Empowering Entrepreneurial Students

Report by Committee on Entrepreneurial Environment & Programs for Students

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Committee on Entrepreneurial Environment and Programs for Students (CEEPS)

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1. Executive Summary and Key Recommendations

In January 2007, the University of Michigan College of Engineering convened a committee to focus on the opportunities for student entrepreneurship and the existing obstacles to the effectiveness of the "entrepreneurial ecosystem." The "Committee on Entrepreneurial Environment & Programs for Students" (CEEPS") arose, in part, from the recognition that innovation and entrepreneurship can help U-M students differentiate themselves in the global economy. At a time when the contents of much "book learning" is on the World Wide Web and when other countries are educating 5-10 times the number of engineers as the U.S., it is the skill to innovate, and to define new problems and markets, that differentiates our Michigan engineering students.

In this Report, the Committee describes the content of an entrepreneurial student program and recommends strategies for implementing that program. It identifies metrics for program success that are directly linked to the mission statement. The Committee believes that the successful implementation of these recommendations will release the entrepreneurial spirit in our students and transform the way the College of Engineering is perceived by its students and the other stakeholders in this entrepreneurial ecosystem.

The mission of the entrepreneurial student programs is:

> To empower the entrepreneurial spirit of the students of the University of Michigan College of Engineering to drive the commercialization of innovations in the State of Michigan, the Nation, and in the global economy.

This mission statement reflects that a good deal of entrepreneurial interest is already present within the U-M College of Engineering (CoE). Because U-M is a state university, we emphasize the impact of these entrepreneurial commercialization activities on the State of Michigan. However, by their very nature, the activities and their impact will spread throughout the United States and into the global economy.

The Committee's efforts were shaped by the strategy of the College of Engineering with respect to the student entrepreneurship programs:

> The CoE intends to create a vibrant educational and research environment to support student interests in entrepreneurship and to retain the participation of those students in this entrepreneurial ecosystem after they graduate.
>
> This includes the creation and coordination of course offerings, research opportunities, streamlined business and legal processes, faculty, alumni, business and technology collaborations, and direct involvement with community leaders and other resources.

The strategy focuses first on the academic and research environments. It notes the role of rules and processes governing intellectual property (IP) policies and the importance of internal

and external support systems for fostering an entrepreneurial ecosystem. CEEPS stresses that collaborations must extend across the University and beyond the boundaries of the University community.

CEEPS developed objective measures of success relating to the program elements in the strategy:

- Number of student innovations (patents, disclosures, open source disseminations)
- Number of companies started by students while in school
- Number of companies started by students within 5 years of graduation

- Number of students getting jobs in small companies[1]
- Number of student internships in small companies
- Number of companies employing CoE grads within 5 years after their graduation

- Number of Michigan companies started by students within 5 years of graduation
- Number of students getting jobs in small Michigan companies
- Number of student internships in small Michigan companies
- Number of Michigan companies employing CoE grads within 5 years of graduation

- Number of total credits in entrepreneurship courses[2]
- Number of students in entrepreneurial programs
- Number of Entrepreneurship Program certificates provided

- Number of CoE students mentored by CoE grads
- Number of business collaborations between students/grads of CoE and those of other schools or colleges within the University of Michigan
- Number and amount of scholarships available to student entrepreneurs

The measures of success fall into five groups addressing important aspects outlined by the strategy – (1) direct entrepreneurial impact of students through inventions and through their creation of new companies; (2) entrepreneurial impact of students in small companies they did not start personally; (3) impact of the entrepreneurial program in the State of Michigan; (4) academic elements in the College of Engineering; (5) interactions beyond the College of Engineering to others in the University of Michigan and to external support. This support will be the most reliable measure of success with regard to the needs of the entrepreneurial ecosystem.

The Key Recommendations implement the CoE strategy regarding student entrepreneurship and are discussed in detail in the Report. They are summarized below:

1. **Entrepreneurship Certificate Program.** Available to CoE undergraduate and graduate students, the certificate is in addition to the diploma awarded at graduation. Students take courses with content relating to innovation and business; faculty may be UM staff or members of the broader entrepreneurial community.

[1]As defined by U.S. Department of Commerce Regulations.
[2]As defined by CoE.

2. **Distinguished Innovator Seminar.** A series of seminars designed to expose students to entrepreneurship in engineering through leaders in business, technology, venture capitalists, attorneys, and others involved in emerging business models, new venture creation, and technology commercialization.

3. **College of Engineering Student Entrepreneurship Center.** Create a CoE Student Entrepreneurship Center to facilitate and coordinate internal and external support services, including access to lab space and equipment, dissemination of information relating to intellectual property and technology transfer; and student access to members of the business, legal, and financial community and U-M Office of Technology Transfer.

4. **Entrepreneurial Opportunities Fair.** A student group, in collaboration with CoE and the business community, should arrange a regular Entrepreneurial Opportunities Fair that exposes students to job opportunities with small, high-tech, emerging businesses in Michigan.

5. **Support College of Engineering Student Entrepreneurship Group.** Creation of a student entrepreneurship group ("MPowered') to host a small company/start-up job fair; run a speaker series; develop networks with the Business School, the Law School, and other students from the University; run a mini-grant competition; and administer small amounts of seed-funding to promising student projects.

6. **Simplification and Clarification of Student Intellectual Transfer Processes.** Align U-M IP ownership policies with entrepreneurial objectives of CoE to create a pro-startup environment on North Campus, simplify use of student technology for use in start-up companies, and create a culture to maximize the public value of the IP created at the U-M.

7. **Entrepreneurship Grants Program and Entrepreneurial Fellowship Competition.** Create entrepreneurship grants program and hold entrepreneurial fellowship competition to support process of technology development through commercialization. A board representing members of the broader entrepreneurial community will review student proposals.

8. **Anchoring in the College of Engineering.** The entrepreneurial activities should be coordinated by a staff director within CoE, who will coordinate across U-M departments and the other components of the entrepreneurial ecosystem, and who will be advised by an entrepreneurial advisory committee representing the broad entrepreneurial community.

9. **Entrepreneurial Environment.** Create a nurturing, inviting environment that encourages idea generation, big "out-of-the-box" thinking and execution, and student "ownership" of their ideas while challenging students to identify and address real world problems by connecting to the community outside CoE and U-M.

The Committee is convinced that implementation of these recommendations will lead to a transformation in the way student entrepreneurship is viewed on campus. It strongly believes that *all* recommendations are critical to achieve this goal.

The Committee consists of members of the U-M College of Engineering community, students, faculty, staff, and also members of the broader entrepreneurial ecosystem, such as entrepreneurs, venture capitalists, and intellectual property attorneys (Appendix A.1). The Committee's work was performed from January – May 2007 using a number of approaches summarized in Appendix A.2.

Figure 2-1: Participants in the College of Engineering Bay Area visit, including Committee members, entrepreneurial students, venture capitalists, and other members of the broad entrepreneurial support system, such as patent attorneys, business lawyers, and recent CoE alumni.

The Committee's work and recommendations were organized around the principles of the entrepreneurial ecosystem, and the challenges that are currently limiting the performance of this system. The parts of the system under consideration are both internal and external to the College of Engineering (Figure 2.1). Such challenges have to date severely limited the formation of an entrepreneurial culture within the College of Engineering.

The key challenges and the resulting recommendations are depicted in Figure 2.2. That figure represents major elements of an entrepreneurial education for CoE students, which are in addition to the resources of the Zell Lurie Institute, the Ross School of Business and many other parts internal and external to U-M. These parts are largely disconnected at this point, as set forth in Section 3 and Appendices A3-A5.

The recommendations provided in Sections 4-6 address these challenges and are described in the bottom of Figure 2.2. They are designed to build connections between the key entrepreneurial

elements previously introduced. Section 7 provides a benchmarking summary, and Section 8 provides a broader outlook.

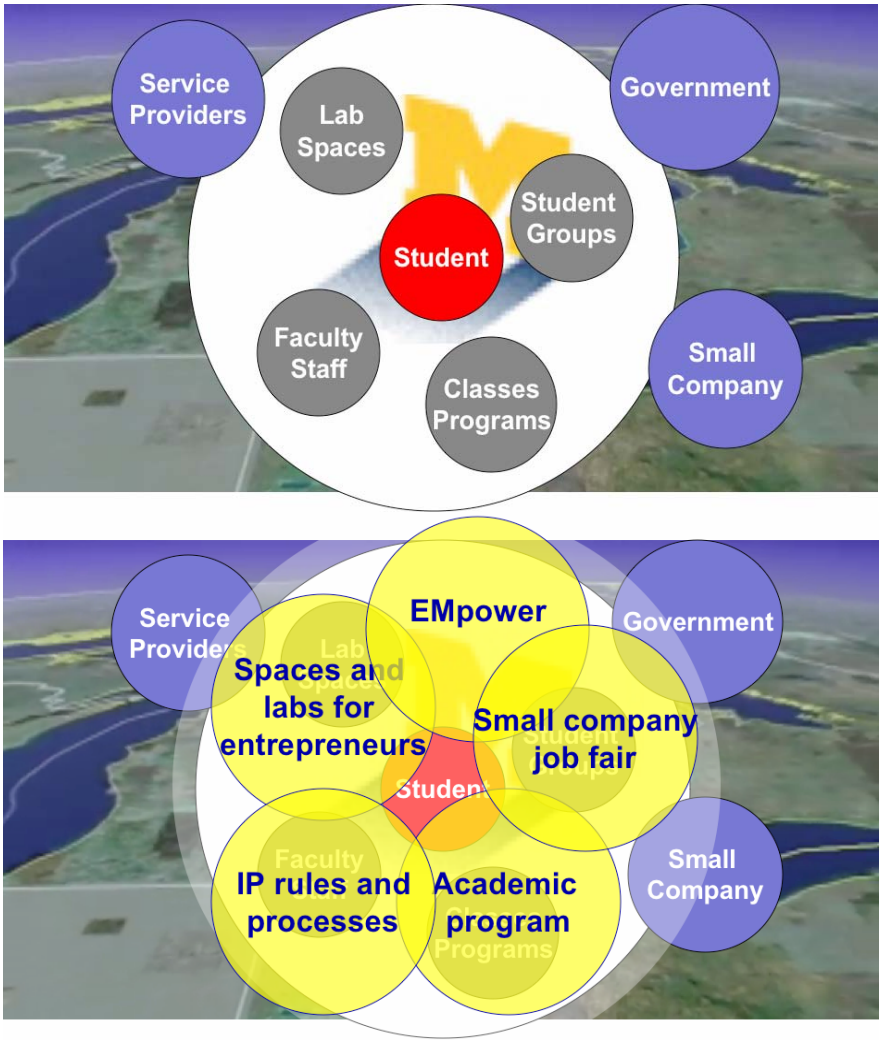

Figure 2-2: Key elements of the entrepreneurial ecosystem that are available to students of the College of Engineering (top). The recommendations in this Report are designed to connect these parts and create an "entrepreneurial ecosystem" (bottom).

2. Report Strategy: Entrepreneurial Ecosystem

The University of Michigan is a state university, and therefore directly linked to the overall State environment. The economic health of the State of Michigan and its business community affect the level of support the University of Michigan has available for its teaching and research. Research activities on campus bring additional revenue to the State, and the students educated at U-M can join existing companies or start their own companies, both of which directly impact the State of Michigan. These interactions link the University of Michigan, and particularly the College of Engineering, to an "***entrepreneurial ecosystem***" which, through the national and international reach of companies and organizations, expands to include the United States and the world.

There is a pressing need for this entrepreneurial ecosystem to work. The State of Michigan is in serious economic trouble caused, in part, by the struggles of the Michigan-based automobile industry. Indeed, a recent Kauffman Foundation study reported metropolitan Detroit had the lowest rate of entrepreneurial activity in the country, 0.13%, compared to the national average of 0.29%.[3] The rate of job growth in the State has also been one of the slowest in the Nation and there has been an outcry for the diversification of the economic portfolio in the State. Similarly, the U.S. needs innovation and entrepreneurship to maintain its leadership position and for continued prosperity and high standard of living.

There is tremendous opportunity for CoE students to flourish in this entrepreneurial ecosystem. Indeed, it is difficult to think of a more robust environment: The University of Michigan contains expertise and current and future leaders in all areas of study; there is tremendous support and encouragement from the local business community; and the CoE has one of the most extended networks of alumni with influence around the globe.

However, this entrepreneurial ecosystem is not performing to its capacity. There are a number of obstacles that prevent the vital interactions in this system in spite of tremendous interest in this area. Although student enrollment in entrepreneurial classes is at or near capacity, students feel little support for entrepreneurial activities:

- In contrast to most engineering programs at leading educational institutions in the U.S., we do not have an academic program in entrepreneurship.
- There are insufficient identifiable resources to support entrepreneurial activities.
- The CoE does not have entrepreneurial spaces where students can meet and talk about their ideas.
- The CoE does not include entrepreneurship as a key value for promotions and annual evaluations, which apparently discourages many faculty members from direct involvement in such activities.
- There is an overarching and broad perception of “legal hurdles” to knowledge transfer in the U-M. Some of this perception is due to lack of accurate information or the absence of streamlined processes. The result is to reduce or prevent interactions between students and university administrators, and sometimes even between students and their professors. This perception is amplified by experiences of the business community that seek to support entrepreneurial activities through legal, venture capital, and other services.
- The connections to the local business community are sparse.

3. Status and Challenges

There are four keys elements for the development of an effective infrastructure that will change the CoE culture towards a flourishing entrepreneurial ecosystem: (1) an engaged and informed student body; (2) educational program support; (3) streamlined cross-campus links

[3] Fairlie, Robert W., "Kauffman Index of Entrepreneurial Activity, 1996-2006" (May 23, 2007). Available at SSRN: http://ssrn.com/abstract=988167

(particularly to the Business School); and (4) transparent rules and processes pertaining to intellectual property issues. Based upon (a) student input from a town hall meeting and on-line survey (Appendix 3), (b) evaluation of the entrepreneurial content in current CoE courses (Appendix 4), (c) assessment of the extent of integration of CoE students with other entrepreneurship programs on campus, (d) examination of U-M rules and processes for intellectual property ownership, and (e) numerous interviews with students, faculty, and members of the broader entrepreneurial community, the Committee determined that there is insufficient infrastructure for these key elements and there are a number of obstacles that prevent the vital interactions in this system in spite of tremendous interest.

3.1. Student Opinions

Status: A large majority of students in the College of Engineering are interested in entrepreneurship. Their interests range from starting a business while still in school to "simply" developing an entrepreneurial mindset. Their grasp of the concept of entrepreneurship ranges from a broad understanding that knowing how to commercialize a technology is a skill that will differentiate them in the marketplace to a narrower belief that entrepreneurship means starting a small business. Whatever their interests or views, they share concerns and observations that are important for a successful entrepreneurship education program. Students are ready to participate in an expansive entrepreneurship education program. They look forward to the opportunity to learn and grow in entrepreneurship by building a community centered in the College of Engineering. The success of the program, students believe, rests in its flexibility and its ability to bridge the gap between student innovation, the strong technology developed in the College and understanding the fundamentals of successful entrepreneurship.

Challenge 1): There is a need for better entrepreneurial course offerings. A principal concern is the limited space and scope of currently available entrepreneurship courses, and their emphasis on graduate students. Students want a sequence of courses aimed at undergraduates that is properly awarded in an academic sense and is flexible enough to fit within the current curriculum.

Challenge 2): There is a need for an advising center to direct resources and information pertaining to the mechanics of entrepreneurship. Many students are interested in pursuing a small business while in school or may be preparing to start one soon after graduation. They might have an innovative technology they have worked on and are in the process of technology licensing. Whatever the case, they all want to understand the legal and business processes necessary to be successful. We recommend an advising center with volunteer lawyers and business experts, who can comment on the marketability of an idea and help develop a business plan.

Challenge 3): The students are very concerned about the atmosphere or environment in which they operate. Many students describe a passive resistance to pursuing anything entrepreneurial and find themselves without a community to support them. One of the major suggestions from students is starting a student entrepreneurship group that will develop the entrepreneurial community within the College while building relationships with the University and broader community.

3.2. CoE Course Offerings

Status: There are over twenty courses offered in the College of Engineering with entrepreneurial content. Student enrollment in these courses is significant and has increased over time, indicating that there is widespread interest in entrepreneurship by CoE students of varying academic level and program of study. Most of the courses are focused on a small fraction of departments, often focusing only on the department's own students. Most of the courses without substantial pre-requisites run at or near enrollment limits.

Challenge 4): There is a compelling need to build and integrate an educational entrepreneurship program at the undergraduate level that carries through the 4-year undergraduate degree. This program needs to address the following needs: (1) expose and excite CoE students to entrepreneurship aspects early on; (2) provide sufficient depth in opportunity identification, business hypothesis testing, finance, and marketing; (3) provide the students with an academic award, such as a certificate.

3.3. Cross-Campus Links to RSB

Status: The current center of University of Michigan entrepreneurial activity, access to venture creation, entrepreneurship mentoring, and courses with entrepreneurial content, is within the Business School. This includes enrollment in courses, and participation in entrepreneurship programs offered through the Zell Lurie Institute (ZLI) for Entrepreneurial Studies. The Ross School of Business (RSB) offers a range of courses that either are directed to entrepreneurship or explicitly incorporate entrepreneurial content, including the courses identified in Appendix 4. Whereas graduate students already participate in these course offerings (47 CoE students enrolled in 2007) and programs, CoE undergraduates tend to take accounting and finance for non-finance majors. ZLI activities also include funded grants programs (*e.g.,* Dare to Dream, Frankel Fund, Wolverine Fund), and Michigan and Intercollegiate business plan competitions, in which CoE students currently actively participate. ZLI further manages the Williamson Collaborative Entrepreneurial Education Initiative (CoE and RSB alum) which provides an entrepreneurial business foundation for engineers. Again, the participation of CoE students is largely biased towards graduate students.

Challenge 5): Even though useful classes are provided by the ZLI, there is no centralized mentoring or entrepreneurial support infrastructure on North Campus to enable students to become educated and apply their potential and enthusiasm towards entrepreneurial opportunities. The RSB has very limited offerings in entrepreneurship for undergraduate students, and existing courses are oversubscribed with business students, sometimes prohibiting participation of CoE students. Furthermore, the focus of the ZLI has been on graduate students as well and mostly on students from the RSB, even though there are exceptions to this (*i.e.*, Dare to Dream).

3.4. Assessment of Rules and Processes

Status: Entrepreneurship, particularly in the field of engineering, involves creation of technologies, ideas, software, designs, prototypes, and other workproduct. This workproduct is generally subject to intellectual property protection by patent, trade secret, copyright, and/or trademark laws.

Student ownership of the legal rights to their inventions can also be subject to Regents Bylaws. Through Bylaw 3.10, the University of Michigan broadly asserts ownership of patents, copyrights, and software arising from activities "of University staff that are supported directly or indirectly (*e.g.,* through the use of University resources of facilities) by funds administered by the University." It disclaims rights in patents, copyrights, and software if there has been "no support, direct or indirect, from the University."

Based on the language of this Bylaw, there are several important and unfortunate implications for student entrepreneurs. Because the phrases "direct or indirect support" and "funds administered by the University" are broad and vague:

- They present the possibility that the University will claim ownership of student inventions, copyrights, and software merely because the student used University facilities, equipment, or technology, or because the student received a stipend or other financial support from the University.
- The University might claim ownership of inventions where a student collaborates with a University educator or researcher and where the staff contribution is patentable.
- A legal analysis is required to respond to the question of "who owns what rights in which workproduct." The outcome is not easily predictable and students may be deterred from collaborating with University staff.
- The rules and process can lead to delays in commercialization of inventions and to cynicism as to University motives in making such sweeping claims of intellectual property ownership.
- The rules and processes may ultimately discourage students from using anything that might appear to involve "support, direct or indirect, from the University."

Challenge 6): There is a need for the CoE technology transfer policies to be clarified and to help students in the pursuit of entrepreneurial goals. CEEPS believes that entrepreneurship and innovation are fostered where students (1) retain intellectual property ownership of their inventions; (2) have rights to use University technology, facilities, and equipment; (3) collaborate with University staff; and (4) have the freedom to share with third parties and with the public their ideas, research, and analytical tools. This Report recommends specific rules and processes designed to help foster an entrepreneurial and collaborative research environment.

4. Academic Program

Recommendation 1: Entrepreneurship Certificate Program. The Committee recommends the creation of a Certificate Program in Entrepreneurship that would be available to undergraduate and graduate students in the College of Engineering. The Certificate would be an additional diploma obtained at graduation, and to obtain the Certificate a student is required to take a minimum of nine (9) credits from a particular selection of courses. Teaching from members of the broad entrepreneurial community, outside of the CoE or the U-M is particularly encouraged.

4.1. Summary

CEEPS recommends the immediate creation of a Certificate Program in Entrepreneurship that would be available to undergraduate and graduate students in the College of Engineering. The Certificate would be an additional diploma obtained at graduation. To obtain the Certificate

a student is required to take a minimum of nine (9) credits from a particular selection of courses. This addresses Challenges 1 and 4 identified in Section 3.1. More specifically, the requirements for the Certificate include:

- one seminar course
- one course from a core set of courses
- one course from an elective set of courses
- a capstone project, internship, or practicum course on entrepreneurship

Although some may suggest that there is no need for the CoE to offer these courses because interested students can take such courses in the Business or Law Schools, CEEPS believes it is important for the CoE to create its own Certificate program for a number of reasons. First, the Certificate would be geared for engineers, enhancing their ability to solve engineering problems with a "holistic" approach. Second, many of the courses in the Business or Law Schools focus on theory and history, whereas engineers need a more practical approach. Third, many of the courses in the Business or Law Schools have prerequisites, making it difficult for engineering students to take the courses because there is not enough time in their schedule. All of the courses in the Certificate program are designed to have no prerequisites. Thus, an interested engineering student would not have obstacles in their path to fulfilling the requirements of the program.

Table 4.1: Overview of proposed Certificate program. The elements of this program are discussed in Sections 5.2-5.

Seminar *(Required)*	**Core Courses** *(At least one from below)*	**Elective Courses** *(At least one from below or from remaining core courses)*	**Practicum or Capstone Project** *(One practicum course from list or Capstone)*
Distinguished Innovator Lecture Series (1 credit) - Lecture followed by reception - Pass / Fail	*EECS 498:* High-Tech Entrepreneurship (4 credits)	*ES 715:* Driving the Innovation Process (3 credits)	Capstone Project with start-up / creation of a business plan
	ENG 599: Entrepreneurial Business Fundamentals for Engineers & Scientists (3)	*ME 508:* Product Liability (3)	*ES/FIN 629/329:* Financing Research Commercialization (3 credits)
	EECS 495: Patent Fundamentals for Engineers (3)	*IOE 548:* Innovative Product Design (3)	*IOE 422:* Entrepreneurship (3)
	ME 509: Patents, Trademarks, Copyrights (3)	*ES 569:* Managing the Growth of New Ventures (1.5)	*ES 615:* New Venture Creation (3)
		FINENG 591: Finance Risk Management (3)	
		STRAT 553: Intellectual Property and Competitive Strategy (1.5)	
		LHC 509: Intellectual Property Law (2.25)	

4.2. Distinguished Innovator Lecture Series

Recommendation 2: Distinguished Innovator Seminar. The Committee recommends the creation of a distinguished innovator seminar series designed to expose students to entrepreneurship in engineering. Its topics should include the latest and most diverse practices and thinking on emerging business models, new venture creation, and technology commercialization, legal, financial, and other management issues. The lecturers should include leading entrepreneurs and executives, technology innovators, venture capitalists, attorneys, experts from the financial markets, and others who support the entrepreneurial infrastructure. The seminar should also facilitate interactions between entrepreneurs across the entrepreneurial community within and outside of the College of Engineering.

The anchor for the Certificate program is the creation of a new seminar course that would be a "Distinguished Innovator Lecture Series." This will be a one (1) credit course with a weekly lecture toward the end of the day, preferably followed by a reception that allows mingling of the audience with the speaker as well as other attendees. This one-credit course should be offered in both the Fall and Winter semesters, so that students can enter the Certificate program either semester. The purpose of the course is to expose the students to entrepreneurial ideas, so attendance for students taking the course for credit will be required. High-profile speakers who are well-known entrepreneurs will be sought to enhance the reputation of the lecture series.

Unlike many one-credit courses, we expect that the Distinguished Innovator Lecture Series will require significant time commitment from the faculty member involved. Therefore, to guarantee the success of the seminar series, formal teaching credit should be provided for tenure-track professors, and secretarial support should also be allocated. A budget should also be provided from the CoE for travel expenses for speakers (the expectation is that alternate weeks will have out-of-state speakers). If possible, it is also recommended that the budget include funds for a reception following each lecture. Furthermore, to make the lectures available to a wider and more diverse audience, the lectures should be podcast. Arrangements might also be made with the U-M television station to broadcast the lectures.

A description for the Distinguished lnnovator Seminar series is as follows:

> This seminar series exposes students to entrepreneurship in engineering. The topics include the latest and most diverse practices and thinking on emerging business models, new venture creation, and technology commercialization, legal, financial, and other management issues. The lectures include leading entrepreneurs and executives, technology innovators, venture capitalists, attorneys, experts from the financial markets, and others who support the entrepreneurial infrastructure.

4.3. Core Courses

The second main element of the Certificate program is the requirement to take a minimum of one course from a select set of core courses. Two of the core courses focus on educating students in what it means to be an entrepreneur, some of the models for entrepreneurship, and the basics of entrepreneurial business creation. The other two courses focus on some of the basics of patents and, more generally, intellectual property. Educating students in entrepreneurship

provides them the opportunity to decide if this is where their passion lies, and some methodology about how to take technology and turn it into commercial entities. Intellectual property is an important element of high-tech start-ups because it can provide entrepreneurs the "runway" for getting their projects off the ground and obtaining funding for their ventures. The four core courses are:

- EECS 498: High-Tech Entrepreneurship (4 credits)
- ENG 599: Entrepreneurial Business Fundamentals for Engineers & Scientists (3)
- EECS 495: Patent Fundamentals for Engineers (4)
- ME 509: Patents, Trademarks, Copyrights (3)

CEEPS recommends that these core courses receive an engineering (ENG) designation so it becomes easier for the students to find and sign up for the courses. Also, the CoE should guarantee that at least one core course is offered every semester, so that students can complete their Certificate in a timely fashion.

4.4. Elective Courses

The third element of the Certificate program is a series of elective courses. Students must take at least one course from the list of electives or any of the remaining core courses. The list of elective courses includes:

- ES 715: Driving the Innovation Process (3 credits)
- ME 508: Product Liability (3)
- IOE 548: Innovative Product Design (3)
- ES 569: Managing the Growth of New Ventures (1.5)
- FINENG 591: Finance Risk Management (3)
- STRAT 553: Intellectual Property and Competitive Strategy (1.5)
- LHC 509: Intellectual Property Law (2.25)

4.5. Practicum or Capstone Project

The final element of the Certificate is a practicum or capstone project. Some might say that entrepreneurship is a mind-set (*i.e.*, risk taking is acceptable). The best way for students to learn and appreciate this will be to "just do it." Students are encouraged to experience entrepreneurship by one of two vehicles. First, the student can participate in a capstone project with a start-up or creation of a business plan. The only requirement for this is that the project has a faculty advisor or mentor who will be responsible for signing for two or more credits in the project. The faculty advisor's role is to ensure that there is an academic aspect to the project and that the student does not turn into just another assistant to the advisor. As an alternative to the capstone project, students may elect to take a start-up–oriented practicum course. Ideally, many or all students would take this second alternative, and hence create on-the-job training and real-life experience. The practicum courses are offered in order to provide options for students who do not have internships. Three acceptable practicum courses, which must be offered without prerequisites, are:

- ES/FIN 629/329: Financing Research Commercialization (3 credits)
- IOE 422: Entrepreneurship (3)
- ES 615: New Venture Creation (3)

4.6. Discussion

Undergraduate or graduate students receiving a Certificate in Entrepreneurship must complete a minimum of nine (9) credits from the courses or capstone projects in the four core courses referenced in Section 4.3, above. One major concern is that obtaining the Certificate does not compel an undergraduate student to extend their stay at U-M by one or more semesters. Certainly, the courses in the Certificate program can count as free electives. CEEPS recommends that the CoE investigate whether some of the courses might also count toward at least some of the social science requirements and cognate requirements. Further, the courses should count toward the professionalism credit required in most engineering degrees. By permitting the courses in the Certificate program to count toward some of these categories, the nine credits can be reached without lengthening the student program.

All of the core courses and electives are existing courses, so the Certificate program can begin almost immediately. The only new element of the program is the Distinguished Innovator Lecture Series, which we recommend that the CoE launch in Fall 2007. One major task for the CoE is coordinating and administrating the Certificate program as well as ensuring that the courses are offered with some regularity. As mentioned before, all of the core courses should receive an ENG designation. In addition, to lower the barrier from the departments in offering the courses, the Committee recommends that the CoE provide funding for adjunct professors to teach the courses. The departments can choose to have an adjunct teach the courses or, preferably, faculty members can teach the Certificate program courses and the adjuncts can be funded to help teach the technical courses within the departments. Either way, the CoE should provide funding for the adjuncts, and the departments can then choose how to use the adjuncts.

Finally, it should be recognized that the above Certificate program proposal is a starting point. CEEPS fully expects that more courses will be added to the program down the road, provided that students "vote with their feet" and sign up for these courses. To facilitate the growth of the Entrepreneurship program within the CoE, CEEPS suggests that the CoE try to secure endowed chairs for engineering faculty members involved in teaching entrepreneurship. If the certificate program proves to be popular, it might also grow into an academic program in its own right, perhaps even with a degree option.

5. Rules and Processes

5.1 Introduction

An extensive analysis of the legal context of student innovation and intellectual properties has been developed. This work included detailed benchmarking with arguably the Nation's best program at Stanford University (Appendix 5).[4] It also included interviews with many former and current University of Michigan innovators.

[4] The Committee provides the comparison with the intellectual property policies at Stanford for purposes of reference, only, and does not suggest adoption of Stanford's policies by U-M. Indeed, after analyzing the text of Stanford's policies and meeting with Stanford and Bay Area innovators, the Committee concludes that it is the spirit and environment in which the policies are administered, and not their language, that makes Stanford so much more entrepreneurial than U-M.

Recommendation 6: Simplification and Clarification of Student Intellectual Transfer Processes. The Committee recognizes that the CoE's intellectual property (IP) and technology transfer practices need to be congruent with its overall entrepreneurial goals or those policies will significantly hinder the College's ability to accomplish its entrepreneurial objectives. The alignment of IP policies with specific entrepreneurial objectives of the College may require a greater degree of autonomy for the CoE Technology Transfer and Commercialization office from U-M's centralized Technology Transfer Office than the CoE office has previously experienced. The Committee believes that this requires that the College of Engineering diversify its models for transferring its research discoveries. These policies and implementations thereof should support an overarching vision that (1) enables the creation of a pro-startup environment on North Campus, (2) simplifies and reduces the risk for students to launch start-up companies, and (3) enables the creation of a culture where maximizing the public value of the IP created at the University of Michigan is the foremost concern.

Recommendation 3: College of Engineering Student Entrepreneurship Center. The Committee recommends creating a College of Engineering Student Entrepreneurship Center to facilitate and coordinate internal and external support services. The entrepreneurship advising center would coordinate with existing support services like the Technology Transfer Office and drive the public relations with students; much like the Career Resource Center does for all things job related. The center would assist and communicate standardized processes regarding intellectual property, technology transfer, business and legal help. It would also provide assistance by identifying lab space and basic equipment open to all students along with processes to access more advanced facilities. The center would also bring in external support services, such as local lawyers, investors, or collaborators. The center should provide meeting space on North campus with areas to socialize, work with marker boards and computers, drink coffee, and use basic equipment to test ideas. Ideally, it would be co-located with the advising center so that all resources, including weekly visits from business and legal experts, are right there.

These two recommendations address Challenges 5 and 6. The recommendations speak to the interfaces of the students in the College of Engineering, and the entrepreneurial environment. Specific implementation strategies are suggested. These were unanimously agreed upon by CEEPS. These implementation strategies are organized according to the goals defined in Recommendation 3.

Goal #1: Enable the creation of a pro start-up environment on North Campus.

To encourage a "pro start-up" environment, we need to disseminate information, enable counseling from those experienced in entrepreneurship, create spheres of research and tinkering where students can explore, build, test, and refine ideas and technologies, and facilitate student retention of their IP rights.

Implementation strategies:

- CoE should have an entrepreneurial resource center at which representatives from outside the University (financial, business, legal, accounting, technology) are encouraged to meet with students.

- To encourage "tinkering," the Dean should define "safe havens" – circumstances where the University would not exercise IP ownership rights that may otherwise be perceived as falling within Regents Bylaw 3.10.
  - For example, workproduct from classroom projects; workproduct developed in specially-designated laboratories, or in connection with designated equipment, or using designated University technology.
- Capstone courses should have simple, uniform contracts that do not divest students of their own intellectual property (or at least do not divest students of their right to use their contribution to and knowledge gleaned from the course). These courses should use consistent introductory letters to potential sponsors that clearly explain the objectives of the capstone course and the benefits of sponsorship.

Goal #2: Simplify and reduce the risk for students to launch startup companies.

In our visit to Silicon Valley, we heard many innovators talk about the "fail fast" approach – meaning, enable innovators to access technologies, funds, and advice as quickly as possible and see what happens. The technology, and the company, will either succeed or fail in the first 18-24 months. Don't worry about every possible problem and don't worry that you might fail – all successful entrepreneurs have failed.

Implementation strategies:

- Create practices that encourage students to take calculated risks on technology-based startup companies by providing – without charges for fees or expenses and for a reasonable time (such as 10-18 months) – exclusive licenses or license options for or to entrepreneurs to enable them to perform technical and business diligence and to raise investment funds.
- Simplify and make more transparent the University IP ownership position. Create a plain-language version of the IP policy, with specific examples, and communicate that policy to students, faculty, staff, and the public.
- Simplify and accelerate the technology licensing process. Create standardized exclusive license agreement terms that are tailored to startup companies[5], and provide the licensing staff the authority to swiftly negotiate the agreements without layers of approvals.
- Sufficiently fund the budget for patent fees and expenses so that the decision to seek patent protection is strategic and directed toward value-creation for the public benefit, and not based on whether the University can, in the short term, seek reimbursement from a third party for its patent fees and expenses.

[5] for example, in which the University takes a small equity position and charges no royalties for licensing

Goal #3: Create a culture where maximizing the public value of the inventions and discoveries created at the University is the foremost concern.

Quite simply, not all technology, ideas, innovation, software, and data are candidates for licensing. U-M, as a part of its public educational mission, should push into the public domain a broad collection of knowledge, knowhow, software, data, and other IP. Similarly, some U-M technology should be made easily accessible to students to use and upon which to build.

Implementation strategies:

- As a general matter,[6] the University should not seek to control the use and dissemination of data, ideas, results of research, drawings, software, algorithms, and other unpatented elements of knowledge when the creators of such knowledge wish to publish or authorize third party access or use.
- Place into the public domain (or use "Ready to Sign Agreements" or "Creative Commons" licenses[7]) those research discoveries, data, tools, knowledge, software, and the like that do not provide, in the near future, a potential licensee with the basis for a competitive product. This will strengthen the perception of the University as a creator and disseminator of knowledge and innovative content for the benefit of the public, and raise the profile of its innovators.

These measures will eliminate (or at least reduce) confusion arising from the legal aspects of IP ownership and technology transfer policies, reserve to students greater IP ownership rights in their inventions, encourage business to seek out CoE as a source of innovation, make more knowledge available to the public, and streamline technology transfer for at least certain types of transactions.

6. Support Systems

6.1. Overview

The College of Engineering is an excellent place to start, and an excellent entity to foster integration of University of Michigan entrepreneurial efforts into the local business community. Our assets are, chiefly, our students– some 6000 of the most talented and energetic members of our community; our faculty, especially those willing to embrace the excitement of change and the challenges of cooperation; tens of thousands of alumni well-situated to provide guidance, criticism, experience in the wider world; and access to human and other capital. We have technological, research, and process assets as good, or better, than any in the world.

We have interesting and complex challenges worthy of our attention. In order to create an entrepreneurial ecosystem as vibrant and productive as Silicon Valley (SV) we must find our

[6] This would not apply to data and other content subject to protection by other laws, such as privacy, confidentiality, and national security; or third party contracts; or that constitute scholarly works or unpublished research of University staff; or products (such as software) that are essentially completed works with commercial markets and available licensees.

[7] Creative Commons licenses are simple, standardized permissions models that address core issues, such as whether uses may be commercial, whether the content may be further adapted and publicly distributed, and how the author is to be credited.

own unique path that capitalizes on our internal and external assets. We must inventory our assets—physical, geographical and infrastructural, commercial and human—and create from them our own unique and vital environment in which thousands of firms, whether existing or new, can flourish. The University has the capacity to create a cooperative applied research initiative across the disciplines, cultural anthropology, natural resources, engineering, business, the social sciences and the "hard" sciences mapping what we have and how we might engage at every juncture, the embedded potential for the benefit of the state.

6.2. Entrepreneurial Opportunities Fair

Recommendation 4: Entrepreneurial Opportunities Fair. The committee recommends the formation of a regular Entrepreneurial Opportunities Fair that complements the Engineering Career Fair (fall) and the Engineering Co-op and Internship Fair (winter) by exposing students to the immense job opportunities offered by the thousands of small, high-tech, emerging businesses that exist within Michigan. It should be a two-day event hosted on the North Campus during the winter semester that seeks to place undergraduate and graduate students into both internships and job opportunities. It should be coordinated by a student group, in collaboration with the College of Engineering and Michigan business organizations to maximize impact.

6.3. Goals and Metrics

The purpose of the Entrepreneurial Opportunities Fair is to complement the Engineering Career Fair (fall) and the Engineering Co-op and Internship Fair (winter) by exposing students to the immense job opportunities offered by the thousands of small, high-tech, emerging businesses that exist within Michigan. It will be a two-day event hosted on the North Campus during the winter semester that seeks to place undergraduate and graduate students into both internships and job opportunities. The Fair will be organized through collaboration between the student-led organization MPowered and Brian Balasia, a board member of the Detroit Regional Chamber. The event will identify and attract the targeted companies by leveraging the collective business relationships that exist between the hundreds of active business associations operating within the State.

To understand the impact of the pilot program we must identify the metrics by which we will measure success. To provide the necessary data, individual companies will be required to provide us with survey responses within 1 month of the close of the event in order to receive their deposit back. In order to be respectful of the attending businesses, deposits will be issued to attending companies within 3 days of receipt of completed surveys. Each company will be asked to provide us with the following information:

- Number of Job/Internship Openings Available by Engineering Department (within next 90 days)
- Number of Resumés Received During the Event
- Number of Student Interviews Requested During Event
- Number of Student Interviews Hosted During Event
- Number of Student Interviews Requested Following Event
- Number of Jobs/Internships Filled by U-M Students by Engineering Department

To understand the impact of the event from the student perspective, we will survey students prior to advertising for the event and two weeks following the event. These results will be compared and presented to understand the level of impact the exposure to these opportunities had on the students. Each student will be asked the following questions:

- Where are you from?
- Do you have a job/internship yet?
- If so, when did you get your job/internship offer?
- If so, are you staying in Michigan?
- Do you plan on looking for a job within Michigan?
- Have you interviewed with any companies yet?
- If so, how many of the companies were in State?
- If so, what size companies did you interview with? (large, small, don't care)
- Where do you plan on looking for a job/internship?
- What type of company would you ideally like to work for? (large, small, don't care)

6.4. Support from Michigan Businesses

Entrepreneurs need coaching from experienced entrepreneurs, access to capital and capital-related services. Part of the puzzle of infusing an entrepreneurial spirit into the CoE culture is strengthening the existing external financial support systems (*e.g.,* New Enterprise Forum, Ann Arbor SPARK, angel investors, venture capital firms, private equity entities, investment and commercial banks, etc.) and creating new ones to support and fund start-ups and assist the growth and change of existing Michigan companies. One crucial element to achieving this goal is providing connections at the University *during* school. Future entrepreneurs should meet their potential VCs and also their attorneys while they are in school and create relationships that attract them to the Michigan market place.

The protection of IP for the entrepreneur, the reasonable sharing of the benefits of the research, and development of technology and other publicly funded research products, are all highly desirable and critical external elements to reinforce an entrepreneurial culture at the CoE. We are fortunate to have access, through our staff and alumni, to forward-thinking lawyers and administrators who can devise the beneficial "Commons" needed to not only allow but to positively reinforce the movement of IP from the College and the University into the market place. We do not have a culture that is deeply committed to saying "Yes" to these efforts. We can and need to create mechanisms to act positively, easily, and quickly to spin out IP. Also, the College and the University would do well to embrace the spirit of the wonderfully successful open-source movement that has created world-changing technology, maintained free and open access to its core benefits, and encouraged the formation of profitable companies and applications that in return continue to add value to the core in a cycle of mutual benefit.

6.5. Student Organization (MPowered)

Recommendation 5: Support College of Engineering Student Entrepreneurship Group. The formation of a student entrepreneurship group "MPowered" was spawned by this committee and its student members. They are taking responsibility for hosting a small company/start-up job fair, running a speaker series, and developing networks with the Business School, the Law School,

and other students from the University. Additionally, they would like to run an independently funded mini-grant competition, or administer small amounts of seed-funding to promising student projects. The student group will provide invaluable feedback into the entrepreneurship programs while building and using an alumni network. A sustainable, independent funding vehicle will ensure the success of the group.

MPowered is an organization focused on fostering and promoting entrepreneurship on campus, addressing Challenge 3 defined in Section 3.1. Its mission is to excite and incite students to explore the opportunities of entrepreneurship through exposure to active entrepreneurs, orientation towards innovation-by-collaboration, and support as students begin their own ventures.

Although MPowered's home is the College of Engineering, it is open to undergraduate and graduates students from other schools and disciplines at the University, including Business, Law, Medicine, Economics, Humanities, Science, Architecture, Information, and the Arts.

In addition to bridging the gap between disciplines, MPowered will foster collaboration with student groups to create further entrepreneurial interactions between students, faculty, industry and the outside world. A sustainable, independent funding vehicle will ensure the success of the organization.

MPowered's future undertakings include:

- Entrepreneurial Opportunities Fair (x2) - The first will be a test for a larger, scaled version during the winter semester. In addition to hosting recruiting companies, the first Fair will also educate students to the entrepreneurial resources available through the College of Engineering, such as the Entrepreneurship Seminar Series. The second will be during the winter semester and larger in scale.
- Entrepreneurship Forum - Facilitate students to exchange ideas and evolve promising projects into business opportunities.
- Mini-Grant Program - Administer small amounts of seed funding to promising student projects.

6.6. Grants and Competition Program

Recommendation 7: Entrepreneurship Grants Program and Entrepreneurial Fellowship Competition. The Committee recommends the creation of an entrepreneurship grants program designed to enable critical steps of an entrepreneurial concept towards its commercialization. The review of such ideas could lead to monetary contributions or to enhanced use of specialized facilities across campus. Reviews should be facilitated by a board representing the broad interest of the entrepreneurial community. CoE should hold a yearly Entrepreneurial Fellowship competition with focus on student entrepreneurship. Any overlap with University of Michigan-wide activities with similar goals should be leveraged in the implementation of the grants program and the competitions.

Entrepreneurs, as a general rule, inhabit resource poor environments; not enough time, not enough equipment and, often, not enough (or any) money. A grants program, which could include any or all of the above components, will foster the growth of ideas by providing

"breathing room" to either catalyze them into early stage businesses or to quickly allow failure. By creating a healthy tapestry of checkpoints that allow everything from micro-grants to Fellowships, a large number of initiatives can be promoted at the appropriate levels of support. Having a coherent range of opportunities to explore will allow student entrepreneurs to succeed or fail at a scale commensurate with their ideas and experience. Transparent review processes themselves will be rich opportunities for interested students to see how the process works, how others approach similar obstacles and how and where useful collaboration can occur. This, in part, will address Challenge 2 addressed in Section 3.1.

A fertile environment containing many entry points magnifies both interest and learning. Some ideas need only a little space, access to some equipment and a few bucks to prove or disprove their viability and the commitment of the entrepreneur. Others can enter the fray at higher levels of support and competition because they might be more scaleable, more complex and require more time to mature enough to provide insight into their viability. In all cases the access to resources at the right time is critical. A busy seed bed of entrepreneurial activity at the College will inevitably produce a more vibrant culture of innovation and send out tendrils of growth to other areas of the University with complimentary visions.

Involving the broader entrepreneurial community as reviewers, mentors, advisors and friends will foster a more permeable boundary for all so that wider ranges of collaboration may occur among students, faculty, the business community and representatives of the larger social landscape.

7. Benchmarking

CEEPS reviewed a number of other university models before crafting the recommendations for this report. A comprehensive forty-three page report was produced by Cornell University in March 2002 on this very topic[8]. Rather than update and re-create that report here, a brief summary will be provided.

University approaches tend to fall into three categories. The most common is the Centralized model in which one entrepreneurship center exists somewhere on campus (usually in engineering or business) and it attracts students from across campus. An example of this is the MIT center which is housed in their business school and serves the entire campus. The other extreme is the distributed model where there are several centers scattered all around campus. Stanford epitomizes this model with many centers dispersed around campus. The third is the hybrid model, which models both centralized and distributed approaches. North Carolina is an example of such a model in which its graduate program is highly centralized (operates out of the B-School) while the undergraduate program is more decentralized. Each of the programs tends to be centered on their strengths. The very distributed Stanford model works as they highly leverage the large venture community that surrounds them allowing them to minimize what would otherwise be significantly redundancy within each school. A summary of the different programs is below:

[8] Steeter, D.H., Jaquette, J. P., Hovis, K. "University-wide Entrepreneurship Education: Alternative Models and Current Trends," WP 2002-02 Department of Applied Economics and Management, Cornell University, March 2002.

- University Entrepreneurship Centers are generally operated to leverage their strengths
  - Stanford model
    - Multiple centers throughout campus (ca. 7)
    - Relatively small programs (Engineering the largest)
    - All greatly leverage Silicon Valley resources (minimize redundancy within school by leveraging outside resources)
  - Cornell model
    - Highly centralized administration (reports to provost) & fundraising
    - Leverages "Cornell" branding
    - Schools run their own courses/programs (Hotel Management, Vet school)
  - Most Universities have B-School or Engineering centralized models
    - Whichever unit is the strongest tends to house the unit
    - Colorado (Eng), North Carolina (B-School), Harvard (B-School)
  - Undergraduate programs (many Kauffman funded)
    - Tend to be centrally coordinated, but implemented independently by the various schools & colleges
    - No/little cross-disciplinary education

Beyond the potential for redundant efforts across campus, highly decentralized models lose the richness of cross-disciplinary learning. Given that successfully creating and operating a complex technology-based company requires a wide range of disciplines, such cross-disciplinary learning has distinct advantages. The decentralized model, on the other hand, does make creating courses easier as the audience is highly homogenous with consistent educational backgrounds and understandings.

For Michigan to leverage its strengths of numerous top-10 schools across a campus that exists in a community of limited entrepreneurial resources, an intermediary model is recommended. This model would have a significant north-campus presence, but be highly coordinated with the Zell Lurie Institute and other entrepreneurial centers across campus. In this way, Michigan resources could be available to CoE students while maximizing the leverage of ZLI and the surrounding entrepreneurial community.

8. Needs

Recommendation 8: Anchoring in the College of Engineering. The Committee recommends that entrepreneurial activities be coordinated by a dedicated leadership structure in the CoE, which will coordinate across departments and with other elements of the entrepreneurial ecosystem. The Committee recommends that the leader be directly included into the CoE planning processes in all elements that affect entrepreneurship, such as proposed in recommendations 1-7. The Committee also recommends the creation of an entrepreneurial staff director for the operational support of these activities. This staff director should be advised by an entrepreneurial advisory committee representing the broad entrepreneurial community.

There are important needs to implement the recommendations provided above. These needs are addressed in personnel, space, and monetary support for labs and grant programs. These needs are now addressed. This, in part, will address Challenge 2 addressed in Section 3.1.

8.1. Personnel Needs

Personnel needs fall into two categories. A proposed "Director of Entrepreneurship" is a College of Engineering faculty and will be responsible for the leadership of all entrepreneurial programs in the College of Engineering and for the coordination of these programs with departments and other activities in the College. The actual title of the proposed director is at the discretion of the Dean. The Committee discussed the necessity of coordination among all traditional roles of the College typically led by Associate Deans. An appointment at the Associate Dean level to demonstrate leadership in these areas may be considered. It is crucial that the level be chosen such as to firmly root entrepreneurial activities in the college and for them to be made resilient to change of leadership.

An Entrepreneurial Staff Director will be responsible for the tactical and operational aspects of the College's entrepreneurial program. The staff director coordinates the high-visibility programs such as the innovator seminar series, and also tracks progress of the programs relative to the metrics described in Section 1. Competitive programs in the Nation have taken great care in hiring well-educated staff directors, often with PhDs, who have more personal experience in entrepreneurial environments than the "Director of Entrepreneurship". Success of the program directly relates to the success of this person. In many organizations, the staff director also teaches as an adjunct professor.

The two leads of the College of Engineering entrepreneurial activities should be supported by Administrative Staff. This support staff would support organizational needs of the entrepreneurial center as well as facilitate student interactions within and outside of the University of Michigan College of Engineering. Finally, the staff directors should be advised by an entrepreneurial advisory committee representing the broad entrepreneurial community.

Figure 8.1 addresses the integration of these roles into the overall College of Engineering organization and its relation to other college activities. Figure 8.1 purposely remains silent on the specific title of the "Director of Entrepreneurship" and the "Entrepreneurial Staff Director".

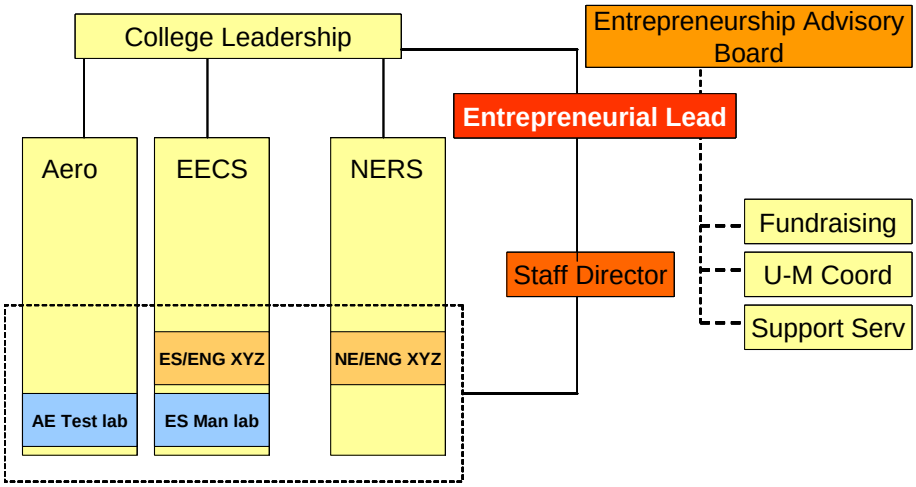

Figure 8.1: Organizational structure of the proposed CoE entrepreneurship program.

This implementation is regarded as transitory and designed for the start-up phase of the student entrepreneurship committee. As the program begins to flourish, the program lead could be a member of the entrepreneurial community.

8.2. Space Needs

The space needs are relatively modest at this stage and are associated with the creation of an entrepreneurial center in the College of Engineering. To improve visibility, this center should be located in a high-traffic area of the CoE. This center should include, as a minimum, space allocations for the following specific functions

1) Office for Entrepreneurial Lead
2) Office for Staff Director
3) Office for staff supporting Director
4) Office for part-time business and legal support
5) Office for part-time business support services from community
6) Dedicated meeting space for entrepreneurial interchange and MPowered office

Space for (2)-(5) should be co-located. Ideally, (6) would also be co-located, but this is not crucial for success. It should be established whether (1) would better be located in the LEC or co-located with (2). In the long run, a co-location with (2) is preferable, but the interactions with CoE units and directors will be enabling during the start-up of the proposed entrepreneurial activities.

8.3. Monetary Support

Monetary support consists primarily of financing of the staff functions described in 9.1. Furthermore, CEEPS proposed the creation of a grant and fellowship program of $50,000. Support is also required to run the Distinguished Innovators series at roughly $3000-4000/presentation and 14 highly visible talks during the year. Finally, monetary support may also be required for adjunct teaching roles mentioned previously. But, such support is not needed in the start-up phase of the program.

Furthermore, a dedicated PR budget of $20,000 is recommended to contribute towards an enhanced Web-presence and advertisement on and off campus.

9. Outlook

Recommendation 9: Entrepreneurial Environment. The Committee recommends creating a nurturing, inviting environment that encourages idea generation, big thinking and execution. The Committee recognizes that many undergraduates view their position in the College as subsidiary and believe that the engineering curriculum encourages closed-form solutions, as opposed to out-of-the-box thinking. The students need to shift their attitude, meaning a shift in the attitude of the College. A bridge must be built between the College's strong technology development and undergraduate innovation. They must feel ownership for their ideas while being challenged to identify and address real world problems by connecting to the community outside College and University boundaries.

There was a strong sense in this Committee that there is a direct connection between the success of a student entrepreneurship program, and the success of the College of Engineering as a whole. If successfully implemented, the first eight recommendations will be transformative for entrepreneurial students. But, it will only provide lasting success, if it leads to a change in attitude towards innovation and entrepreneurship across the college (addressing Challenge 2 in Section 3.1).

There is also an overwhelming feeling that our initial recommendations merely provide the *beginning* of such a transformation. In order to take full advantage of the entrepreneurial opportunities of the University of Michigan, this entrepreneurial transformation has to continue. It has to include faculty who will be key in this process. It will also involve the creation of new connections between the many parts of the University of Michigan. And, it will require that there is a transformation in the way the University of Michigan is regarded by the local business community. As part of this evolution, the student entrepreneurship activities should evolve to become part of a broad entrepreneurial system. Deep connections between the proposed activities within the University of Michigan and the broad community are essential to increase the economic impact in the State of Michigan.

CEEPS strongly encourages these broader evolutions that were beyond the scope of this Committee. There is general agreement in the committee that they should be undertaken in the same spirit as the work CEEPS has done: under the inclusion of all key elements of the broad Michigan Entrepreneurial ecosystem.

Finally, due to the intrinsically evolutionary character of the problem at hand, CEEPS recommends that student entrepreneurship activities be reviewed within a reasonable time-period (probably three years) and changes to personnel and program structure be implemented as a result of this, in order to increase the effectiveness of these programs.

10. Acknowledgements

The CEEPS members wish to acknowledge the countless members of the broad University of Michigan community who have participated in this report. Chanda Doxie supported the entire Committee work administratively, but also with great advice and help. She also did all travel

arrangement and logistics support for the trip to the Bay Area during spring break. Colleen Zimmerman was responsible for the program and all logistics during that trip – it almost was a miracle how it all came together to become two of the most exciting days of the entire year for all participants. The following members of the broad Michigan Entrepreneurial community provided their time and help in organizing a successful trip: Rama Aysola, Rick Bolander, Tom Byers, Steve Carnevale, Bruce Dorfman, Ben Dubin, Fred Gibbons, Roger McCarthy, Ken Pelowski, Jeff Schox, Tina Seelig, Ikhlaq Sidhu, Micah Siegel, Bob Stefanski, Alan Steremberg, Thomas Tobiason, and Mark Tonoury. Debbie Eddy patiently supported the generation of this Report. Thanks to Kelley Heath from kdh designs for her design of the report cover page and the layout of the report. Finally, we would like to acknowledge many members of the broad Michigan community who have supported this activity by providing advice and encouragement along the way.

A. Appendices

A1. Charge to Committee

The committee was set in place in October 2006, with a charge as defined by Dean Munson, which is provided in Section 2.1. Section 2.2 defines updates to the committee leadership that occurred in the middle of the semester to address specific personnel needs that surfaced in the deliberations.

A1.1. Original Charge to Committee

Envision and describe an environment that would encourage and support Engineering College student entrepreneurship at the University of Michigan.

Develop a plan for coordinated entrepreneurial curriculum offerings and for an infrastructure to support student entrepreneurship in the College of Engineering. Tasks include:

1) Identify organizational impediments that limit current College of Engineering students in entrepreneurship.
2) Survey existing course offerings, identify gaps and duplication and propose a syllabus that will provide Engineering College students the opportunity to learn the teachable aspects of entrepreneurship.
3) In carrying out this assignment, the Committee should consider courses offered by other units – especially the Ross School of Business (RSB) – that are available to CoE students and the educational value of offering courses in the Engineering College.
4) Define the requirements for a support structure for student projects that might develop commercializable intellectual property (IP); consider needs for mechanisms, facilities, funding, and procedures that would enable students to start companies to commercialize their IP, while continuing their studies. Develop a fair and consistent practice for managing student generated IP.
5) Define success metrics for a student program in entrepreneurship in the College of Engineering.
6) Estimate the funding, staff and space requirements to implement the plan.

The Committee should be aware of the deliberations of a Panel of distinguished educators, chaired by Richard Newton, Dean of Engineering at UC Berkley, convened by the Kauffman Foundation for a related purpose. The Kauffman Panel's charter is to review best-practices and develop a well-articulated common set of principles and skills for entrepreneurship that can be taught. Such a canon may significantly accelerate the rate at which students become aware of entrepreneurial activity, its importance to our economy and society, and the extraordinary future opportunities it offers. http://kauffman.org/news.cfm?itemID=710

Original Committee Membership

Thomas Zurbuchen, AOSS & AERO, Chair
Dan Broderick, CoE TT&C
Tim Faley, RSB
Richard French, Grad Student AOSS
Mohammed Islam, EECS

Susan Kornfield, Bodman LLP
Ken Ludwig, I&OE
Mary-Ann Mycek, BME
Kazuhiro Saitou, ME
Marc Weiser, RPM Ventures
Tom Zdeba, DRDA

A1.2. Midway Corrections to Committee Organization

There were three changes to the membership of the committee. Brian Balasia, from Digerati Solutions was added to represent the University of Michigan Alumni Association and to represent the Michigan business community. Mr. Balasia is a member of the board of directors of the Detroit Regional Chamber. We also added Peter Adriaens (CEE) who is currently on sabbatical as a fellow of the Zell-Lurie Institute. We added Ashwin Lalendran as an undergraduate representative and also as the current lead of MPowered, the student entrepreneurial group.

Furthermore, due the tragic passing of Richard Newton, PhD and dean of the College of Engineering at the University of California-Berkeley only days after starting the Kauffmann Panel's deliberations, the panel recommendations were delayed and moved beyond the time-horizon of this committee's work. This connection remains important and should be pursued as part of the implementation plan of these recommendations.

Final Committee Membership

Thomas Zurbuchen, Ph.D., Associate Professor for Space Science, Associate Professor for Aerospace Engineering, University of Michigan; Committee Chair

Peter Adriaens, Ph.D. P.E., University of Michigan Department of Civil and Environmental Engineering, and University of Michigan Ross School of Business

Brian Balasia, Founder and President, Digerati Solutions, Inc.; University of Michigan College of Engineering Alumni Society Board of Governors

Daniel Broderick, Director, Office of Technology Transfer, College of Engineering, University of Michigan

Timothy L. Faley, Ph.D., Managing Director, Zell-Lurie Institute for Entrepreneurial Studies, University of Michigan Ross School of Business

Richard French, Graduate Student, Department of Atmospheric, Oceanic and Space Sciences, University of Michigan

Mohammed N. Islam, Ph.D., Professor, Electrical Engineering & Computer Science, University of Michigan

Susan M. Kornfield, J.D., Partner and Chair, Intellectual Property Practice Group, Bodman LLP; Adjunct Professor of Copyright Law, University of Michigan Law School

Ashwin Lalendran, Undergraduate Student, Mechanical Engineering, University of Michigan

Kenneth Ludwig, Lecturer II, Industrial and Operations Engineering, College of Engineering, University of Michigan

Mary-Ann Mycek, Ph.D., Associate Professor, Biomedical Engineering Department, Applied Physics Program, and Comprehensive Cancer Center, University of Michigan

Kazuhiro Saitou, Ph.D., Associate Professor of Mechanical Engineering, College of Engineering, University of Michigan

Marc Weiser, Founder and Managing Director, RPM Ventures; B.S. Aerospace Engineering and MBA, University of Michigan

Thomas W. Zdeba, J.D., Senior Project Representative, Division of Research Development and Administration, University of Michigan

A2. Committee Process

The Committee's work was pursued using elements of committee work.

First, weekly meetings were held throughout the entire semester. Typical attendance was around 70-80% of the committee's membership and often included guests. All meeting presentations and deliberations, as well as critical email traffic, were archived using a dedicated CTOOLS site.

Second, specific inputs to the Committee were sought through 20+ CTOOLS observers from whom we solicited inputs on numerous occasions for quick feedback. These observers included knowledgeable members of the extended U-M entrepreneurial community within the University of Michigan and also beyond this. Such broad inputs were also solicited as part of a trip to the Bay Area for benchmarking and to get detailed inputs from a broad set of members of the extended Entrepreneurial Ecosystem to whom we seek to connect.

Figure A2.1: Three student members of the Bay-Area Entrepreneurial trip with Steve Carnevale, a CoE alumni and Bay Area Venture Capitalist. The picture, from left to right, shows Anna Bronson, Elizabeth Perez, and Yaning Zhang.

Third, the inputs were delegated to subcommittees. These subcommittees met with interested members of the overall committee, and sometimes also with members beyond the membership of CEEPS, and summarized the inputs for deliberation by the total committee. Subcommittee chairs were R. French (Student Inputs and Recommendations), M. Islam (Academic Programs), S. Kornfield (Rules and Processes), B. Balasia and A. Lalendran (Entrepreneurial Opportunities Fair).

The Committee initially set out to report by the end of April. It was then decided to add an external review after a final draft of the committee's report, in order to provide the opportunity for one more round of feedback from interested parties beyond CEEPS.

External Review Committee

Blouse, Richard	President and CEO, Detroit Regional Chamber, EAC member
Bolander, Rick	Bay Area VC and Alum
Byers, Tom	Director Stanford Engineering Entrepren. Program
Carnevale, Steve	VC and entrepreneur, Michigan Alum
Carter, Bill	Chair, CoE Alumni Society Board of Governors, EAC member
Forrest, Steve	EECS faculty, entrepreneur, and VP of Research
Gibbons, Fred	Entrepreneur, and Faculty and Stanford Program
Kinnear, Tom	Director of ZLI, Prof in Entrepren. Studies in RSB
Korybalski, Mike	Michigan Entrepreneur, Board of Ann Arbor SPARK, EAC member
Nisbet, Ken	Exec Director of Office of Technology Transfer
Sidhu, Ikhlaq	Director of UCB entrepreneurial program

A3. Student Inputs

Many of the student inputs came from a town-hall meeting on January 29, 2007, and from student questionnaires. Longer and more detailed summaries of these inputs are attached to supplement the information in the report.

A3.1. Town-Hall Summary

A large group of undergraduate and graduate students in the College of Engineering have not had the opportunity to develop themselves as entrepreneurs. They have not taken advantage of the opportunities in the College of Engineering, indeed in the entire University, and applied their skills to solving real-world problems through entrepreneurship. Some have struggled through passive resistance, engaged willing professors and colleagues, and succeeded. However, when a world-class College of Engineering, Law School, and Business School have not yet together committed themselves at the highest levels to creating an environment, a community of entrepreneurs, to foster entrepreneurship, it is not surprising more students have not been successful. On January 29, 2007 over 65 students and faculty met with CEEPS to discuss their concerns and their successes, and to recommend ways to begin building a community of entrepreneurs at the University of Michigan. By the end of the night issues ranging from generating the big idea and the support of the faculty, to the obstacles to successful entrepreneurship were discussed and suggestions for change were made.

Early in the conversation an anecdotal example was given by a student who had taken a course called Analytical Product Design. After spending the semester studying product development models, idea generation, and the decision-making paradigm, even concluding with

a design project that included prototype construction to test design concepts, the project ended. There was no follow-through, no sales pitch, and no attempt at commercialization. That student and his colleagues no doubt gained valuable insight and learned important lessons. Unfortunately, an opportunity was missed. Missed opportunities were a recurring theme of the evening. However, this is also a foundation on which to build. Here is a small incubator of big ideas, a microcosm in which to ask questions like, 'Is this a good idea?', or 'Can it make money?' On the other hand, many students expressed the concern that they have not been given the place or had the chance to come up with a big idea. Other students, who had an idea, had not had the chance to test and develop it into a real business plan. Outside of the classroom, as well as in it, promising ideas are falling by the wayside.

The support of faculty was also discussed. An institutional perspective, while not universal, seems to discourage entrepreneurship, particularly at the undergraduate level. Students look to professors for guidance and as role models. Students also perceive that many professors view entrepreneurship as un-academic. This has been described by some as the 'passive resistance' with which even successful student entrepreneurs have had to overcome. The lack of connection to academic programs, absence of an academic reward for entrepreneurial activities, and poor visibility of entrepreneurial initiatives at the University of Michigan, were also identified as fundamental reasons a strong community of entrepreneurs does not exist. The students are demanding supportive faculty to bounce ideas off of, to help direct resources, and generally encourage more risky idea-generation. They also suggest that directed collaborative efforts between the Schools and Colleges are necessary. However, even without systematic encouragement many students have pursued entrepreneurship, and they have come up against other obstacles.

The obstacles to successful entrepreneurship extend beyond faculty support. They also include everything from the more mundane mechanics of starting a business to fears of intellectual property theft and lack of resources to develop an idea. Many of the obstacles are imagined – there are resources to help with a business plan, people to help deal with intellectual property and technology transfer issues and even money for a budding entrepreneur. In many cases a simple lack of communication is all that stands between engaging a wider audience in entrepreneurial activities. However, resources are limited and are not targeted at underrepresented groups, like undergraduates. Too few opportunities exist for unencumbered money, even small amounts, with which to get started.

Too few incubators or labs for testing an idea are available, or are known to be available to students with an idea. Limited entrepreneurial course offerings also restrict the number of students who can participate. In particular, undergraduate students feel that there is little room for them to innovate in a College that traditionally values graduate students and refereed academic journals. Additionally, outside of software the tools for developing an idea are either prohibitively expensive or access is limited to students with a faculty sponsor. Without the chance exposure early on, an undergraduate can at best hope to be involved in an entrepreneurial senior design project.

To be fair, the graduate programs, particularly the Masters programs, are doing an increasingly good job at encouraging undergraduates to stay for another year. Unfortunately,

many students cannot or choose not to stay. An undergraduate entrepreneurship program will be important for a successful community of entrepreneurs. Luckily, students can also help to solve the problem, to help build a community of entrepreneurs empowered to take their ideas to the next level and make a difference.

At the heart of the students' suggestions is the idea of a community of entrepreneurs. Specifically, a student-run organization that brings students together to brainstorm ideas, develops business plans, build relationships, and pools resources. A strong student group, adequately empowered, would solve many of the problems evidenced in the town-hall meeting. The student group would need faculty support, in fact, a commitment by a core nucleus of faculty in particular from the College of Engineering, the Ross Business School, and the Law School.

It is, however, important that it is student-led and operated. The student group would be the focus for organizing and sponsoring the workshops, speakers, and forums that are needed to fill the knowledge and experience gaps. It would ideally have a meeting place and would help direct the resources necessary to test and develop ideas. For instance, it would work with departments and schools to identify and engage available lab facilities and faculty supporters. It could also be empowered to distribute micro-grants to students or groups of students. While a healthy student organization supported by the College is recommended, it is not the only suggested change.

One of the most obvious complaints was the lack of focus on undergraduate entrepreneurship education. An undergraduate sequence of classes to start the learning process early would no doubt be well attended. An apparatus for awarding academic credit for entrepreneurial activities outside of the classroom should be implemented as well as encouraging more independent studies in entrepreneurship. Many courses already exist that could more effectively present entrepreneurship. Engineering 100 would be an ideal vehicle to start the undergraduate educational sequence as well as to inject more entrepreneurship into existing sections. An undergraduate entrepreneurial sequence would also lend itself to a certificate program while independent studies and out of class activities could support a practicum. Finally, focusing on undergraduate entrepreneurial education must then connect with the growing graduate infrastructure. However, for those students operating outside of the classroom an added obstacle and solution was evident.

A principle complaint from the students was the lack of an entrepreneurial advising center. An entrepreneurial advising center could facilitate the dissemination of information including legal advice, business processes, and taxes. It could also connect students to College and University resources, like Technology Transfer and ZLI, acting as the go-to location and public relations house in the College for all things entrepreneurial. Their website would also collect the resources, co-locating them and making them readily available on the web.

If entrepreneurship is to become a major value in the College of Engineering three principle actions are recommended by the students. First, a student organization to develop the community should be empowered. A forum for student interaction must be the nucleus of a successful community of entrepreneurs. Second, undergraduate entrepreneurial education should be given priority to encourage, at an earlier stage, the development of ideas and skills necessary

to become a successful entrepreneur. Such a program can only bolster the growing graduate programs. Third, an entrepreneurial advising center should be created to address the knowledge gaps preventing students from becoming successful entrepreneurs and act as the locus for information and portal for resources. In the students' views these actions will enable them to better pursue their entrepreneurial interests and establish Michigan as a leader in entrepreneurial education. Whatever the model turns out to be, balancing the needs of the students, from those interested in a sequence of courses teaching skills for later use to those interested in starting a business immediately, is critical.

A3.2. Summary of Student Responses to Questionnaires

In February of 2007 an online survey was offered to students in the College of Engineering soliciting their opinion of various aspects of entrepreneurship. Almost 400 students responded to the survey. While the results were mixed, 76% of the respondents expressed an interest in taking entrepreneurship courses. An even larger percentage (89%) expressed an interest in joining a student entrepreneurship club. Almost half of the respondents (43%) suggested they would like to start and run their own company in the future while another 17% expressed an interest in joining a small, more-entrepreneurial firm. The results of the survey are shown below.

Who Responded

384 students responded to the survey. These students were a mix of undergraduates (70%) and graduate students (30%). These respondents represented the following departments:

➢ Aero	12.2%	➢ EECS	20.8%
➢ AOSS	3.1%	➢ Interdisc, ug	1.8%
➢ Applied Physics	0.5%	➢ IOE	6.8%
➢ Automotive	0.3%	➢ ME	22.4%
➢ Biomed	9.1%	➢ MSE	4.4%
➢ Chemical	7.8%	➢ NAME	2.1%
➢ Civil & Env.	5.7%	➢ NERS	2.9%

Courses in Entrepreneurship

76% of the respondents expressed interest in taking entrepreneurship courses. A certificate program is important to roughly half of the respondents, while an equal number agree that courses on North Campus are important for their participation in entrepreneurship courses. Awareness of and understanding the benefits of entrepreneurial courses is also important for a vast majority of the respondents.

I'd be more likely to take entrepreneurial classes if:

- Aware of courses: 82%
- Knew how courses would benefit me 61%
- Courses counted as cognates 65%
- Courses offered in my department 40%
- Courses offered on north campus 42%
- Courses contributed to certificate program 45%

Student Entrepreneurship Club

89.4% of the Respondents expressed interest in joining a student entrepreneurial club. While these results are extremely diverse, 60% of students believe the club should be a CoE club while 40% want the club to be university-wide.

The respondents' preference was for an entrepreneurial club for:

- CoE undergrads 25.8%
- CoE graduates 9.9%
- For any CoE student 23.0%
- For all UM undergrads 6.8%
- For all UM grad students 7.9%
- For an UM student 26.6%

These results, along with many of the open comments provided by respondents, suggested many students have little concept what entrepreneurship may mean in the context of an engineering education and only affiliate the word with starting a small business. This suggests that when launching an entrepreneurial program, the College of Engineering should simultaneously define what an entrepreneurial education would mean to a Michigan Engineer.

It is clear that some of the respondents understood that knowing how to think about commercializing a technology would be a skill that could differentiate them in the marketplace:

> "I believe that entrepreneurship is one of the most important skills one can have in creating a successful future."

It is equally clear that other respondents see entrepreneurship solely as starting a small business and are focused on the legal/accounting mechanics of doing such:

> "If one course covered how to open a small business, like LLC forms, taxes, insurance and such, and counted as a technical elective, I'd probably take one."

> "I'm skeptical of a course that teaches entrepreneurship. I do think, though, that the University should provide services for students interested in entrepreneurship, including legal advice…"

Entrepreneurship is clearly important for many students in the CoE. Their interests range from starting a business immediately to growing an entrepreneurial mind-set. A student entrepreneurial group, a certificate program and an entrepreneurship advising center are critical elements to serving that wide range of interests.

A4. Course Offerings

A4.1. Courses in the College of Engineering

A4.1.1. Overview

In order to meet the charge of developing a plan for coordinated entrepreneurial curriculum offerings, the Committee examined existing course offerings that are available to CoE students.

The Committee identified courses in which aspects of entrepreneurship are taught, surveyed student participation in these courses, and estimated the entrepreneurial content of the courses.

The Committee considered courses offered by the CoE, as well as the Ross School of Business (RSB). Our findings indicate that although there appears to be widespread interest in entrepreneurship among CoE students and faculty, the existing course offerings have widely varying entrepreneurial content and are not coordinated at present.

A4.1.2. Process

To identify existing CoE course offerings with entrepreneurial content, all CoE Department Chairs and faculty were surveyed for their input on relevant courses. For the purposes of the survey, the term "entrepreneurial content" was described as including elements such as innovation, product development and marketing, intellectual property licensing and protection, business organization and business decision making.

Information on specific course sections and student enrollment in the courses identified by these surveys was obtained from the M-Pathways SA03 Student Records data set by Ellen Crissey, CoE Director of Data and Information Services in the CoE. She used the Subject/Catalog # combinations of these classes to pull a list of all sections offered within the designated timeframe (Fall 1999 - Winter 2007), then pulled detailed student enrollment information for all of the classes/sections on the final list approved by the Committee. (We note that EECS 496 was identified too late in the term to be included in this process.)

To assess the entrepreneurial content of these courses, recent course instructors were contacted and asked to estimate the approximate entrepreneurial content of their course. Because the term “entrepreneurship” is likely to be interpreted differently by different instructors, this assessment provides at best a rough guide to the entrepreneurial content of these course offerings. Due to the large number of ENGR 100 sections, individual ENGR 100 instructors were not contacted and, instead, a relatively low entrepreneurial content (4%) was assumed for all ENGR 100 courses. This process should ensure that the exposure to entrepreneurship that some ENGR 100 students receive is accounted for in the overall analysis.

We note that information is presented also on two future CoE course offerings that were identified during the survey process.

A4.1.3. CoE Course Offerings with Entrepreneurial Content

The survey process identified 20 CoE courses containing some degree of entrepreneurial content, including 2 new courses to be offered in academic year 2007-2008. These courses are listed in Table A4.1, which shows that such courses are offered by multiple CoE Departments and can vary widely in estimated entrepreneurial content from 4% to 100%.

Table A4.1: CoE Courses with Entrepreneurial Content

Course #	Course Name	Entrepreneurial Content
AEROSP/AOSS 582	Spacecraft Technology	50%
AEROSP/AOSS 583	Space System Design	70%
BIOMEDE 550	Ethics and Enterprise*	80%
BIOMEDE 599	Graduate Biomedical Innovative Design**	50%

CHE 496	Problem Solving, Troubleshooting, Entrepreneurship and Making the Transition to the Work Place	7%
CHE 696	Foundations of Nanotechnology	10%
EECS 495	Patent Fundamentals	50%
EECS 496	Major Design Experience / Professionalism	60%
EECS 497	Major Design Projects	35%
EECS 498	Hi-Tech Entrepreneurship**	100%
ENGR 100	Introduction to Engineering	4%
ENGR 599	Entrepreneurial Business Fundamentals for Engineers and Scientists	100%
IOE 452	Corporate Finance	100%
IOE 453	Derivatives Instruments	100%
IOE 491	Entrepreneurship	100%
MATSCIE 480	Materials and Engineering Design	15%
MATSCIE 489	Materials Processing Design	25%
MECHENG 455	Analytical Product Design	50%
MECHENG 509	Patents, Trademarks and Copyrights	50%
MECHENG 599	Biomedical Design and Manufacturing	33%
MFG 590	Global Product Design	33%

*content will decrease to 50% in future offerings
**new course to be offered in Academic Year 2007-2008

As shown in Table A4.1, the survey identified two new CoE course offerings with entrepreneurial content that will be offered during the coming academic year: *Hi-Tech Entrepreneurship* (EECS 498, Fall 2007, 100%) and *Graduate Biomedical Innovative Design* (BME 599, a 2 semester course offered Fall 2007 / Winter 2008, 50%). We note that BME 550 will decrease its entrepreneurship content from 80% to 50% in future offerings.

The enrollment headcount in these courses is significant and has increased over the time period examined. This trend was observed for both graduate and undergraduate student enrollment, although undergraduates dominated the enrollment headcount. To assess student exposure to entrepreneurial material, the enrollment headcount data was scaled by the percentage entrepreneurial content of the course. When this was done, undergraduate exposure to entrepreneurship was greatly reduced, relative to graduate student exposure. This data suggests that although student demand exists for courses with entrepreneurial content at both the undergraduate and graduate levels, exposure to entrepreneurial content is limited, particularly at the undergraduate level. Also shown, is the exposure to entrepreneurial content in CoE courses broken down by the student's primary field of study, for both undergraduate and graduate students. Results were found to vary widely among the many different fields of study, indicating broad student interest and exposure to entrepreneurship content in CoE courses.

A4.1.4. Summary of Key Findings

- At present, there are 21 courses containing some degree of entrepreneurial content offered at the CoE by several departments. This finding indicates some degree of widespread faculty interest in teaching these courses and exposing students to this material.
- Student enrollment in these courses is significant across many fields of study and is increasing over time, indicating that there is widespread interest in entrepreneurship by CoE students of varying academic level and program of study.

These courses are not coordinated in any organized fashion at present and have widely varying entrepreneurial content, which results in limited student exposure to entrepreneurship, particularly at the undergraduate level.

A4.2. Courses in the Ross School of Business

The RSB offers a range of courses that either are relevant to or explicitly incorporate entrepreneurial content, including in the following areas (specific courses are identified in Table A4.2): (i) Opportunity identification; (ii) Formulation of a business framework; (iii) Feasibility assessment; (iv) New venture creation; (v) New venture investing; (vi) High potential venture management and growth; and (vii) Special topics (incl. legal and targeted entrepreneurship opportunities). Except for the launch of a course in AY06 that was specifically designed (under the Williamson Initiative) to include graduate engineering students, these course were designed and primarily offered as second-year MBA elective courses. While some engineering graduate students took these courses, the uptick in graduate engineering student participation (see figure below) was significant when these students were openly welcomed (47 CoE students enrolled in RSB entrepreneurial courses in 2007). CoE undergraduates, on the other hand, tend to take accounting and finance for non-finance majors (enrollment in these courses is consistently over 300 per year over the past five years). RSB has only a few undergraduate entrepreneurial courses which fill rather quickly with RSB undergraduates. Few CoE undergraduates therefore manage to get enrolled in these courses (6 in 2007).

Table A4.2: Classes offered by the RSB, and basically available for CoE student.

Bus. Stage	Course	Course Name
Opportunity Identification		
	BA 518	Business of Biology
***	ENGR 599	Entrepreneurial Business Fundamentals for Engineers & Scientists
Fomulating a Business Framework		
***	ES 715	Driving the Innovation Process
Feasibility Assessment		
**	Strat 647	Strategies for Technology Commercialization
	Strat 746	Strategies for Emerging Markets
**	FIN 629 FIN 329	Research Commercialization Practicum
New Venture Creation		
	ES 395	Entrepreneurial Management
	ES 516	Entrepreneurship via Acquisitions
	ES 581	Urban Entrepreneurship
**	ES 615	New Venture Creation
New Venture Investing		
	ES 701	Wolverine Venture Fund
	FIN 325	Venture Capital
**	FIN 623	Venture Capital
	FIN 624	Private Equity
	FIN 626	VC & PE in a Global Context
	Strat 682	Mergers, Acquisitions, and Corporate Development
High Potential Venture Management & Growth		
	ES 530	Economics of Franchising

Table A4.2: Classes offered by the RSB, and basically available for CoE student. (continued)

Bus. Stage	Course	Course Name
**	ES 569	Managing the Growth of New Ventures
	ES 730	Marketing for Entrepreneurs
	ES 735	Entrepreneurial Turnaround Management
	BA 553	Multidisciplinary Action Projects – MAP Entrepreneurial MAP (Domestic & International)
	BA 615	Decision Management
	BE 580	Competitive Tactics
	BIT 578	Human Interface Design
	BIT 581	Business Network Infrastructure
	BIT 582	Enterprise Systems Strategy
	Strat 553	Intellectual Property and Competitive Strategy
	Strat 645	Social Enterprise: Innovation in the Information Society
	Strat 676	Strategies in technology-intensive industries
	Strat 681	Strategic Management of Alliances
	FIN 565	Real Estate Feasibility Analysis
	MO 611	Business Leadership in Changing Times
	MO 617	Developing & Managing High Perf. Teams
	MKT 607	Distribution Systems
	MKT 608	Pricing & Strategy Tactics
	MKT 625*	Innovation & New Product Management
	OMS 572	Business Forecasting - Spreadsheet Applications
Special topics		
	ES 504	Legal Aspects of Entrepreneurship
	ES 627	Family Business
	BA 519	Managing the Nonprofit Organization
	BE 565	Business Transactions
	LHC 503	Business Ethics, Science and Technology
**	LHC 509	Intellectual Property Law
	LHC 510	Negotiation & Dispute Resolution
	LHC 521	Writing Fundamentals for Entrepreneurs
	OMS 548	
	IOE 548	Innovative Product Design
***	ME 599	Biomedical Design & Manufacturing

** Courses which engineering students have participated

*** Course specifically designed to include engineering graduate Students

The student enrollment in all classes provided in Table A4.2 has been analyzed and integrated. There is a major increase of student participation, focused on a few classes, some of which marked by yellow in Table A4.2.

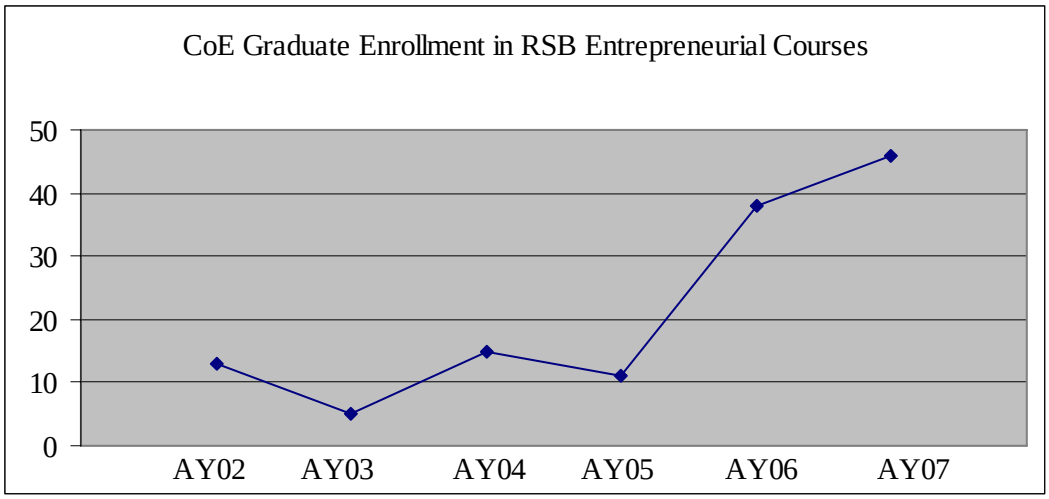

Figure A4.1: College of Engineering student participation in all classes provided in Table A4.2.

A5. Stanford - University of Michigan Comparison Relative to Technology Transfer

Subject	Stanford	Michigan
Ownership of faculty inventions	Title to all potentially patentable inventions conceived or first reduced to practice in whole or in part by members of the faculty or staff (including student employees) of the University in the course of their University responsibilities or with **more than incidental use of University resources, belongs to the University.**	Intellectual Property made (e.g., conceived or first reduced to practice) by any person, regardless of employment status, **with the direct or indirect support of funds administered by the University (regardless of the source of such funds) shall be the property of the University, except as provided by this or other University policy.** Funds administered by the University include University resources, and funds for employee compensation, materials, or facilities.
Student inventions **Student use of equipment and other resources**	Graduate students, postdoctoral scholars, and all others participating in research projects (including undergraduates working on research projects, either for pay or for academic credit) are covered by the Stanford University policy Inventions, Patents and Licensing. **This policy states that these individuals must disclose "all potentially patentable inventions conceived or first reduced to practice in whole or in part . . . in the course of their University responsibilities or with more than incidental use of University resources. Title to such inventions shall be assigned to the University."** The phrase "University responsibilities" is not generally interpreted to include a student's regular coursework. However, if, in the course of this work**, a student makes more than incidental use of University resources (including specialized equipment, laboratories and research facilities) to create a potentially patentable invention, that invention must be disclosed to Stanford and title assigned to the University.**	The University will not generally claim ownership of Intellectual Property created by Students. (A "student" is a person enrolled in University courses for credit except when that person is an Employee.) However, the University does claim ownership of Intellectual Property created by students in their capacity as Employees or with **direct or indirect support of funds administered by the University.** Such students shall be considered to be Employees for the purposes of this Policy. Students and others may, if agreeable to the student and OTT, assign their Intellectual Property rights to the University in consideration for being treated as an Employee Inventor under this Policy.
Copyrights	Copyright ownership in original works by students shall remain with the **creator "unless the work is a work-for-hire, is supported by a direct allocation of funds through the University for the pursuit of a specific project, is commissioned by the University, makes significant use of University resources or personnel, or is otherwise subject to contractual obligations**	Computer software created by members of the University staff in connection with administration, research, or other educational activities supported directly or indirectly by funds administered by the University, regardless of the source of such funds, shall be the property of the University. Such computer software may be made available for use on a nonexclusive basis by those who pay appropriate charges

		to reimburse the University for the costs of development, distribution, and reproduction. Patents, copyrights, and property rights in computer software resulting from activities which have received no support, direct or indirect, from the University shall be the property of the inventor, author, or creator thereof, free of any limitation which might otherwise arise by virtue of University employment. Students who create academic works while at the University (e.g., dissertations, theses, student projects) own the copyright to such works, unless: (1) the works qualify as works made for hire in the course of employment at the University; or (2) a written transfer of copyright is obtained.
Research Project	**If a student research project is funded by a sponsored project, ownership of intellectual property resulting from the student's work is specified by Stanford policy and by the terms of the particular funding agreement.** If a student is the sole inventor of an invention resulting from the use of resources of both Stanford and an outside entity, Stanford may agree to co-assignment of the intellectual property. If an invention is co-invented by a student, and involves both a co-inventor from an outside entity and more than incidental use of Stanford resources, the technology will be jointly owned by Stanford and the outside entity, pursuant to patent law. Depending on their contributions, the faculty advisor and perhaps other faculty, students, or staff may be co-creators or co-inventors. However, in the rare circumstance where a student's entire project is performed at an outside entity with no involvement of Stanford resources other than the student's involvement, the student's work may be governed by the intellectual property policies of the outside entity.	