Markets & Management Studies Capstone Course (MMS 190)

U.S. Engineering Education Reports
Duke Engineering Outsourcing Project

Facing the Challenge of Globalization in the 21st Century in U.S. Engineering Education
University of Pennsylvania and Cornell University

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Abstract

This analysis covers unique programs in engineering education at the University of Pennsylvania and Cornell University. The Jerome Fisher Program in Management and Technology at the University of Pennsylvania and the Engineering Communications Program at Cornell University provide a model of how universities should be educating their engineers in order to remain atop of the global marketplace. Both of these elite universities have developed programs designed to train leaders and so-called “dynamic” and “versatilist” engineers. The aim of this project is to identify how top institutions are modifying their curricula to develop a new type of engineer merged with a business leader whose skills will be able to withstand the threat of outsourcing and off-shoring.
Introduction

How are the U.S.’s top institutions adapting to the new global environment? In order to maintain a competitive advantage in engineering, many American institutions are modifying their curricula to develop a new generation of engineers whose skills will be able to withstand the threat of outsourcing and off-shoring. Yet how successful are these efforts?

This analysis covers unique programs in engineering education at the University of Pennsylvania and Cornell University. The Jerome Fisher Program in Management and Technology at the University of Pennsylvania and the Engineering Communications Program at Cornell University provide a model of how universities should be educating their engineers in order to remain on top of the global marketplace. Both of these elite universities have developed programs designed to train leaders and so-called “dynamic” or “versatilist” engineers\(^1\). The aim of this project is to identify how top institutions are modifying their curricula to develop a new type of engineer merged with a business leader whose skills will be able to withstand the threat of outsourcing and off-shoring. We will examine two niche programs from these similarly-sized, Ivy League universities that use different strategies to tackle the challenges of the economy of the 21st century.

Table 1: A Comparison of the University of Pennsylvania and Cornell University

<table>
<thead>
<tr>
<th></th>
<th>University of Pennsylvania</th>
<th>Cornell University</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Enrollment</td>
<td>10,422</td>
<td>13,515</td>
</tr>
<tr>
<td>Engineering Enrollment (% of Undergraduate Enrollment)</td>
<td>1,640 (15.7%)</td>
<td>2,680 (19.8%)</td>
</tr>
<tr>
<td>Enrollment in Specialized Program (% of Undergraduate Engineers in Program)</td>
<td>55 (3.4%)</td>
<td>536 (20%)</td>
</tr>
</tbody>
</table>

Sources: www.upenn.edu, www.cornell.edu

\(^1\) Kristina Johnson, in an op-ed piece of January 8, 2006, defined “dynamic engineers” as those “…who have a holistic perspective of their field, are able to integrate knowledge across the disciplines, work well in teams, possess persuasive communication skills, and have a respect and an understanding of other cultures.” See Johnson, “US Engineers…”; Friedman 291.
University of Pennsylvania: The Jerome Fisher Program in Management & Technology

In January 1995, Jerome Fisher, founder and chairman of the Nine West Group, donated $5.5 million to endow and support the Management & Technology Program. When Fisher announced his endowment of the program, he stated that "understanding the relationship between business and technology is increasingly vital to building and maintaining competitive advantage in the global marketplace."² (M&T Website). Mr. Fisher’s foresight in his support of this program is remarkable.

Students in the Management & Technology Program earn two undergraduate degrees upon completion of their studies. There is one program from which students receive both a Bachelor of Applied Science degree from the School of Engineering and Applied Science and a Bachelor of Economics from the Wharton School. This track provides basic technical knowledge about the engineering discipline. Additionally, there is another program for students who wish to become professional engineers. At the completion of this program, the student receives a Bachelor of Science in Engineering degree and a Bachelor of Economics degree. The length of the program is dependent on how much Advanced Placement credit that the student has upon entry, though. The vast majority of students graduate in four years. It is estimated that only about 10% of the students in the M&T Program of the Class of 2005 stayed more than four years (Engle, April 7, 2006).

The overall goal of the program is to provide sound knowledge of engineering fundamentals and a firm foundation in management. Lea Engle, the Administrative Director of the M&T program, explains why this joint degree leaves the student with a distinct advantage over the traditional student, claiming, “M&T Students are at a distinct advantage from single degree engineering students because their schooling teaches them to exercise both sides of their

brain. In Penn Engineering, their thinking is very quantitative and analytical; in the Wharton School the thinking is still quantitative, but also carries a great deal of qualitative work. For employers, they are actually getting one person who can understand and communicate with individuals in several areas because of their education (Engle, March 6, 2006).

This joint-degree program was originally developed in 1976. When the program was conceived, it was revolutionary. The University of Pennsylvania’s Board of Overseers, a distinguished group of corporate executives and academicians, emphasized that an understanding of the fundamentals of engineering and technology is as essential to the background of future leaders in business and industry as is a sound knowledge of management principles. The Board “saw an opportunity to create a much needed, distinctively unique and dynamic program.” Engle explains that “Penn has always been an institution that engages in a global learning community across our 12 schools, Penn Engineering included… I think you could directly relate the beginning of the M&T Program to the expanding global market.” This was one of the first programs in the world to bridge these two disciplines and aimed to attract students who are interested in careers that involve both managerial and technical responsibilities in the new world market.

Due to the desirability of this program, admission is highly selective. Only about 55 students are accepted per year, while Penn Engineering accepts an average of 410 freshmen per year. The program offers much more flexibility than the typical engineering undergraduate education, with only two required courses. The first is an introductory engineering course and the second is a management of technology course. Outside of these two courses, students are permitted to define a path of study appropriate to their interests and post-graduation plans. The general curriculum of the M&T program includes exposure to the liberal arts and managerial disciplines, and a concentration in an engineering field. The depth and breadth of engineering
courses varies depending on whether the student is pursuing the five-year track (Bachelor of Science in Engineering/Bachelor of Science in Economics) or the four-year track (Bachelor of Applied Science in Engineering/Bachelor of Science in Economics). All students in the M&T Program, however, must fulfill certain requirements addressing accounting, management, finance, communications, law and the global environment (Appendix 3). Interdisciplinary study is highly encouraged, and integration of managerial and technological knowledge is emphasized in coursework throughout the course of the program. Two specific courses, *Technological Innovation and Entrepreneurship* and *Technology Management* emphasize the integrative nature of the program by requiring students to apply all of their knowledge to address extremely complex issues that they will likely face in the workforce (Appendix 4). Ms. Engle also stated that she believes that “some of the case studies the students work with [in the Technology Management course] deal with outsourcing,” but she was not positive.

The M&T Program stresses relating academic knowledge to “real-world” applications. In the senior year, students design a project in which he or she applies technical and business skills to the definition and solution of a "real-world" problem. Furthermore, activities that bring students into contact with business leaders, such as internships, technological entrepreneurship seminars, and industry roundtable discussions, are also highly encouraged.

Graduates of the Management and Technology Program do not solely pursue positions within the engineering field. Many alumni of the Management & Technology Program currently work in strategic planning, financial analysis, product management, and managerial or technical consulting. Some have founded new firms in emerging technical fields; others go on to complete graduate education in business, engineering, law, and medicine. Engle states, “Post graduation options for M&T students are endless… M&T students are the highest paid on average across the University (Engle, April 7, 2006).”
The overarching mission of the Management & Technology Program is to provide the mastery of skills necessary to define and solve problems in the rapidly changing global marketplace, while allowing students flexibility in tailoring their studies towards their interests. According to Lea Engle, there are no specific changes or modifications planned for the program in the next five years. The only goal for program administrators is for “the Program to keep getting better and continue attracting the best students.”

Cornell University: The College of Engineering – Engineering Communications Program

“Communication is an important way of acting in the world. And, because the world is constantly changing, professionals in engineering must be prepared throughout their career to learn to learn how to communicate,” states the Engineering Communications Program’s website. As we have observed, the dynamic world economy requires the training of dynamic U.S. engineers. A senior professor and director in the program, Rick Evans, noted that the program seeks to train more “reflexive” engineers. Cornell’s program, although very different from Penn’s, seeks to accomplish a similar end: “to enable undergraduate engineering students to develop strategies for learning to learn how to act effectively and efficiently as communicators” (ECP web site). In the global economy, communications skills will be crucial for US engineers if they hope to maintain a competitive advantage.

To understand Cornell’s approach, an understanding of the ECP structure and curriculum is necessary. The program was initiated in 1986, in response to employer demand for engineers with better “people skills.” Although only three courses and four professors compose the department, professors like Rick Evans and Jerry Gabriel contribute to additional “WI” courses;

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engineering courses that integrate writing skills into traditional coursework (Appendix 5). The courses are not required for all engineers, but can be used to fulfill the technical writing requirement of the College of Engineering. It is common for engineers to take these classes to fulfill the six liberal arts courses required for engineers. According to junior Robert Pavlenco, who is enrolled in Professor Evans’ ECP course, “[ECP courses] serve to expose students to humanities of all types and broaden the base of their knowledge. They also seek to expose future engineers to organizational behavior and the way people conduct themselves in a professional atmosphere.” Cornell graduates about 700 engineers per year. Professor Jerry Gabriel estimates that approximately 20% of these are involved in ECP courses.

A conversation with Jerry Gabriel, professor and director in the ECP program, provided primary insight on the mounting challenges facing engineers and how Cornell is dealing with these issues. Gabriel joined the ECP team about four years ago, and in his time has seen a movement by the department as a response to the recent trend of global outsourcing of engineering jobs. “Although a small part of the college of engineering is involved in ECP, there is an increasing awareness [of globalization]. The Dean’s office is busy creating partnerships for all engineers with institutions in China, India, France, and Hong Kong as a response to globalization. We are trying not to be so insular so that our engineers can participate in the global community (Gabriel, March 3, 2006).” Gabriel is of the opinion that what Cornell is doing for its engineers is extremely valuable. It provides them with a sophisticated framework of communications skills that will give them an edge in the increasingly competitive marketplace. “US engineers will be at a disadvantage without similar communications programs in other institutions,” says Gabriel. In this regard, ECP is part of a group of programs in top engineering schools, along with the Jerome Fisher Program at the University of Pennsylvania. Though the two programs are quite different, they illustrate that an effort in addressing these challenges
facing U.S. engineers will become valuable and necessary in the coming years, if in fact the world does continue to “flatten” (Friedman, 2005).

Since 1986, Cornell’s program has changed drastically. It has expanded from one course, not required of engineers, to an entire department that about a fifth of Cornell engineers participate in. While the curriculum may not have directly responded to globalization thus far, Professor Gabriel has noted a change in the attitudes of engineering students in recent years. He calls these past few years a “transitional phase” in which ECP students are less likely to be “just filling requirements.” Instead, Gabriel has seen an increasing number of “self-selected engineering students who understand globalization’s challenges very well.” He also notes, “[Globalization] is a part of the engineering paradigm; understanding the context of globalization and having the ability to walk into a culturally ‘different’ scenario are reasons for the development of the ECP.” While interest and enrollment in ECP may not have grown appreciably in response to globalization, awareness of students in the program has. Gabriel has seen this in engineering team project groups. These groups, through their work and interaction with the real world, have “woken up” to the importance of their ECP participation. While in the past, the ECP administration has worked in a very top down manner, Gabriel has noted a change in the sense that students are beginning to take their own initiative. Robert Pavlenco provides a student’s perspective: “As engineering (and actually all fields) becomes more and more geared towards doing business internationally, classes like this become more and more necessary to include in an engineering curriculum. I suppose this course would help in that respect but there is no language requirement in the College of engineering. Maybe that too could change in the future (Pavlenco, March 2, 2006).” Professors Gabriel and Evans, along with Pavlenco, all stated that ECP courses have yet to directly address globalization as a part of the coursework.
This might be a valuable reform to consider in order to bolster the growing awareness of international competitiveness issues.

Is this program making a direct difference in the jobs that engineers get coming out of the program with this additional communications experience? The ECP website indicates that it should. Within ECP, Cornell offers a writing intensive co-op program in which students involved in co-ops can fulfill the technical writing requirement in a “real–world” work setting. “By participating in the Writing-Intensive Co-op, students receive communications instruction integrated with workplace experience.” The growing popularity of this program amongst engineering seniors will surely contribute to the hire ability of Cornell graduates. Not only are they being trained in dynamic communications skills, but they are also given real world work experience before graduation. Because engineering programs tend not to offer much flexibility in curriculum choice due to strict regulations enforced by the American Society for Engineering Education, a co-op is a unique opportunity that surely gives Cornell graduates an edge when entering the work force. Robert Pavlenco has a somewhat more cynical view of ECP’s effect on job placement: “I don't think ECP would have a profound effect on what types of jobs Cornell Engineering students get after graduation since most students only take one class in the department if they do at all. However, I'm sure employers are pleased to see that our engineers have some type of exposure to this area, as it helps greatly in a real-world work environment (Interview, March 2, 2006).” Whether or not ECP has made a difference so far, U.S. engineers will be facing greater competition for jobs in the coming years. The skills taught by the program will begin to have a more observable effect in the search for jobs.
Comparing the Two Programs

The Engineering Communications Program at Cornell and the Management and Technology Program at University of Pennsylvania seek to develop individuals with entrepreneurial skills that are better suited to leadership roles within corporations. This modification is absolutely essential to the success of those graduates in the global marketplace. U.S. competitiveness in the coming years depends on such students.

These schools emphasize an interdisciplinary education and foster real-world experience and application within the programs. Such experience makes these individuals more attractive to companies at home and abroad. The broadly defined and more flexible guidelines of study in these programs allow for the creation of engineers and business people who can bridge the gap between technical and managerial disciplines. As stated by William F. Hamilton, the director of the M&T Program at the University of Pennsylvania, “Technology and management, while typically considered as distinctly separate fields of academic study, are closely linked in practice. Rarely, if ever, do technical developments have much impact without significant managerial input.” Therefore, it is essential to create engineers with the ability to manage projects from inception to completion, those with the ability to innovate and then be able to put such innovation into practice.

The Jerome Fisher Program focuses on the development of a business leader. It is a comprehensive course of study and takes a real commitment by the student. The Engineering Communications Program is more narrowly focused. Its emphasis is on creating writing and verbal communication skills. ECP focuses on creating a better-rounded engineer. Both programs strive to enhance traditional engineering education with a multi-dimensional approach.
The Changing Job Market

The success of these programs reflects a much larger trend in the global marketplace. The increasingly fluid and flattened world presents a more complex job market, even to graduates of elite programs from Ivy League universities, such as the University of Pennsylvania and Cornell University. These programs are attempting to educate the executives and leaders of the future. However, the same number of these types of opportunities may not be available to U.S. graduates in the coming years.

In a phone interview, Jeffrey Heath, President of the Landstone Group, expressed that the traits that they look for in finding talented executives have changed little in the past twenty years. The Landstone Group is an executive search and consulting firm that specializes in securing talent for multinational technology companies such as IBM, Philips, Kenwood and Sanyo, among others. He explains that it is the average employee whose job is at risk in “Globalization 3.0” (Friedman, 2005), not the leader. This is not to say, however, that the marketplace for executives has not changed. In years past, companies in foreign countries had looked to expatriates to run their corporations. This led to a multitude of problems. The cost of moving the expatriate to the country of choice was extremely costly, both economically and emotionally. They often suffered “culture shock” and did not want their children to be educated abroad; in many cases, they returned to the United States after only a few years.

Now, it is more common for multinationals abroad to look for executives who are Americanized natives of the country. This next generation of executives would be foreign-born, but educated in the U.S. Upon graduation, they return to their home country. In effect, in terms of executive talent, the United States is now suffering from a “reverse brain drain.” Vivek Wadhwa, Executive-in-Residence in the Master of Engineering Management Program at Duke University’s Pratt School of Engineering, echoed this idea in a lecture on March 6, 2006. He
stated that Indian and Chinese engineers are now better off going back to their own country after graduation from American universities than they are staying in the U.S. Although they will make half as much in salary, they will be able to live four times better because of the low cost of living.

Furthermore, Jeffrey Heath went on to explain that the United States is providing top-notch education to employees in the counties that receive these outsourced jobs. The U.S. companies want these foreign employees to provide an extremely high level of service to the customer, so they spend a considerable about of money to be sure they are adequately educated to handle these tasks. Coupled with the high standard of education already provided in these countries, this practice is creates model employees.

Heath, however, does not believe that all jobs can eventually go overseas, as has been suggested by some other analysts. Heath goes on to explain that he believes that some natural cap will arise on the amount of a company’s business activities that can be outsourced because “American businesses need our touch.” He believes that this is what people outside of the United States have come to expect from our companies and they continue to associate American leadership with quality.

Conclusion

An important issue in examining the future of U.S. engineering education is the actual appeal of the engineering field to young Americans. “The job market has worsened for young workers in S&E fields relative to many other high-level occupations, which discourages U.S. students from going on in S&E, but which still has sufficient rewards to attract large immigrant flows, particularly from developing countries,” proposes economist Richard Freeman in his paper entitled “Does Globalization of the Scientific/Engineering Workforce Threaten U.S.
Economic Leadership?” (see Appendix 2). ECP, the Jerome Fisher Program, and similar programs in top U.S. institutions will need to begin to take an awareness and interest in this problem. For potential students, it is no longer simply the level of income and prestige that an engineering degree can offer that truly matters, but also the concern of whether a preferential and secure job might even be available to an average U.S. engineer. An average “transactional” engineer will no longer be sufficient to maintain U.S. competitiveness in S&E (Duke Study, 2005). Educational institutions must continue finding ways to produce dynamic engineers with some sort of advantage over foreign engineers.

It is interesting to see that some Cornell engineers might still be oblivious to the challenges that they might have to face in the future. “I think the enrollment and interest in engineering has remained pretty constant regardless of the rise of global outsourcing, and the same goes for interest and enrollment in ECP. An engineering degree is extremely versatile in other sectors such as business, so a Cornell Engineering degree will always be desirable,” says Pavlenco. For his sake and for the sake of U.S. engineering competitiveness, we hope he is right. But the increasing importance of the global economy and the increasingly level playing field for engineers worldwide may prove that even programs as excellent as Cornell’s ECP and Penn’s Jerome Fisher Program may not be sufficient in producing engineers that will continue the U.S. tradition of excellence in S&E.

In describing the “engineer of the future,” Kristina M. Johnson, Dean of the Pratt School of Engineering at Duke University states, “[they] need to know how to appreciate and practice the art of persuasion and how to be a good listener. They must have cultural awareness, sensitivity and respect for diversity. They need to know how to solve problems and if they’re going to be leaders, they must understand project management, finance and accounting” (Johnson, 2005). One could design a program that encompasses all of these facets to create the
“engineer of the future” by merging the focus on communication of Cornell’s Engineering Communications Program and the managerial, financial and entrepreneurial focus of Penn’s Jerome Fisher Program in Management & Technology. Such a program would create an outsourcing-proof engineer who is a lifetime learner with an adaptable and broad base of managerial skills and technical knowledge. The success of these programs is indicative of the revamping trend of U.S. engineering education at top universities across the nation. We do not feel, however, that these two programs individually provide education sufficient to create the “engineer of the future.” In order to maintain the U.S. competitive advantage in science and engineering industries, a more comprehensive and universal education must become the standard, not the exception.
APPENDICES

APPENDIX 1: Common Interview Questions posed to Faculty, Administrators, and Students

- How exactly is the program structured? Do students have to take an additional year of classes?
- Is this program part of a niche? Or is this program a reflection of how engineering education needs to change in general?
- What are the goals of the program?
- Is it possible that someday a communications/business/management aspect will be required of all engineers?
- How long has the program been in existence and what prompted its development?
- What jobs do people get after graduation from the program (as opposed to those who do not partake)?
- Do you believe this program is reflective of the engineering education necessary to compete in the global market?
- When this program began, was it revolutionary?
- Was it modeled after other program?
- Have other schools modeled programs after yours?
- Has the threat of global outsourcing influenced the creation of or the curriculum of this program?
- Have you seen a rise/decline in enrollment or interest in engineering with the wave of outsourcing? A rise in popularity of niche programs?
- Does coursework address outsourcing?
APPENDIX 2: Income in Dollars and % Change in Income for Professional Occupations in the United States, 1990-2000

<table>
<thead>
<tr>
<th>Occupation</th>
<th>1990</th>
<th>2000</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>PhD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering</td>
<td>$64,600</td>
<td>$91,100</td>
<td>41.0</td>
</tr>
<tr>
<td>Mathematics</td>
<td>$58,300</td>
<td>$86,600</td>
<td>48.5</td>
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<tr>
<td>Natural Science</td>
<td>$56,300</td>
<td>$73,000</td>
<td>29.7</td>
</tr>
<tr>
<td>Social Science</td>
<td>$54,200</td>
<td>$74,600</td>
<td>37.6</td>
</tr>
<tr>
<td>Life Science</td>
<td>$45,600</td>
<td>$62,700</td>
<td>37.5</td>
</tr>
<tr>
<td>Doctor</td>
<td>$98,800</td>
<td>$156,400</td>
<td>58.3</td>
</tr>
<tr>
<td>Lawyer</td>
<td>$76,900</td>
<td>$114,700</td>
<td>49.2</td>
</tr>
<tr>
<td>Managers, college + 2 years</td>
<td>$61,300</td>
<td>$84,900</td>
<td>38.5</td>
</tr>
<tr>
<td>College Grads, 4 years Only</td>
<td>$30,800</td>
<td>$46,900</td>
<td>52.2</td>
</tr>
</tbody>
</table>

(Richard Freeman: Does Globalization of the Scientific/Engineering Workforce Threaten U.S. Economic Leadership?)
APPENDIX 3: Curriculum Worksheets from University of Pennsylvania

Bachelor of Science in Engineering/Bachelor of Science in Economics

1. Required Wharton/CAS Courses - 9 cu
   ACCT 101  FIN 100
   ACCT 102  FIN 101*
   ECON 001* MKTG 101
   ECON 002* MGMT 100
   MGMT 101  

2. Communications Requirement
   Writing Requirement
   Foreign Language
   Competency*:

3. Business Breadth - 2 cu
   (MGMT237**)

4. Business Concentration - 4 cu
   May not include introductory courses.

5. Gen. Education/Global Environment - 4 cu

6. Societal Environment - 1 cu
   Choose 1 of the following:
   Legal Studies 101*
   Legal Studies 210*
   Public Policy and Mgmt 203

   ** MGMT 237 also counts as a Business Concentration course for Management majors and a
   Business Breadth course for non-majors.

7. Quantitative/Computational Skills - 5 cu min.
   Number of credit units vary by engineering major.
   MATH 104  SYS 301
   MATH 114  SYS 302
   (         )

   [Statistics 430 & 431 may be substituted for Systems 301 & 302, if the latter sequence is not
   required by your particular Engineering major.]

8. Natural Sciences - 5 cu min
   Number of credit units vary by engineering major.
   Physics 150  

17
9. Engineering Concentration
Number of credit units vary by engineering major.

10. Other / Application Oriented Focus Professional Electives
Number of credit units vary by engineering major.

11. Social Science and Humanities - 7 cu

Bachelor of Applied Science / Bachelor of Science in Economics

1. Required Wharton/CAS Courses - 9 cu
ACCT 101
ACCT 102
ECON 001*
ECON 002*
MGMT 101

2. Communications Requirement
Writing Requirement*  
Foreign Language  
Competency*:  

3. Business Breadth - 2 cu
(MGMT237**) 

4. Business Concentration - 4 cu
May not include introductory courses.

5. Gen. Education/Global Environment - 4 cu

6. Societal Environment - 1 cu
Choose 1 of the following:
Legal Studies 101*  
Legal Studies 210*  
Public Policy and Mgmt 203  

* Denotes approved SSH course in Engineering.
** MGMT 237 also counts as a Business Concentration course for Management majors and a Business Breadth course for non-majors.

7. Quantitative/Computational Skills - 5 cu min.
Number of credit units vary by engineering major.

MATH 104 _____ SYS 301 _____
MATH 114 _____ SYS 302 _____
( _____ ) _____

[Statistics 430 & 431 may be substituted for Systems 301 & 302, if the latter sequence is not required by your particular Engineering major.]

8. Natural Sciences - 5 cu min
Number of credit units vary by engineering major.

Physics 150 _____
Chem 101 & 53 _____
Bio 101 or 120 _____
Science Depth _____
Natural Science _____

9. Engineering Concentration - 10 cu
CSE 110 / CSE 120 / OPIM 101 _____
MGMT 237 _____
EAS 499 (Applied Project) _____

NOTE: A computer science class is required for all M&T students.

10. Concentration
Number of credit units vary by engineering major.

11. Social Science and Humanities - 7 cu
APPENDIX 4: Course Descriptions of Integrative Courses from the Jerome Fisher Program

Technological Innovation and Entrepreneurship

This course offers a basic understanding of technological innovation and entrepreneurship in today's society. Students learn how to identify technology-based venture opportunities, evaluate technical feasibility and business potential, and develop a plan for successful commercialization.

Technology Management

Examining the technical and managerial challenges presented by emerging technologies, this course gives particular consideration to the forces affecting innovation and the managerial options available to organizations, whether entrepreneurial or established.
APPENDIX 5: Course Descriptions of Integrative Courses from the ECP Program

ENGRC 350 Engineering Communications - The ability to communicate well plays an important role in professional success.

ENGRC 350 prepares students for that success. They write various types of documents (e.g., letters, memos, executive summaries, problem analyses, proposals, and progress reports), give oral presentations, and incorporate graphics in both their oral and written work. Students learn how to communicate specialized information to different audiences (e.g., technical and nontechnical people, colleagues and clients, peers and supervisors, in-house departments, and government agencies), work in teams, and address organizational and ethical issues. The course material is drawn primarily from professional contexts, principally engineering, and it generates lively discussion. The class size ensures close attention to each student's work.

ENGRC 335 Communications for Engineering Managers

ENGRC 335 reviews the kinds of communication particular to an institution and/or organization, how those kinds of communication lead to action (or fail to do so), and what opportunities there may be for communication to improve productivity. ENGRC 335 provides students with the foundational knowledge related to communication in institutions and/or organizations. In addition to demonstrating facility with that foundational knowledge, students will be asked to apply what they learn to study communication in a number of real-world contexts, determine the structure and purpose of that communication, and if necessary, consider how one might redesign that structure in order better to enable a desired purpose.

ENGRC 334 Independent Study in Engineering Communications

ECP instructors can offer independent (or "directed") study in engineering communications. A student doing independent or directed study works one-on-one with an ECP instructor. Various types of projects are possible, e.g., studying forms of technical documentation, creating user manuals, analyzing and producing technical graphics, reading and writing about problems in engineering practice, and writing about technical topics for the public. Credits may vary (one-three). Students who want to do an independent or directed-study course must contact and make arrangements with a particular ECP instructor.
Sources


Pavlenco, Robert. Student, Engineering Communications Program. Cornell University. E-mail interview. 2 March 2006.