

The Max for the Minimum: Offering an Industrial Engineering Specialty With Less Than One Faculty Member

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Abstract

The University of Tennessee at Martin (UT Martin) offers the Bachelor of Science in Engineering with specialties in civil, electrical, industrial, and mechanical engineering. The degree program was instituted in 1996 after a great deal of work by both the faculty and the Industrial Advisory Board (IAB) on behalf of the then School of Engineering Technology and Engineering. The original curriculum did not require a student to declare a specialty area. A nine-semester-hour set of upper division engineering electives and an additional six semester hours of technical electives were taken with the advice and consent of the School Degrees Committee. With the urging of the IAB and strong support of the faculty and administration of UT Martin, the specialty areas were added in 1999. Each area now consists of 24 hours of upper division coursework.

A majority (65-70%) of the students choose the civil or mechanical specialty area as entering freshmen. An overwhelming majority has gravitated to these two specialties by graduation (85-90%). This leaves limited resources for the hiring of faculty and teaching of required classes for those interested in the industrial specialty.

The UT Martin Department of Engineering has continued to offer the industrial specialty to serve the desires of enrolling students and needs of regional industry. A curriculum using courses offered by a combination of departments and a senior design/research course has produced graduates that have been enthusiastically accepted by regional employers.

The purpose of this paper is to explain how The University of Tennessee at Martin has developed and maintained a successful industrial engineering specialty with limited resources.

Introduction and History

The history of engineering and engineering technology on the University of Tennessee at Martin campus extends back to the 1930's when the school was a junior college. The University was known as The University of Tennessee Junior College, and the engineering program consisted of the first two years towards a baccalaureate degree in the student's chosen field of engineering. The University became a four-year college in 1951. Most degree programs were transformed

into full four-year baccalaureate programs at that time. The engineering program remained a two-year transfer program with most students transferring to the University of Tennessee at Knoxville. By the mid-fifties, the two-year engineering program at Martin had the largest enrollment of any department on campus. During this time period, an estimated one-third of the graduates from the engineering program at UT Knoxville had attended UT Martin.

In the fall of 1967, a formal proposal was developed by the UT Martin Department of Engineering and submitted to the College of Engineering at Knoxville for an engineering degree with majors from one of six areas: graphics, electrical power, electronics, industrial, mechanical, and surveying. In the fall of 1969, University of Tennessee system approval was granted for a four-year engineering technology degree. The six engineering majors were reduced to three technology majors: electrical, mechanical, and surveying. (The surveying major later became a major in civil engineering technology.) The Tennessee Higher Education Commission granted approval to offer the degree the following spring. The program received ABET/TAC accreditation in 1976 and maintained the accreditation until it was discontinued in 1997.¹

In the 1982 Southern Association of Colleges re-affirmation report, a suggestion was made that UT Martin conduct a study to determine the feasibility of upgrading the two-year, pre-engineering program to a full four-year baccalaureate program. From 1983 to 1985, numerous studies, surveys, and discussions with the University of Tennessee system officers resulted in a recommendation to establish a Bachelor of Science in Manufacturing Engineering degree. The degree was a hybrid cross between the traditional mechanical and industrial engineering degrees. The proposed degree program required courses such as fluid flow, thermal sciences, machine design, and material and processes from the mechanical area and engineering economy, manufacturing systems, and production engineering from the industrial area.² The recommendation failed to gain the necessary political support, and the University of Tennessee system decided to “shelve” the proposal. The proposal was withdrawn in 1988 with no further consideration.

An attempt to implement a co-operative degree with the University of Tennessee at Knoxville in industrial engineering was initiated in 1993. Courses in production management, quality, quantitative methods, and engineering economy were put into place on the UT Martin campus. The only course that was actually offered by the School of Engineering Technology and Engineering was engineering economy. The remaining courses were cross-listed management courses taught by an industrial engineer on staff with the School of Business Administration. The remaining courses were to be delivered via distance learning. The attempt was aborted after it was determined that UT Knoxville was unwilling to co-operate in the program. The cross-listed courses remained in the UT Martin catalog and served as a basis for the current industrial specialty area.

In early 1994, at the request of UT Martin constituents, a study team was appointed to assess the need by employers and the demand by students for engineering technology and engineering at UT Martin. A final recommendation was made in January 1995 to terminate the three engineering technology degree programs and to replace them with a single Bachelor of Science in Engineering degree. The program was to be built with no separable majors and was to be

consistent with goals set forth in the ASEE report, *Engineering Education for a Changing World*, (Fall 1994).³

The Bachelor of Science in Engineering (BSE) degree was approved by the University of Tennessee system in June 1995 and received final approval by the Tennessee Higher Education Commission in July 1996. Students had been allowed to take a limited number of junior courses as the final program approval was sought. This resulted in the first graduates from the program in May 1997. The program received ABET/EAC accreditation in 1999 and has maintained the accreditation to the present.

Curriculum

The total hours required for the BSE degree are 129. When the degree was implemented nine hours were termed “engineering electives” and six hours termed “technical electives”. Engineering electives were to be selected from upper-division engineering courses that together would form a cohesive set providing depth of knowledge and design content in a specialty area. The technical electives were to build on the engineering electives but were not limited to engineering courses. These fifteen hours had to be approved for each student by the School of Engineering Curriculum and Degrees Committee.⁴ This approval process was so burdensome on the Committee that sets of non-published electives were established for specialties in the civil, electrical, industrial, and mechanical areas in early 1998. Students were not required to select one of these areas but were strongly encouraged to make a selection.

In 1999, specialty area electives were approved and published in the University catalog. The total number of electives required was also increased to 21 hours at this time. At the urging of faculty, students, and employers, the designation on a student’s transcript of the specialty was also approved. The four areas were now established as the *de facto* majors within the degree. The number of specialty elective hours was increased in 2001 to 24 hours.

The industrial specialty has survived with the use of cross-listed courses. When determining the industrial specialty electives, the courses that were first cross-listed with management in 1993 became the basic building blocks. Additional courses in engineering management and human factors were developed by the Department of Engineering.

The current industrial specialty requirements are summarized in Table 1.

The UT Martin Division of Academic Affairs requires a course to have a minimum of five students enrolled in order for it to be included in the instructor’s workload analysis. By using the cross-listed courses and an alternating year rotation of the Engineering courses taken by the industrial specialty students, classes with at least five students are generated. Additionally, human resource management majors are required to take Engineering 381, Human Factors in Engineering. Frequency of offering the required courses that are unique to the industrial specialty and students enrolled in these courses are presented in Table 2. Without the qualified faculty and cooperation from the Department of Management, this arrangement would not work and the specialty would be discontinued.

Course	Title
Engineering 316	Engineering Analysis II
Engineering 381	Human Factors in Engineering
Engineering 413	Engineering Management
Engineering 462	Linear Control System Design
Engineering 475	Automated Production Systems
Industrial Engineering 310	Production Management
Industrial Engineering 330	Quality Design and Control
Industrial Engineering 412*	Applied Operations Management
Math 455*	Design of Experiments
<i>*Student chooses either IE 412 or Math 455</i>	

Table 1: Industrial Specialty Electives

Course	Title	Frequency of Offering	Enrollment*	IE Specialty Enrollment
Engineering 381	Human Factors in Engineering	Even Year Fall Semester	12	5
Engineering 413	Engineering Management	Odd Year Fall Semester	9	9
Industrial Engineering 310	Production Management	Every Semester	105	2
Industrial Engineering 330	Quality Design and Control	Every Semester	8	4
Industrial Engineering 412	Applied Operations Management	Spring Semester	5	0
Math 455	Design of Experiments	Even Year Spring	7	1
<i>*Most recent completed semester</i>				

Table 2: Course Frequency and Enrollments

In addition to the electives in a specialty area, each student is required to complete a senior research/design sequence of four semester hours. This sequence allows the student to work on an engineering problem (project) requiring integration of previous knowledge and possibly the acquisition of new knowledge relevant to the specialty area. Industrial specialty projects have dealt with human factors, quality issues, simulation, and currently, a group of students are working on a production line modification for a local industry.

All BSE students are required to take a three-semester-hour engineering economy course. This brings the total industrial engineering course hours (including the senior research/design) to 31 hours. The remaining 98 semester hours are comprised of 44 semester hours of engineering core courses and 54 semester hours of general education requirements.⁵

Faculty

The Department of Engineering currently has six full time faculty and two ½ time faculty. The specialty area breakdown for the faculty is presented in Table 3.

Specialty Area	FTE
Civil	1.5
Electrical	2.0
Industrial	1.0
Mechanical	3.5

Table 3: FTE by Specialty Area

The numbers do not take into account the core courses that must be taught by faculty. The industrial faculty member teaches .625 FTE in core courses and .375 FTE in the industrial specialty area. This also explains the apparent imbalance in the mechanical specialty area. This area has teaching responsibility in many of the core courses.

The Department of Management has a faculty member on staff with an industrial engineering Ph.D. and another faculty member with a Ph.D. in operations research. The operations research faculty member teaches Industrial Engineering 310 and 412. The industrial engineer in the Department of Management teaches Industrial Engineering 310 and alternates annually with the Department of Engineering industrial engineer teaching Industrial Engineering 330. Both management faculty members have extensive experience involving engineering applications. The IE is well known in West Tennessee and West Kentucky for his consulting work in the quality area.

Working with the engineering department faculty member, the management faculty insures that engineering students have an appreciation of the course from an engineer's viewpoint. This involves additional, more rigorous assignments for the industrial specialty student. The assignments usually are centered on the theoretical concepts involved with the course. The management student learns to 'plug' numbers into a computer program and review output. The industrial specialty student is required to learn what calculations the computer is performing.

During the 1998 ABET/EAC accreditation visit, the Department was cautioned to monitor the percentage of courses taught by engineers in the industrial specialty. Currently, an engineer always teaches six of the eight required courses. Three of the eight courses are shared specialty electives with other areas (mechanical or electrical). A mechanical or electrical engineer teaches these three courses.

Graduates

Since May 1997 ninety students have graduated from UT Martin with a BSE degree. Table 4 presents the numbers of graduates in each area. As can be seen from the raw numbers, a very high percentage of students graduate with the Civil or Mechanical specialty.

Graduates of the program who have chosen the industrial specialty have been well received by employers in the region. The majority of the graduates have taken jobs in the manufacturing sector. Employers include Parker Cooper Products, Trane, Lennox Hearth Products, Dana Corporation, and Aisin Manufacturing. Their titles include plant engineer, manufacturing engineer, development engineer, and engineering manager. One recent graduate is the start-up engineer for Aisin Manufacturing for a new faculty in Illinois.

Specialty	Graduates*
Civil	35
Electrical	14
Industrial	10
Mechanical	34
*Total is greater than 90 due to double majors.	

Table 4: BSE Graduates by Specialty

Future/Conclusion

The future looks bright for the specialty area. This fall five students in the sophomore class made the determination to change from the mechanical to the industrial specialty area. More and more students are expected to make the move as they come to understand the opportunities and challenges of being an industrial engineer.

Gaining approval to offer the Bachelor of Science in Engineering degree at UT Martin was not any easy task. It was the culmination of over 40 years of dreams and efforts. The regional employers have continued to appreciate the graduates of the program and expect prepared employees. The industrial specialty is no exception to this expectation. Because of dedicated faculty in both the Department of Engineering and the Department of Management, UT Martin can continue to serve the needs of the region.

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