

An Undergraduate Program in Technology and Management

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ABSTRACT

A new program in Technology and Management at the University of Illinois at Urbana-Champaign brings together undergraduate students from the colleges of engineering and commerce and business administration to gain knowledge and experience in complementary, cross-disciplinary fields. The program provides custom-designed and mainstream courses in engineering and business subjects as well as interdisciplinary team projects supported by industry sponsors. Students enter the two year program as juniors and complete twenty two credit hours beyond the requirements for their major degrees. This paper describes the curriculum and administrative structure of the program. It also describes the backgrounds and motivations of students who enter program and offers some lessons learned based on early experience and feedback from recent graduates and their employers.

I. Background

The need to expose engineering students to ideas and people outside of engineering has been recognized for some time¹⁻³. The workplace which engineering students will encounter when they graduate has undergone profound and irreversible change in the last decade⁴⁻⁵. Many companies have eliminated entire layers of middle management and have moved to a team-based project management model. This model requires effective interaction of team members from diverse academic backgrounds and widely different problem-solving experiences. It places a premium value on those who can function effectively in such an interdisciplinary and interdependent environment.

The Technology and Management Program at the University of Illinois at Urbana-Champaign is a new course of study in which engineering and business majors learn together in an integrated program without sacrificing disciplinary depth in their major fields of study. The focus is on the undergraduate student. Teams of business and engineering students working together develop comprehensive solutions to real world problems. There is an emphasis on experiential learning and inclusion of hands-on elements in each of the courses in the program.

The program provides undergraduate students a working knowledge of the fundamental elements of their cross-disciplines and the opportunity to exercise this knowledge by working together on interdisciplinary project teams that mirror those found in many companies today. The goal is to prepare these students to “hit the ground running” in their first job.

II. Administration

The program resides organizationally between the Colleges of Engineering and Commerce and Business Administration. It is co-directed by two senior faculty members, one from each of the colleges, who report to their respective deans in this capacity. Faculty are drawn from throughout the university and include both junior and senior professors who volunteer to teach in the program. These faculty also serve as individual advisors to the students in the program. Funding for the co-director positions is provided by the university. Funding for other expenses, including release time for faculty who teach the program-specific courses and for the salary and office expenses of a program administrator, are paid from corporate sponsorships and individual gifts.

Students enter the program at the junior level and pursue the prescribed course of study while satisfying all requirements for a bachelor's degree in their engineering or business major. Admission to the program is competitive and requires application by prospective students during the spring semester of their sophomore year. Admission is based on academic standing, extracurricular activity, and essays in which the students describe their background, experiences, motivation, and career objectives. Applicants who pass an initial screening of qualifications are interviewed individually by faculty of the program to assess interpersonal skills and to ensure that they understand the level of commitment required to complete the program.

The most recent entering class was comprised of 22 business and 22 engineering students chosen from 110 applicants. The average grade point average for this class was 3.8 on a 4.0 scale. This places them in the 95th percentile of all juniors in the two colleges. There was no significant difference between students from the two colleges with respect to grades or other qualifications.

In order for the program to accommodate highly qualified students and to maintain a low student/staff ratio, enrollments are intentionally limited. The goal is to admit equal numbers of students from the College of Commerce and Business Administration and the College of Engineering.

III. Curriculum

The curriculum is shown in Table 1. Business students in the program take three courses in the College of Engineering: Materials Science, Electrical and Computer Engineering, and Mechanics. Engineering students take three courses in the College of Commerce and Business Administration: Marketing, Finance, and Accounting. In these cross-disciplinary courses there are two primary objectives. The first is to give students a working knowledge of the underlying principles and a vocabulary of the subject so that they can have a meaningful technical discussion with a colleague from that discipline. The second is to expose students to the environments in which their cross-disciplinary classmates learn and solve problems. This need for "cultural" awareness and respect is sometimes overlooked but can profoundly affect the success or failure of interdisciplinary teams in industry.

Some of the courses in the curriculum are standard offerings taken by other students pursuing a major in one of the respective colleges. Among these are the finance course taken by engineering students and the materials science course taken by business students in the program. Other courses, like mechanics and electrical engineering taken by business students and marketing and accounting taken by engineering students in the program have been customized and are offered in sections restricted to students in the program.

The engineering courses have been structured to accommodate differences in core math and science requirements of the college of commerce and business administration. These and other cross disciplinary courses are designed to provide a student a comprehensive view of the subject in one semester. The explicit learning goals in each of the cross-disciplinary courses are to ensure that students have a basic understanding of underlying principles, a working knowledge of the vocabulary of the subject, and an awareness of the types of problems and approaches to solutions that students who major in that discipline employ. The implicit goal is to enable students to engage in meaningful, constructive discussions in the workplace with colleagues who majored in those subjects.

	<i>Engineering Students Only</i>	<i>Business Students Only</i>	<i>Engineering and Business Students</i>
<i>Fall 1st Semester</i>	Marketing	Materials Science	Managing Innovation
<i>Spring 1st Semester</i>	Accounting	Electrical Engineering	Product Development
<i>Fall 2nd Semester</i>	Finance	Mechanics	Process Modeling
<i>Spring 2nd Semester</i>			Integrated Project

Table 1. Technology and Management Curriculum.

Students also take four courses together: Strategic Management of Innovation and Technology, Business Process Modeling, New Product Development, and Integrated Project. These course combine students in the same year group from both colleges. In these courses, interdisciplinary teams are formed to solve problems drawn from real business experiences. The case study method is used extensively. Teams of two engineering and two business students are formed at the beginning of the courses and work together throughout the semester on case study analysis and other course-specific projects.

The Integrated Project is the capstone course in the Technology and Management Program. In this course, teams of three engineering and three business students work on technology-related business problems provided by industry sponsors. Guided by a faculty member and a designated project manager from the sponsor, they interact directly with the sponsor’s technical and business staffs. The problems posed to these teams are real, current, and messy. Each team presents its analysis and recommendations to the sponsor at the end of the semester. Students receive two grades at the conclusion of the project: one grade, which is the same for all members of the team,

is assigned by the instructors based on the quality of the project; the second is a grade which reflects the quality of the student's individual contribution and is assigned by the instructors using formal peer evaluation assessments as well as their own.

IV. Outcomes

In confidential interviews with an external evaluator, students in the program report satisfaction with their decision to enter the program and with the value of the experience. By virtue of the competitive admissions process and by their own self-selection in applying for admission, students in the program are academically capable and highly motivated. Many of them came to the University of Illinois on major scholarships and began to distinguish themselves even in their freshman year. Most students in the program arrived with advanced placement credit (typically 20 credits) which enabled them to accommodate the 22 credits which the Technology and Management Program adds. Even so, it is not unusual for a student in the program to attend one summer session and/or stay an extra semester to complete their undergraduate program.

Designation of the curriculum as a minor is currently pending approval by the university. The students perceive this to be an important step, both for the credential it provides to them, and for the status they believe it conveys to the program. In confidential interviews many students identify their participation in the program not only as an individual academic undertaking but also as a fraternal connection with their classmates. Their expectation in this regard emphasizes the importance of creating a sense of community and shared identity among those engaged in the program. We have found that activities that permit social interactions (informal gathering that permit personal contact with faculty and with each other outside of class for example) are often cited as "very important factors" when graduates are interviewed about their experiences.

In interviews with students immediately post-graduate and at one and two year anniversaries, the majority of program graduates rate their experience in the program favorably. However, because of restricted admissions during the pilot phase, the data set is small. Much of our longitudinal assessment at this point is subjective and based largely on anecdotal information. Most of the early graduates of the program are still in their first job. They typically report having a better understanding of their company and its technologies than they believe they would have had with their BS degree alone. Employers characterize graduates of the program as being generally more aware of their environment and more effective in personal interactions than their cohort in the company. It does not appear at this point that students in the program are receiving "better" jobs (their assessment) at higher salaries upon graduation as a direct consequence of their program experience. They do report that it provides a perceived advantage in securing interviews with prospective employers. Continued tracking of these students will be essential for determining the long-term value of this experience to the students and their employers.

V. Looking Forward

When the minor designation is approved, the program will move out of its pilot phase. Based on our assessments of outcomes for five classes of students to date and on feedback from students and their employers we believe that the curriculum design is basically sound. The faculty have identified a need for greater integration of specific learning objectives among the courses to provide reinforcement. We are seeking ways to make the integrative project experience more representative of the environment the students will see when they begin work. We must also continue to refine the tools we use for assessing applicants to minimize the incidence of attrition and maximize the value of the program to students who are the most likely to benefit from it.

As the program is currently designed, the substantial additional workload it presents to undergraduate students will limit the number who can be enrolled to approximately 60 per class. Thus the program will remain relatively small when compared to total enrollment in the two colleges. It may be viewed in this regard as a learning laboratory whereby the understandings of cross-disciplinary education and interdisciplinary teams developed through our experience with the students in this program, can be translated into pedagogical tools and programs for students in traditional engineering and business curricula.

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