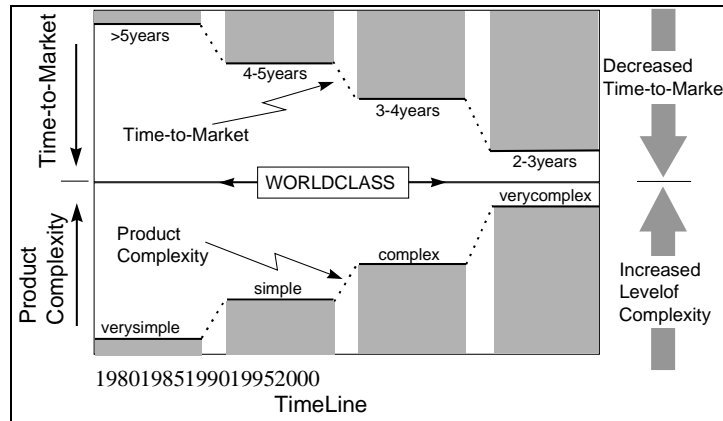


Figure 1 – Showstimetomarket/productcomplexitytimechart

We feel that it is essential that students work on real -world problems of industrial relevance in the later stage of their academic career. Engineering students go through school performing assignments that are generated by academicians. Depending on faculty interests and background, these simulations may or may not model the real world. In addition, most coursework seem to compartmentalize subject rather than integrate it. It is the integration that is at the heart of engineering.

To address these shortcomings of the traditional engineering program, our course involves students working with industrial partners on real world problems with real schedules, deadlines, and budgets. This brings realism into the academic environment in a unique way that engages students not only in the technical aspects of engineering research and development, but also in the non -technical aspects that strongly dictate engineering decision making on a daily basis. It accomplishes these objectives under the careful guidance of campus -based faculty, who can provide the necessary linkages to the overall curriculum and who can assure that the unique learning experiences are truly shared by the entire class. The importance of the involvement of campus based faculty is therefore essential, and is a feature that sets this program apart from the more usual “co -op” type of programs that tend to offer more individual, and much less structured learning environments.

B. The Approach

Our approach involves creation of an exciting engineering entrepreneurial environment for students, through a combination of learning experiences acquired through close collaborations with industry on actual projects, and enhanced by lectures from a variety of industrial participants. The experience involves a 2 -semester effort, which carries the Brown course numbers EN 193 and EN 194, and it is open to advanced undergraduates (mainly seniors, but a few juniors were admitted). This section describes how the course was structured during the first year of its offering (1999 -2000). The same model is being followed during the current academic year, albeit with different companies and/or projects.

The students were selected based upon application, which permitted the instructors to achieve the proper balance in the project teams, and allowed some initial exploration of the strength of commitment to seeing the project through. It is probably significant that a large majority of the originally selected project teams did choose to remain for both semesters (they were under no obligation to do so). The teams of students were drawn from all of the different engineering disciplines and very importantly included students from the sciences, social sciences and humanities. These teams were truly multidisciplinary, and their members brought to the teams a wide variety of experiences and expertise. It was felt that the integration of the engineering and non -engineering students into a business team was an essential part of the learning experience for both parts of the group. Representing as it does the real business environment. The two faculty co -ops and two or three senior executives from the participating companies supervised each group. This was affirmation of the interest that industry has in such programs.

Our approach was to closely interact with three carefully selected local companies on developing a technology-oriented product. The companies provided the seed ideas and thus these were projects, in which the companies had genuine commercial interest, but lacked the in -company resources to develop. The selected companies were local, in order to provide the students maximum access to the company facilities and personnel. Key project meetings were often held at the companies, with all of the team members and faculty supervisors present.

It was made clear to the companies at the outset that the teams would not provide “tech service” as often characterizes engineering co -op learning programs. Rather it was emphasized that the students were to simulate a

startup or spin-off company, seeking a business relationship with the parent company. They need to create technology-oriented product with significant commercial value to succeed. The company executives were also asked to assist in a second way. At the end of the process, after the teams identified a plausible product line for their startup, the executives were asked to assume the role as a potential investor, and to evaluate the financial prospects of the proposed startup. All three companies were comfortable in providing this kind of input, and the results were quite satisfactory.

A total of roughly thirty students were divided into three teams of about ten each. Each team had between half and two-thirds engineering concentrators, and the remainder were non-engineers (mainly drawn from the social sciences). All companies that were approached to participate immediately accepted. The three participating firms were The Foxboro Company (a manufacturer of automatic control equipment), Albany International (an industrial fabrics and specialty materials company) and Comtec Information Systems (a manufacturer of portable, radio controlled thermal printing and labeling equipment). All three are international firms with excellent reputations and well-known product lines in their respective areas. The contact persons with whom the students regularly met were very senior executives. For example, at the Foxboro company, a regular participant was Dr. Gene Yon, Vice President for Intelligent Automation Technology; at Albany International, the students met frequently with Paul Allingham, Director of Marketing for Industrial Fabrics and Filters; and at Comtec, the students met with Chairman and CEO Alfred Petteruti, Executive Vice President Steven Petteruti, and Director of Marketing Robert Danahy. The high level of these executives assured the sponsoring companies' continued interest throughout the semester, and the ability of the teams to access other key company personnel and resources. These, and many other individuals, all gave generously of their time and provided extremely valuable feedback to the students both following the formal presentations held throughout the semester, as well as more informally.

The final products of the projects were in all cases a formal business plan, relevant sales collateral, and a final presentation of product concepts (and in some cases, prototype products) to company personnel. All were warmly received by the company, and all of the ideas developed by the student teams are still alive as potential products (or product components) within the companies. The companies were supportive of the students' own continued pursuit of the product ideas, but this became impractical because too high a percentage of each project team had decided to pursue other independent career paths following graduation. Nevertheless, the companies all regarded the projects as real successes.

II. Overall Objectives

A. Technical Objectives

1. To provide real-world experience with engineering science and design methodology: From the classroom to a real industrial program is a gigantic step—one in which graduating engineers find very difficult and often painful. This was the students' first 'taste' of the real world. Our primary objective here was to demonstrate to students that these problems and their solutions cannot be found in a textbook. The students certainly applied some of their classroom knowledge to the problem, but quickly discovered that it will take ingenuity and creativity beyond their background to accomplish the identified tasks. The students needed to formulate the problem and figure out all of the issues that may be associated or a factor in the engineering design.

2. To demonstrate the power, as well as problems, of a multidisciplinary technical team: In today's high technology environment, it is virtually impossible to have the complete technical skill-set and knowledge to solve the complex problems that will face an engineer. Our objective here was to introduce the students to an environment in which the electrical engineer will have to rely on the chemical engineer, for example, or vice versa. It took students a great deal of effort to overcome the technical vocabulary differences in their respective disciplines. This was especially true vis-à-vis the technical and non-technical students.

3. To introduce problems that require significant optimization and trade-offs: Our objective here was to show students that in many circumstances, there is no such thing as a right answer, only a lot of wrong ones. They were faced with trade-offs of a technical nature, as well as modifying the technology to meet safety regulations or environmental issues at the expense of performance, for example.

4. To introduce students to the concept of concurrent engineering concepts: The concept of concurrent engineering, which cannot be learned in a lecture hall or textbook, is at the very heart of today's high technology industries. It was originally proposed as a means to minimize product development time which is necessary today in light of the convergence of increased product complexity and decreased time to market. The students learned a systematic approach to the integrated, concurrent design of product development, including related processes,

manufacturing, commercialization, and customer support. The projects will force student developers, from the onset of the project, to consider all elements of the product life cycle from conception through commercialization or disposal, including quality, cost, schedule and customer requirements.

B. Non-Technical Objectives that Influence Engineering Decisions

1. Training in preparation of a business plan: A business plan is the starting point for getting a company or core business unit off the ground. It is one of the most important and critical documents a high-tech entrepreneur will learn to prepare. The students prepared a business plan that was to convey two essential messages: (1) the market opportunity and (2) the ability of the team to exploit it. This should enable the students to identify their team's strengths and weaknesses. If, for example, the students perceive a weakness in marketing or finance, they should take the necessary measures to fill the gap. The preparation of the business plan at the start of the technical project was to ensure that the team has the necessary people in place to accomplish the proposed development agenda.

2. Training in developing a management infrastructure: The students were responsible for developing an organizational chart indicating the positions and key responsibilities of the management, and the key personnel for the proposed tasks. In order to develop this infrastructure, the students will have to take into account human factors such as relevant experience and background of the team members, personality traits, and communications skills.

3. The importance of market research and marketing of the product: This could perhaps be the most difficult aspect that the engineering entrepreneur might face. At first sight, marketing may seem obvious, trivial and a matter of common sense to the students, but the engineers in the groups quickly realized how important it was and how it can influence engineering.

To make a mistake in marketing can have catastrophic effects on the success of the project. Unfortunately, engineers and inventors often underestimate the importance of marketing. One of the primary objectives here was to emphasize to students that high-tech business is market driven, irrespective of how brilliant a product is technologically. Obviously there will be differences between marketing from one project to another, but suffice it to say, the students in all of the projects had to balance the marketing effort against the stage of development of their core technology. The students also learned that defining a market strategy is an iterative process to be consolidated over a period of acquiring market information. Also, the students learned about product distinction. How do I distinguish my product over my competitors? Are there performance, safety, cost, ergonomic, environmental advantages to be exploited? The students had to assess the market demand, utility, and commercial potential.

4. Recognizing the role of intellectual property: This is also an extremely important educational objective for the students. The students were asked before the preparation of the business plan to identify all prior art in the public domain. Searching both the patent literature and the scientific and technical literature were used in their research. If their ideas were not original, they will explore the price and consequences of using someone else's idea (e.g. license, royalties, legal maneuvers, etc.). Overlap in intellectual property could have occurred in many cases, and the ramifications of such overlap needed to be explored by the student team.

5. Learning the product development cycle: The students needed to estimate how long it will take to develop the product. They quickly realized that the time scales could depend on market size, information acquired about their competitor, the overall economy, and the rate of technological change. The students needed to discuss the possible emergence of a competitive technology and retain their objectivity on how well the product they were developing compared to competition.

6. Setting the price of the product: The students learned that the majority of work that initially goes into pricing is an extension of market research. The relationship between sales and marketing is different for every high-tech project, and there is no way to predict how this would evolve. The intent was to dispel the notion that pricing is determined merely as direct costs plus indirect costs, with an additional profit. They were to analyze the pitfalls in failing to account for all costs, in underestimating the market value of the product, and begin to anticipate the potential response of competitors.

7. Summarize rewards and attendant risks: The students needed to accurately identify the risks of their development path and the potential payoffs. They needed to decide how to minimize these risks. Because the product development time was short for this program, as in the real world, the students were forced to simulate risk. There are many ways to predict the probability of occurrence of an undesirable outcome of the strategy that the students may have wished to implement. When the students engaged in some sort of risk analysis they should be able to assess the risks associated with making various business and technical decisions; for example, what is the probability that the product will recover our financial costs? What is the likelihood that it will incur a financial loss? What are the chances that production can not keep up with demand? What is the probability that the project be completed on time?

8. Environmental, health and safety considerations: Many brilliant engineering ideas are never commercialized because they fail to meet certain environmental, health and safety considerations imposed by the customer or the government. The students needed to carefully consider these issues and do extensive research to ensure their product met all of the necessary considerations. It was one of our goals for the students to realize that these issues can add substantial costs to the product and increase the product complexity manyfold.

9. Seamless Integration: Vertically and Horizontal Integration: The objective here was to introduce students to the logistics of integration by working closely with the mother company. Vertical Integration puts the emphasis on management, policy, procedures and practices, whereas horizontal integration deals with their functional activities, such as mission, customer requirements, product management, process management, product support, field support, etc., shifting emphasis from individuals to collaborative cooperation. In some projects, the student's goal would be to start with raw materials and transform them into finished goods or products with the highest enriched value, as well as meeting the end customer's needs. Since the students were dealing with these projects as a core business unit of the mother company, logistical integration was a major factor in the project.

10. The value of teamwork and project management skills: We expected that this will be one of the most important lessons for the students to learn, and, indeed, it was. They quickly realized the importance of group efforts. This cooperative team experience was a lot different than working on homework sets together, it demonstrated to the students the importance of trust, collaboration, responsibility, ethics, project management and camaraderie, all of which are necessary components for a successful high-tech core business.

11. The important role of presentation and public speaking: It can be very intimidating for students to stand in front of their colleagues and give presentations. Being a skilled communicator is essential in today's engineering firms, and therefore the ENTERPRISE course gave many opportunities to students to learn how to present their projects in a professional manner. Groups gave presentations to the class as a whole, to other engineering management courses at Brown, to executives of companies not affiliated with the program, and (of course) to the parent company whom they were working for.

We were more successful in meeting certain objectives than we were in meeting others. However, overall we are very pleased with the results. In the next section, we hope to go through each of the three projects and explain the development of the groups' start-up businesses.

III. Details of Course Organization and Examples

A. The Classroom Component

As noted above, the students met for three hours of instruction per week in the course's regularly scheduled meeting time. In addition to using this time to convey logistic information, the instructors of the course also wanted to teach some of the important aspects of entrepreneurship. Lectures were delivered to the class on the following topics:

- Financial Reporting and Accounting
- Intellectual Property
- New Product Development
- Cash Flow/Allocation of Resources
- Human Resources
- Team Building/Personnel Management
- Personnel Evaluations
- Sales and Distribution
- Capital Formation
- Life Cycle of Products
- Manufacturing Issues

The textbook used in the course was Engineering Your Startup (Michael Baird, Professional Publications, 1992). However, supplemental case studies were also used. The Billion Dollar Molecule (Barry Werth, Simon and Schuster, 1994) illustrated the plight of the start-up Vertex, inc. Also the Harvard Business School (HBS) case study on FILL_I N was used to illustrate FILL_IN.

The classroom meeting time was also used often as a place for groups to give presentations on their business. The class as a whole would listen to the presentation, and then critique it.

B. The Albany Group

The assignment presented to the Albany group was to redesign a filter-bag cage used in dry fabric air filtration to reduce the shipping cost incurred by Albany in distributing their product around the globe.

The group was organized into two teams, marketing and design, during the first half of the project. This organizational structure came out of a meeting the group had somewhere around Sept. 22nd (very soon after our first

full meeting with Albany). They decided to look into two basic items (i) the volume / cage issue and (ii) the viability of a four potential start-up business.

Towards the end of the first semester, Albany International made it clear that they wanted the primary focus of the engineering and marketing effort should be in developing their modular cage concept into a viable product. After looking into the modular concept, the students identified two problems with the modular concept. The first problem was the additional cost of assembly incurred on site would outweigh any savings from reduced shipping volume. However, what they also found was that the modular cages were prone to structural defects at an alarming rate. Given the labor-intensive manner of assembly, it was very easy for the cages to be bent or broken during the assembly process. The students presented their findings to AI over the course of two meetings in December and February.

After the modular cage idea was put aside for the time being, the Albany team was charged with coming up with a viable business in less than three months, and still no primary product had been identified. The group refocused their marketing effort to find out more about what AI's customers were interested in. They researched more about AI's competitors, finding out what products and services these companies were offering. The team discussions ranged from a company that "would just create cages" to a company that would offer a wide array of products for, services for, and construction of baghouses.

Finally after the group consulted with their professors and industry contacts they had made – they refocused their effort to solely think of Albany International as their customer, specifically not focusing on AI's customers. In April and May the team pitched their idea of offering AI a redesigned modular cage that would not be prone to structural failures, a new assembly tool that would reduce the assembly time, a marketing / sales package, and a software package that would initially be used as a sales tool – but was scalable to include the ability for AI to receive on-line orders for cages, automatic replacement schedules, etc.

They presented their products to AI's vice president in mid-May. The company executive was quite pleased with the results, and considered using the student team's company. The end of the academic year, however, also marked the end of the students' interest in fabric filtration.

C. The Comtec Group

The assignment given the Comtec group was to develop a plan to market electronic shelf labels (ESLs) to retail stores. They began by doing a lot of research on both the marketing and design aspects of their project. They also split their group into two teams, design and marketing. The design team was charged with learning about the ESL technology, and specifically how they use RF transmissions to wirelessly communicate. The marketing team organized the research of state regulations requiring accurate price displays, current use of ESLs, potential competitors, and the pricing of ESLs and their alternatives.

About halfway through the first semester, the Comtec group ran into a large problem. They estimated that ESLs would not be a profitable venture for the next five years. While demand for such a product was low and select, the technology behind each unit was quite expensive. Their market research showed that store managers would not be willing to spend the up-front cost required to install the systems in their stores, nor would the profits from the units be large enough for Comtec themselves to install the units.

However, when the team researched the technology some more, they found a way to integrate in-store advertising displays with the ESLs. The idea is a central computer, housing both the product/price database as well as the advertising media, transmits information to access points throughout the store, which then transmit their information to the individual ESLs. If they used the access points to transmit both price information as well as

Team Membership by Concentration

Albany Group

Sc.B. Chemical Engineering
 Sc.B. Applied Mathematics – Economics
 A.B. Organizational and Behavioral Management (OBM) and Economics
 Ph.D.(c) Materials Science
 Sc.B. Chemical Engineering
 Sc.B. Chemical Engineering
 Sc.B. Materials Science
 Sc.B. Materials Science

Comtec Group

A.B. Economics and Urban Studies
 Sc.B. Materials Science, A.B. in Economics
 Sc.B. Mechanical Engineering, A.B. in Architectural Studies
 Sc.B. Mechanical Engineering
 Sc.B. Electrical Engineering, A.B. in Modern Culture and Media (MCM)
 Sc.B. Electrical Engineering
 Sc.B. Electrical Engineering
 A.B. English
 Sc.B. Electrical Engineering
 A.B. East Asian Studies and Engineering

Foxboro Group

A.B. Business Economics
 Sc.B. Chemical Engineering
 Sc.B. Electrical Engineering
 Sc.B. Chemical Engineering
 Sc.B. Computer Science
 Sc.B. Electrical Engineering
 A.B. Public and Private Sector Organizations
 Sc.B. Chemical Engineering

advertising media – they could use the revenue from the advertising media to offset the fixed costs associated with installation. Concurrent with all of this, the Comtec company was bought out by Zebra Technology Corporation in April. The merger took up a lot of the company's time – thus slowing down the project towards the end of the academic year.

In May the team held a demonstration in the Brown University Bookstore of one of these modified access points. While not entirely successful, it did demonstrate that the technology was feasible, and the group leaders could have had a product to sell to the Comtec company in “about three more months”. Two of the group's members were offered jobs with Comtec, one accepted their offer and is working for their marketing unit this summer.

D. The Foxboro Group

The task given to the Foxboro group was to further develop and market their wireless factory process control system (the *Mobile Workstation*). This task had several components – meeting safety/regulatory compliance, addressing customer concerns over new technology's reliability, and market needs assessment.

The group initially divided the work among two groups; an engineering group and a marketing group. They also elected a group leader. By the middle part of the second semester, the Foxboro group was quite successful in identifying their core product groups. They designed and planned to market a special protective case for the mobile computers (so they would avoid being damaged on the plant floor) and a software suite that would optimize the work of the engineers and maintenance staff using the mobile units. They had a prototype of the case and an alpha version of the software by the end of the academic year.

The Foxboro company offered some of the students jobs at the company, and the project was generally viewed as a success by all sides.

IV. Observations

Being the first year of this innovative project, the students, faculty, and participating companies were all asked to evaluate how the experimental class fared, and to offer suggestions to improve the project in subsequent years. We have compiled these comments in the following sections.

A. Student Motivation

The course is designed to teach the skill sets needed in the fast paced high technology sectors of our workforce. Today, as we noted before, there is an effort to use entrepreneurial skills and motivation to build a successful company in both small startups and large corporations. The common thread that runs throughout the entrepreneurial idea is that of motivation. The people involved in startups genuinely love their field of study. Whether software or hardware, engineering or biochemistry, the people involved in these companies are invested (more than just monetarily) in their projects. This is a key element that was missing from our class. Students interested in learning entrepreneurial skills enrolled in the class and then the instructors designed teams based around existing skills and expertise to form start-up companies. One student suggested the following idea. Open up the course to as many students as possible during the first week of school (or before, if possible). Give a detailed presentation on the projects to which students could be assigned, and explain what directions these projects could take (of course leaving open the possibility that other avenues could be pursued). Then, have students apply to a particular project – and use this restricted set of students only to populate each of the project teams using the same decision calculus discussed above.

The theory is that students will only apply to the project they feel that they could be invested in – and want to put in the absurd amount of time and energy that a real entrepreneurial project demands. When they join a group they will already be interested in some aspect of the project – and ready to attack that aspect of the project. This will solve one of the problems we faced which was some students feeling lost and unsure about their role in the project. While this may cause a problem within a team, where some members of the group are asked to leave their projects and work on one for the betterment of the team, this is much more akin to a real startup than the opposite.

B. Company Participants

One of the reasons that the Foxboro group did so well was the encouragement shown by the Foxboro company towards the project. From the very beginning, senior management personnel were invested in the work of the students. This gave the students extra incentive to “show off” what they are capable of doing. In addition to having management personnel with “decision making power” invested in the project, there are a few other small but important things a participating company should keep in mind. First, share all the information with the students.

Nothing is more disheartening to the students than to work hard for two months finding out information only to discover that their parent company had that information already. Second, find a contact person within the parent company who is fully invested in the success of the project. This does not have to be the manager with decision making power... but it also should not be someone in the company who was asked to do this "in addition to his or her other responsibilities".

C. Instructors

At Brown, we had two professors, Prof. Greg Crawford and Prof. Eric Suuberg, manage the course. In this capacity they organized the in-class lectures, provided invaluable advice and counsel, and most importantly did all of the legwork required before the class began to set up all of the company contacts and prepare the course.

One student we talked to suggested the following scalable model for the course. Currently, both professors worked very hard to be able to keep up with three groups while maintaining their own individual research labs. Depending on the demand (both on the student as well as faculty side), it may be possible to split up the course slightly differently. Have two faculty members assigned to each group – the advantage to having two professors is to allow for personality conflicts and schedule conflicts to be resolved easier. In addition, each faculty member should be asked to mentor two groups, but not necessarily paired with the same faculty member for both projects.

The faculty members should be advisors, not necessarily experts in the field. In our case, Prof. Suuberg was often one to keep the groups focused on the goal of making a financially successful business, hammering down this point often enough earned the phrase "The Suuberg Question" – How do you make money from this? While an anecdotal, it does show a very important role of the faculty, one of semi-removed yet quite interested persons. The analogy most often used is that the faculty members should act as the Board of Directors or Advisors.

D. Work Space

One of the most important, and I'll bet overlooked, aspects of the Brown University project was the investment made by the Division of Engineering allowing exclusive use of a lab for this project. This lab space offered the groups 24-hour meeting space, lab space, three computer stations at their disposal, photo-copy equipment, fax machines, telephones, and (the cheapest and yet perhaps the most used) a blackboard. Having a dedicated space to work made it easy for students to stay late and work on their project, often times squeezing in their other course work during the slow times.

E. Grading Criteria

Some of the students noted that grading the work in this class in the traditional letter grade manner was not appropriate given the format of the course. They suggested instead to restrict the classes to a pass/fail option. At Brown University, there are courses that are restricted to Satisfactory / No-Credit only, and this seemed to be favored by the majority of students. However, if you are going to issue a letter grade for the work, it is important to distinguish between the course goals and the business goals. One student commented that they felt some students were tailoring their work, not for the betterment of the startup, but for the professors.

V. Summary and Conclusions

This paper showed the results from the first year of a three-year Brown University/NSF project in Entrepreneurship where student teams are paired with parent companies to form start-up ventures on projects. The program attempts to teach upper-class students the skills required in the entrepreneurial world of high technology. We offer our best wishes and assistance to those who wish to try to implement a similar program at their institution.