Syllabus
Technology Management: Innovation and Entrepreneurship

This course will prepare students for work in the technology and information economy by providing the knowledge and skills necessary for technology innovation and entrepreneurship. The technology domains are broad and include but are not limited to those that are typically characterized as mechanical, electrical, chemical, civil, and environmental engineering, as well as technologies with roots in biological, biomedical, healthcare, computer, materials, and environmental sciences. Course topics include concept development, team-building, business models, business plan structure and development, market analysis and strategy, intellectual property, sources of capital, cash flow management and financial modeling. The course format includes lectures, discussions, workshops, guest lecturers, and consultants from relevant fields.

A substantial team project with a strong real-world component is used to integrate the course content and to illustrate the diverse challenges of commercialization and entrepreneurial endeavors. The project enables students to engage in additional pursuit and further development of a topic beyond the context of this one-semester course. Projects often focus on technologies developed within the research enterprise of the university, but other project sources from students, faculty or the private sector are welcome depending on course capacity and subject to instructor approval. Students are strongly encouraged to bring their own ideas for projects as well as to identify potential team members. Teams will be balanced as far as possible, to assure that complementary skills in science, engineering and business will be available to each team, and teams skills will be supplemented by the instructors or other experts as necessary. Teams of students enrolled for 3 credits will produce an executive summary, a financial *pro forma*, and a presentation describing the technology and the business. Teams of students who can devote the time and energy to develop a full business plan should register for another 3 credits of independent study; all team members must enroll for the same credit load.

Engineering or science majors taking this course need no prior exposure to business topics. Likewise, business majors need no prior exposure to science and engineering. Background materials will be provided as needed. The course is open to graduate and upper-level undergraduate students within the 5-Colleges.

Learning objectives

As a result of this course students should:

1. Understand basic concepts of technology innovation, commercialization, and entrepreneurship.
2. Appreciate the importance of technology innovation in society, past, present and future, and understand their own role as engineer, scientist or manager in shaping the knowledge driven economy of the future.
3. Understand basic concepts of intellectual property rights, market research and marketing, accounting, finance and entrepreneurial management.
4. Gain insights into the world of financing technology development and commercialization.
5. Know how a typical business plan, a license agreement, or technology development proposal is structured.
6. Gain skills in communication, public speaking and team building.

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Teaching assistant: Mr. N. Javed, Electrical & Computer Engineering, njaved@ecs.umass.edu. Additional TA to be announced.

Course registration and meetings: Due to the project-based format, capacity is limited and auditing is not feasible. Students are advised to register immediately. For registration in Spire use one of the following as appropriate for your program of study: SCH-MGMT 797B, course #30996; ENGIN 797B, course #33452, SCH-MGMT 597B, course #31408, ENGIN 597B, course #33718. Classes meet Tuesday evening, 5:30-8:00 P.M. in the Isenberg School of Management. Preference will be given to students in the Engineering Management minor (597B) or in the IGERT program (797B) and to students who have project ideas and/or add to the diversity of teams.

Note: Student teams often find this course helpful in preparation for the campus business plan competition, the Technology Innovation Challenge (www.umass.edu/innovation).

Expectations

This course requires both team and individual work. Students are expected to:

- Actively participate as a team member in a project and contribute to preparing and delivering regular presentations describing the project. The team should clearly define the project with the instructors by the second class meeting.
- Take an occasional short quiz on readings and participate in the related discussion;
- Do additional research and reading as needed for the project work;
- Complete one or two individual assignments or essays on readings and lecture topics;
- Co-author and deliver oral progress reports and elevator pitches.
- Co-author the team project final report. An oral and written presentation of the project constitutes the final exam for the course.

Teams and Projects

At the first class meeting, students are invited to describe their own idea for a project and the type of help they believe is needed. If necessary, the instructors will also provide potential project ideas. If university research results are a basis for the concept, at least one of the team members should be actively involved in the research and the faculty members directing the research should agree to the project. Students should supply a short written description of the concept or needs as the basis for a technology commercialization project.

Teams, typically of 4 students, will be formed around a concept. A "charter" specifying objectives, milestones, deliverables, schedule, and individual responsibilities will then be developed. The teams will be responsible for their own internal management, meeting deadlines, organizing and distributing the work load among the team members and eventually producing a comprehensive high-quality final report and a professional standard oral presentation. Effectively managing the teams to produce a high quality output delivered on-time is an essential learning

objective. A Faculty Champion will guide the team and meet with the team once a week at an agreed upon fixed schedule. Attending these weekly meeting will be required. A Technical Liaison will be available to consult with the team on technical matters. The team projects will move forward on a structured schedule with milestones negotiated with the Faculty Champions.

Teams will be required to make several oral presentations and progress reports during the semester. As a final exam, the team will make a comprehensive presentation followed by Q&A.

Each team will be provided with a budget of up to $150 for preparation of a professional-standard final report if a full business plan or the equivalent is prepared. If prototype work is involved, the team can apply for additional support and resources on a case-by-case basis.

Grades: Based on deliverables below; details will be provided in class.

Individual Deliverables:

1. Preparation and participation in class discussion evaluated by the instructors and by occasional quizzes on the assigned reading.
2. Contribution to team project as evaluated by instructors from team meetings and meeting reports, team evaluations (to be discussed in class) and questions and answers at oral presentations.
3. Solution of assignment on Intellectual Property, questions 1 and 2.
4. Optional extra credit book review.

Team Deliverables:

1. Team Charter: each team will create one page summary of its project goals, to be updated as needed.
2. Class Presentations: Each team will present its project 5 times before the class with a PowerPoint presentation. Each presentation may have a different emphasis, but as you progress through the semester, subsequent versions of the presentation should refine and improve upon the prior. Each presentation will generally be 10 minutes long and limited to at least 5 and not more than 10 slides. Both an electronic version and a hardcopy of your presentation should be submitted to instructors and the TA on each occasion it is delivered. For the first presentation, a draft of the slides is due one week before the oral presentation.
3. Reports:
    a. In addition to the presentation, an extended Executive Summary of two pages (single-spaced, 12 point font) plus a financial *pro forma* (including numbers and detailing assumptions) are required.
    b. Business Plans or equivalent (in place of item 3a). You should outline this early in the semester and update it in parallel with your presentations. The written document should reflect the state of your project but provide more details not suitable for slides and oral presentations. The working copy of this document should accompany the slides when they are submitted to the instructors as described in item 2. The final version of the written document should not exceed 25 pages long (not including references and appendices). Proper attention to the outlining and updating of this document will substantially reduce the stress and

improve the success of your final submission. Selected example reports from prior years will be available.

Communications

Web communications will be set up for the class. Primary instructional materials, such as copies of lecture notes, other than copyrighted materials requiring purchase, will be provided electronically.

Required reading

The following articles and portions of the books listed will be required reading.

1. Swanson, J. A. and Baird, M. L. (2003), *Engineering Your Start-Up,* 2nd ed., Belmont, CA: Professional Publications.
2. "From Invention to Innovation," US Department of Energy. Available free of charge for downloadable from http://www1.eere.energy.gov/inventions/pdfs/fromi2i.pdf
3. DeThomas, A. and Grensing-Puphal, L. (2001), *Writing a Convincing Business Plan,* 2nd ed., New York: Barrons.
4. Drucker, P.F. (1994), "The Theory of the Business," *Harvard Business Review*, September-October 72(5), 95-104.[1]
5. Drucker, P. F. (2000), "The Discipline of Innovation," *Harvard Business Review*, May, (originally published 1985, May-June, 63(3), 67-72.[1]
6. Kuemmerle, W. and Coughlin, W. J. (2004) "Term Sheet Negotiations for Trendsetter, Inc.," Case No. 9-801-358, Harvard Business School Press.
7. Levitt, T. (2004), "Marketing Myopia," *Harvard Business Review*, July-August, 82(7/8), 138-149.[1]
8. Katzenbach, J.R. and Smith, D.K. (2005), "The Discipline of Teams," *Harvard Business Review*, July-August, 83(7/8), 162-171.[1]
9. Magretta, J. (2002), "Why Business Models Matter," *Harvard Business Review*, May, 80(5) 86-92.[1]
10. Pressman, D.W. (2005), *Patent It Yourself,* 11th ed., Berkeley CA: NOLO Press.[2]

Materials from the lists below may also be helpful for class discussions, for general knowledge of innovation and management, for your project, or for extra credit.

Supplementary reading (you are encouraged to read at least one of these)

In addition to the readings above, students may select and read one of the following titles and prepare and present a review of the book for **extra credit towards the final grade**.

1. Christensen, C. M. and Raynor, M. E. (2003), *The Innovator's Solution: Creating and Sustaining Successful Growth*, Boston, MA: Harvard Business School Press.
2. Chesbrough, H. (2003), *Open Innovation: The New Imperative for Creating and Profiting from Technology*, Boston, MA: Harvard Business School Press.

[1] Available online through links at UMass Amherst Library; also available for purchase and download from Harvard Business School Press, http://www.hbsp.com, generally with updates and annotations (recommended).
[2] Available online via UMass Amherst library; you will need to register at http://library.books24x7.com/

3. Collins, J. (2001), *Good to Great: Why some companies make the leap and others don't*, New York: HarperCollins.
4. Drucker, P. F. (1985), *Innovation and Entrepreneurship*, New York: Harper.
5. Friedman, T. M. (2006), *The World is Flat: A Brief History of the Twenty-First Century*, (Expanded and Updated Edition), New York: Farrar, Straus and Giroux
6. Hargadon, A. (2003), *How Breakthroughs Happen*, Boston, MA: Harvard Business School Press.
7. Kawasaki, G. (2004), *The Art of the Start*, New York: Penguin Group. (also see http://www.garage.com)
8. Rosenberg, N. (1982), *Inside the Black Box: Technology and Economics*, New York: Cambridge University Press.
9. Mowery, D. C. and Rosenberg, N. (1998), *Paths of Innovation*, New York: Cambridge University Press.
10. Shane, S. A. (2005), *Finding Fertile Ground*, Upper Saddle River NJ: Wharton School Publishing.
11. Utterback, J. M. (1996), *Mastering the Dynamics of Innovation*, Boston: Harvard Business School Press.
12. Varian, H. R. and Shapiro, C. (1999), *Information Rules: A Strategic Guide to the Network Economy*, Boston, MA: Harvard Business School Press.

Additional general references

Highly motivated students will also want to read significant sections of the following texts as part of their general education:

1. Burgelman, R. A., Maideque, M. A. and Wheelwright, S. C., *Strategic Management of Technology and Innovation*, New York: McGraw-Hill (2001).
2. Freeman, C. and Soete, L. *The Economics of Industrial Innovation*, 3rd ed, Boston: MIT Press. (1995).
3. *Harvard Business Review on Innovation* (Collection of articles), Harvard Business School Press (2001).[2]
4. *Harvard Business Review on Entrepreneurship* (Collection of articles), Harvard Business School Press (1999).[3]
5. Katz, R. Editor, (2004), *The Human Side of Managing Technological Innovation*, Second Edition, New York: Oxford University Press.
6. Razgaitis, R., (2003), *Valuation and Pricing of Intellectual Property*, Hoboken NJ: Wiley.
7. Rogers, E.M. (2003), *Diffusion of Innovations*, 5th ed., New York: Simon and Schuster.
8. Teece, D. J. (2000), *Managing Intellectual Capital: Organizational, Strategic, and Policy Dimensions*, Oxford, England: Oxford University Press.

Software: *Business Plan Pro* with manuals and documentation will be made available. MS Word, PowerPoint and Excel may also be used in addition to or instead of *Business Plan Pro* for generating presentations, financial plans, assignment solutions and the final report. Also see the resources and templates at http://www.elearning.hbsp.org/businesstools/

[3] Available for purchase and download from Harvard Business School Press, http://www.hbsp.com

Class structure

The class will generally be divided into three activities as follows: **Discussion**: Students will come to class prepared to discuss the Reading and should submit one question at the beginning of the class in writing. Generally, 25-45 minutes will be devoted to discussion of the topic and questions. **Teams**: activities in working sessions and/or progress reports, presentations. **Lectures**: guest experts or the instructors. Details and **Deliverables** are also listed below.

Schedule (subject to change)

Class 1, 9/4/2007

Reading: DOE report, "From Invention to Innovation," and Part 1 of *Engineering Your Start-Up*, (front matter, plus pp. 1-36).

Submit: One page sketch of your background, how you expect this course to further your learning and future personal goals, and what skills you can bring to a project. Please be prepared to describe and discuss a concept for a class project.

Lecture: Course Overview

Team Activity: Working session on team formation and project concepts

Class 2, 9/11/2007

Reading: Katzenbach & Smith, "The Discipline of Teams;" *Engineering Your Start-Up*, Ch.7.

Guest: Mr. Mike Davis, UMass Amherst Libraries

Lecture & Workshop: Team concepts and workshop

Team Activity: Working session on project and content for first progress report.

Class 3, 9/18/2007

Reading for Class: Magretta, "Why Business Models Matter;" Drucker, "The Theory of the Business;" *Engineering Your Start-Up*, pp. 137-155, 171-181; *Writing a Convincing Business Plan*, pp. 1-9; http://en.wikipedia.org/wiki/Business_model;[4]

Lecture: Business plan, value proposition and business models.

Team Deliverables: Submit draft presentation of first project oral report (max 5 PowerPoint slides) and Team Charter. The purpose of this submission is to get feedback in preparation for the first oral presentation is in Class 4 (see notes below).

References for Presentations: *Engineering Your Start-Up*, p. 214; guidelines and tutorial at http://www.allianceofangels.com/startups/presentation_guidelines.html; *The Art of the Start* and the related web site, http://www.garage.com/resources/index.shtml.

Class 4, 9/25/2007

Reading: Drucker, "The Discipline of Innovation;" Levitt, "Marketing Myopia;" *Engineering Your Start-Up*, Ch. 8.

[4] Wikipedia is a popular website as a source of information, but it is not a recognized authoritative and independent reference source. See the information at http://en.wikipedia.org/wiki/Wikipedia and you will understand that caution is required when you use it.

Team Deliverables: Present first team oral report (max 5 slides/10 minutes). Submit revision of slides and Team Charter (if any) plus a written description of the concept for the product or service, the value proposition, and the business model. The written document should contain the high-level outline of your business plan.

Lecture: Entrepreneurial Marketing Fundamentals

Class 5, 10/2/2007

Reading: *Engineering Your Start-Up,* pp. 155-164, 182-186

Teams: Working session on project, including financials.

Lecture: Accounting concepts and the *pro forma*

Class 6, 10/16/2007

Reading: *Engineering Your Start-Up,* Ch. 9; *Writing a Convincing Business Plan,* pp. 43-96.

Team Activity: Working session on project, emphasizing financials and market aspects

Lecture: Market and industry analysis, product development

Class 7, 10/23/2007

Reading: *Engineering Your Start-Up,* Ch. 6, pp. 164-169

Team Deliverables: Present second project report (oral); maximum 5 slides, 10 minutes. Include any revisions to value proposition and business model, plus market analysis and *pro forma*. Submit slides, plus working draft of business plan document (The working draft is a complete outline and as much content as currently available. It is expected that several sections will be missing or incomplete.)

Class 8, 10/30/2007

Reading: *Engineering Your Start-Up,* Ch. 19; *Patent It Yourself,* Ch. 1, 2 & 5.

Team Activities: Present an elevator pitch, 2 minutes, up to 2 slides, one speaker.

Lecture: Intellectual Property

Class 9, 11/6/2007

Individual Deliverable: Intellectual property assignment, Questions 1 and 2

Reading: *Engineering Your Start-Up,* pp. 169-170, Ch. 11 and 12; and "Term Sheet Negotiations for Trendsetter, Inc."

Lecture: Time value of money and profitability. Entrepreneurial finance and exit strategies.

Teams: Working session on content of third project report, including IP

Class 10, 11/13/2007

Reading: *Engineering Your Start-Up,* Ch. 17.

Team Deliverables: Present third project report (oral); maximum 5 slides (3 preferred) or 5 minutes. In the written document, emphasize revisions to previous reports, plus intellectual

property search and strategy. The latter is your (team) solution for Question 3 of the IP assignment.

Lecture: Valuation of intellectual property and ventures, Guest Speaker: David A. Spieler, CFA, Managing Director and City Leader, Duff & Phelps, LLC, Boston.

Class 11, 11/20/2007

Reading: *Engineering Your Start-Up,* Ch. 20.

Team Activity: Working session on project, including exit strategy and elevator pitch.

Lecture: Ownership structures

Class 12, 11/27/2007

Reading: "About SBIR and STTR programs" at http://www.sbirworld.com/. See especially the overviews slides and the links to the SBA description and data on SBIR/STTR awards.

Team Deliverables: Present fourth project oral report (oral) and submit updated report (working draft).

Lecture: Licensing, SBIR/STTR proposals and funding.

Class 13, 12/4/2007

Event: *Technology Innovation Challenge*

Teams: Elevator pitch as part of the *TIC* (class attendance is required; participation in the TIC is optional.)

Class 14, 12/11/2007

Team Activity: Working Session in preparation for final report and presentation.

Lecture: Course Wrap-Up and Discussion

Class 15, Date & Location To Be Announced once Final Exam Schedules are Published

Individual Deliverables: Self-Analysis and individual component of Team Evaluation

Lecture: None

Teams: Final project presentations; final report due within 24 hours of presentation.