AC 2009-265: MASTER OF ENGINEERING PROGRAM AS A MECHANISM TO PROVIDE RELEVANT GRADUATE EDUCATION TO WORKING PROFESSIONALS

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Master of Engineering Program as a Mechanism to Provide Relevant Graduate Education to Working Professionals

Abstract

The paper describes a new degree program, the Master of Engineering (MEng) Program, and compares this new program with the traditional MS program. The characteristics of the new program are presented and the advantages for working professionals are discussed. The outcomes achieved in the initial offering of the program are also described.

Need for the Program

The report Reshaping the Graduate Education of Scientists and Engineers states "A world of work that has become more interdisciplinary, collaborative, and global requires that we produce young people who are adaptable and flexible, as well as technically proficient"[1]. Today's engineers must be integrators of knowledge, able to innovate and collaborate in an interdisciplinary environment. Major change in the engineering education system is necessary if it is to meet the needs of the nation and the world in the coming century. Recent national reports on engineering education [1,2,3,4,5] stress the need for flexible graduate programs focusing on advanced practice and the world of work of the future. Bordogna[5] puts it this way "There is a growing consensus that professional engineers need an integrative masters degree and that our universities need to offer more practice oriented masters degree programs that have stronger connections to industry and to the social, economic and management sciences". From these sources and our own conversations with technical organizations, there is clear and compelling evidence for the need for a graduate program specifically targeted to the needs of working professionals.

Surveys conducted by both Northern Arizona University [6] and JACMET[7] indicate that there is a need and market demand for practice-oriented graduate education. The results indicate that course length should be shorter than the typical three-hour graduate course. In addition, place-bound graduate engineers would like to operate in a virtual university climate, that is, be able to access course material 24 hours per day, 365 days per year.

The National Science Foundation[8], in a report entitled Higher Education in Science and Engineering: Graduate S&E Students and Degrees in the United States - Overall Trends in Graduate Enrollment states that "Terminal master's degree programs might be viewed as the science equivalents of master's degree programs in business administration. Although these programs have existed for many years, industrial and academic interest is growing in programs that prepare students to enter emerging science and engineering (S&E) fields as skilled professionals."

In preparation for establishing the new program, the College of Engineering at the University of Cincinnati prepared an educational needs assessment to quantitatively measure the interest in the proposed master of engineering program. The assessment was made available to College alumni through a web-mediated survey.

The survey asked if the Master of Engineering Program would be a benefit to an engineer's profession. The overwhelming majority of respondents indicated that program could be of benefit, with 66% indicating that the program would have benefit to their profession. Figure 1 illustrates the responses to the survey.

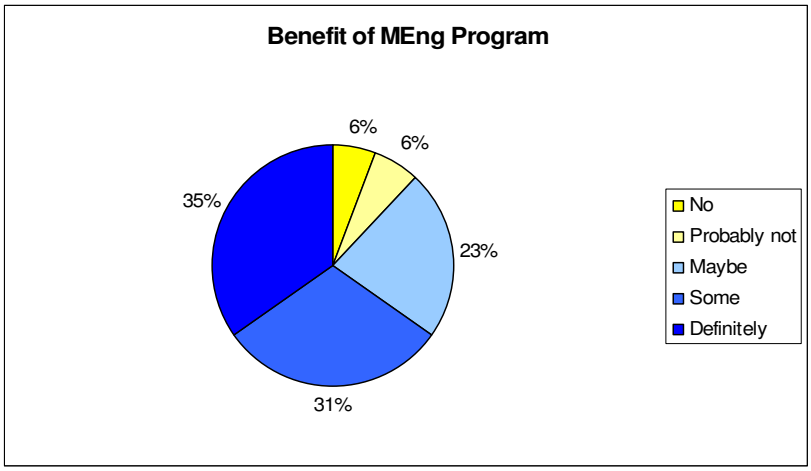

Figure 1. Percentage of Individuals Benefiting from MEng Program

The survey asked for the educational objectives of individuals interested in the program. Participants were allowed to select more than one category so the percentages add to greater than 100%. Table 1 indicates that respondents felt the Master of Engineering program would serve several of these educational objectives.

Table 1. Educational Objective of Working Engineers

Educational Objective	Interest
Individual course	29%
Advanced degree	46%
Professional Development	38%
Maintain licensure / certifications	44%

These survey results are consistent with an earlier educational needs assessment conducted in 1999[9]. In that survey, 70% indicated such continuing education programs would be of benefit to their profession. However, one of the concerns found from the survey responders was the tuition cost required if the costs were not to be covered by the employer.

A number of engineering schools have established Master of Engineering degree programs and several of these include online degree programs. A synopsis of these institutions is given in Table 2. In Ohio, only Case Western has a somewhat similar degree, the Master of Engineering and Management. This program has a different emphasis in that it combines engineering and business topics into an integrated program offered on campus. There are no programs similar to the proposed MEng program in Southwest Ohio.

Table 2. Institutions Offering Master of Engineering Degree

Institution	Degree	Characteristics
Case Western Reserve	Master of Engineering and Management	Specific curriculum (one program) offered on-campus
University of Illinois at Chicago	Master of Engineering	Engineering program with a high degree of course flexibility; offered on-line
University of Colorado	Master of Engineering	Centered around computer science with cross-discipline coursework; on campus or on-line
Penn State University	Master of Engineering	Several program specific degrees; most on campus, at least one on-line
Michigan Tech University	Master of Engineering	Coursework and project at participating company; on campus
University of Nebraska - Lincoln	Master of Engineering	Flexible curriculum within 5 areas of emphasis; some on campus, some on-line
North Carolina State University	Master of Engineering	On-line
Arizona Partnership	Master of Engineering	Collaborative effort among ASU, UA and NAU

Characteristics

The Master of Engineering program provides a graduate degree that focuses on the practice of engineering in order to better serve working professionals. Rather than culminate in a research experience and a thesis, the Master of Engineering curriculum provides skills and expertise that enhance the individual's ability to contribute to the technical workforce. The difference between the traditional Master of Science degree and the Master of Engineering degree is not on the rigor of the coursework or a lack of competencies, but rather on the focus of the curriculum.

The program provides advanced training to students interested in expanding their knowledge and expertise. Depending on a student's interest, the degree could add significant depth to an individual's understanding of the practice of engineering or the program could be constructed to focus on greater inter-disciplinary breadth if that is the educational objective of the student.

In today's competitive technology environment, industries need to have highly skilled practicing engineers who are flexible in their professional capabilities. The MEng program is a practice oriented, focused degree and caters to this need. Graduates will contribute significantly to the technical competitiveness of business and industry.

The degree is based on the successful completion of a minimum of 45 credits of graduate-level course work and does not require a thesis. The Master of Engineering has a common core curriculum that all students are required to take regardless of their discipline specific goals and a number of discipline required courses. There is also ample opportunity to choose electives that meet the students learning and degree objectives. The degree is practitioner focused so the common core provides coursework and skills that benefit practicing engineers regardless of discipline or industry.

Table 3 contrasts the Master of Engineering program characteristics with those of the Master of Science program.

Table 3. Characteristics of MEng and MS Programs

	Master of Engineering	Master of Science
Student Base	Working professionals with several years of experience	"Traditional" graduate students – most just having finished a BS degree, many international students
Entrance Requirements	BS in an engineering discipline, GPA over 3.0, letters of recommendation, Statement of intent	GPA over 3.0; GRE
Degree Emphasis	Applications of technology; integration of technical and business skills	Research; generation of new knowledge
Degree Requirement	Completion of 45 credit hours	Credit hour requirement; Research (thesis)
Course Delivery	Traditional or Internet based delivery	Traditional classroom and laboratories
Tuition	Common tuition rate applied; employer tuition remission	In / Out of state tuition; UGS (full and/or partial) awards for most

Curriculum

The curriculum is structured to provide a foundation of advanced engineering topics while allowing students flexibility to meet their specific educational objectives. The curriculum includes:

- Program core courses taken by all Master of Engineering students
- Track required courses from the discipline of interest
- Elective courses that provide depth or interdisciplinary focus depending on student educational objectives
- Capstone project demonstrates applications of skills and synthesis of knowledge

Core Curriculum

The core curriculum is required of all MEng students, regardless of which track they pursue. The core provides skills in the effective practice of engineering recognizing that for experienced practitioners, effectiveness includes technical skills, project and task management skills, and interpersonal skills. Students are required to take 2 courses from the Project / Task Management set, 1 course from the Interpersonal set, and 2 from the Advanced Technical set. A portion of the courses available in each area is shown below.

Project / Task Management Development

- Engineering Economic Analysis
- Quality Engineering and Management
- Project Management

Interpersonal Skill Development

- Management of Professionals
- Leadership
- Effectiveness in Technical Organizations

Advanced Technical Skill Development

- Computational Methods*
- Optimization in Engineering Design, or
- Optimization Modeling for Managers

** This course can be satisfied with a discipline-specific computational methods course.*

Students who have strong interest in engineering management topics are advised to take all three courses in the Interpersonal set (additional courses counted as program electives.) This requires advisor approval.

Track Required Courses

The College of Engineering offers graduate degree programs in nine distinct disciplines. Students enrolled in the MEng degree program can pick their area of emphasis from any of these disciplines based on their interests and career needs. Each discipline has established the number of track courses / credit hours required for the MEng degree with an emphasis in that discipline.

Elective Courses

Students select elective courses to satisfy their educational objectives. Frequently, the elective courses will be selected from the discipline focus area of the student in order to provide depth in a particular topic. However, students may also select courses from other engineering disciplines, from other appropriate science and math courses, or from appropriate business courses. Participation in the elective course requires permission of the student's academic advisor and the instructor for the course.

Capstone Project

A capstone project is required that will normally be 3 credit hours. Projects that include significant data collection, extended collaborations, travel, and / or extensive analysis can be 6 credit hours. The capstone projects provide a mechanism to demonstrate a synthesis of knowledge and application of concepts to a specific problem. Faculty and in many cases professionals in the workforce will oversee and guide the capstone experience. The capstone project typically includes a written report and a presentation.

The capstone project is expected to be a practice-oriented application of knowledge and skills. Many students in the program from industry can apply what they have learned through the program to a specific problem faced in their business. A capstone project could include a report

to their organizations suggesting a solution to that problem. Students who are not in the workforce are expected to apply knowledge gained through the program to a known problem or a new opportunity in the context of the practice of engineering. These students work with a faculty member to identify an appropriate topic and application.

First Year Results

In the initial year of the program, twenty-six students have enrolled; twenty-one full-time and five part-time students. The students are pursuing a variety of disciplines and have a variety of career objectives from improving job skills to changing industries to starting a new company. The program attracted a larger number of international students than was expected. In a number of cases these were students who applied to traditional MS programs but were not admitted to their program of choice. The MEng program provided an alternative means for them to pursue an advanced degree.

There are three courses that have been developed in a distance learning format to support the program. While we knew these would be a benefit to the part-time students from industry, we did not expect the significant participation by the full-time students. These students report that the ability to take the online course provides them beneficial flexibility in their schedule. Since the on-line course has no required meeting times, even the full-time students indicate that these courses help them accommodate their other course work and other commitments.

There have been mixed reactions from faculty regarding the program. Since the MEng students do not complete a thesis the amount of time graduate faculty need to spend advising and working with the students is significantly less than for the traditional MS programs. However, the flexibility in the degree results in many students seeking guidance on coursework and areas of emphasis. Since the program is based on coursework only there was a sense among some faculty that little to no time would be required working with these students. For those faculty and departments who were expecting "minimal involvement" the amount of time spent by faculty is greater than expected due to advising regarding courses and the capstone project. For other faculty and departments who expected to work with the students, the workload has been as expected and manageable.

Students in the Master of engineering program are not eligible for tuition scholarships, and since they are not in a research program, they are not sponsored on grants and contracts. Some have tuition remission offered through their company but many are paying full tuition for the program. The University has realized a healthy increase in tuition collected as a result of this program. In a time of declining budgets, this is a significant outcome.

Based on the success to date the College is seeking to increase enrollment in the program both among the original target audience – working technical professionals – and those pursuing the degree full-time after completing an undergraduate degree. The College needs to continue to increase the opportunities for academic advising for the students and increase the awareness among faculty of the needs of this student population. In order to facilitate increased enrollment of working professionals the College must increase the number of courses available through distance learning as well as courses offered at times and locations convenient to the workforce.

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