Innovative Master's Degree in a Professional Program

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Abstract

The American Society of Civil Engineers has directed the Society's Educational Activities Committee to develop a policy for the first professional degree in civil engineering. Two degrees, the Master of Engineering (ME) and the Master of Engineering Management (MEM), are recommended as programs which may satisfy the criteria for the first professional degree. The ME can, in general, be considered a technically oriented program without a research component. The MEM has a large management/business emphasis for students interested in this area. A six-year Doctor of Engineering (Engr. D.) program is also introduced as an alternative which may eventually be adopted in order to obtain full professional recognition.

I. Introduction

Recently, the Board of Direction of the American Society of Civil Engineers (ASCE) approved a resolution "endorsing the master's degree for the practice of engineering." The board also directed the Educational Activities Committee to develop a society policy for the first professional degree in civil engineering [2]. These actions may partially be in response to legislation in various states limiting the number of hours that a state university may require to obtain a bachelor's degree. In addition, numerous practitioners and educators perceive that students need additional courses in the communications and financial areas in order to practice engineering at a professional level when they graduate.

In particular, the ASCE Board believes today that engineers must have skills in information and computer technologies, foreign languages, and an understanding of the economic and social implications of civil engineering projects. Along with the aforementioned breadth, increased specialty area knowledge is also required [1]. This level of knowledge is difficult to develop in the current four-year B.S. program format. In fact, the U.S. Department of Education indicates that the first professional degree signifies a level of academic and professional skills beyond that normally required in a bachelor's degree program. The ASCE Board believes that the proposed increased educational requirements may improve the professional stature of civil engineers in addition to enhancing the compensation levels of the profession [1].

In order to study alternatives to the ASCE recommendations, this paper investigates the requirements associated with two graduate degrees, Master of Engineering (ME/M.Eng./MEng) and especially the Master of Engineering Management (MEM), that may serve as the first professional degree in an engineering program. The specific credit hours and typical courses required to obtain a particular degree are indicated. In addition, the concept of a Doctor of Engineering degree (Engr. D.) is also introduced. It is hoped that the information presented will assist the Educational Activities Committee and civil engineering departments in their investigation of alternatives to satisfy the ASCE first professional degree recommendations.

II. Master of Engineering (ME) Degree

Most professions (business, law, medicine, etc.) do not consider a bachelor's degree to be a professional degree. Considerable additional course work is required for professional practice [7]. Engineering, however, as mentioned in the previous section, does not follow U.S. Department of Education guidelines and still treats the B.S. as a professional degree. Nevertheless, a number of universities have begun offering a Master of Engineering Degree Program for graduate students. Programs such as those at Cornell University are generally designed to prepare students for professional practice rather than careers in research[4]. For example, the professionally-oriented Master of Engineering (M.Eng.) Degree at Cornell has been offered for many years. This program features a strong emphasis on professional practice and design. Real-life projects are brought to the campus by prominent practicing engineers who return to campus several times during the year to interact with the students and participate in the design project. The degree is usually obtained in nine months, which includes an intensive three-week design session held during the January intersession.

The M.Eng. Degree at Cornell University has a distinctly different emphasis from the traditional M.S. Degree and is considered ideal for anyone interested in engineering practice and/or management. Thirty credit hours of coursework are required (including six hours for the design project). Areas of concentration include:

- Engineering Management,
- Environmental Engineering,
- Fluid Mechanics and Hydrology,
- Geotechnical Engineering,
- Structural Engineering,
- Transportation Systems Engineering, and
- Water Resource Systems Engineering.

The program has become popular with both Cornell students and graduates of other universities.

For some institutions, such as the Massachusetts Institute of Technology (MIT), the Master of Engineering (MEng) Degree may be perceived as a radical 180° departure from the standard Master of Science (SM) Degree [3]. At MIT, the MEng program is a highly focused one-year curriculum that concentrates on classes and teamwork. In fact, MEng students are required to take one-third more courses than students in the standard SM curriculum. Non-technical topics such as communication skills building, negotiation, business practices, and strategic management are considered vital to the program. A major group project involving practical engineering work is also required. At present, possible tracks include the following areas:

- Environmental Science,
- Information Technology,
- Environmental Geotechnology, and
- High Performance Structures.

Roughly one-quarter to one-third of the students enrolled in the program have an undergraduate degree from MIT, while the remainder have degrees from other universities.

The time required to obtain a Master of Engineering (ME) Degree from various universities appears to vary between two and three semesters. Some programs require an engineering report or thesis. Master of Engineering programs tend to be flexible and are designed to encompass students with varying backgrounds. For example, the ME curriculum at Lamar University uses an interdisciplinary approach[5]. Students are required to satisfactorily complete a minimum of three core courses, nine semester hours, selected from a list of 5 categories as shown below:

- Computer Control and Instrumentation or
  Computer Methods in Statistical Quality Control
- Engineering Application of AI/Expert Systems or
  Computer Aided Software Engineering
- Computer Methods of Engineering Project Management
- Computer Methods of Engineering Optimization
- Hazardous Waste Management

Civil Engineering students generally chose to take Computer Aided Software Engineering, Computer Methods of Engineering Project Management, Computer Methods of Engineering Optimization and/or Hazardous Waste Management. A minimum of 27 semester hours of electives are also required. These may be chosen from the list of core courses or other graduate civil engineering courses designed to enhance the professional interest of the individual student. Those students who have passed the Fundamentals of Engineering Examination or are a Professional Engineer may satisfy course requirements by completing 24 semester hours of electives toward a total of 33 semester hours provided a Design Project Course is included in their program.

The ME program at Lamar University (as in most universities) is not accredited by The Accreditation Board for Engineering and Technology (ABET). Nonetheless, it has been well received by engineering graduate students, especially those who are working during the day and are enrolled on a part-time basis. Flexibility appears to be one of its greatest attributes. Overall, statistics indicate that approximately 52% of the master's students in engineering receive ME Degrees at commencement.

III. Engineering Management Degree

A number of universities now offer Engineering Management Degrees. A typical Engineering Management program was developed in 1988 at Cornell University [4]. This program enjoys an increasing reputation worldwide as an excellent professional degree course of study. The coursework adds quantitative managerial skills to the background of graduate students from all fields of engineering and enables them to move quickly into management positions in technical fields. For students with adequate preparation, the Engineering Management program at Cornell can be completed in only two semesters. The program consists of a combination of coursework and team projects, with added emphasis on computer and communication skills. Areas of concentration include:

- Decision Support and Systems Development
- Energy Systems management
- Environmental Systems Management
- Manufacturing Management

- Property Development and Construction
- Transportation Management
- Urban Infrastructure management, or
- Study in any engineering discipline.

Specific courses involve finance, management science, organizational behavior, project management and accounting.

At Lamar University, the Master of Engineering Management (MEM) is a non-thesis degree program for students who wish to combine the concept of management with engineering. Course work is designed to build onto the education received while completing an accredited bachelor's degree in engineering and the individual's professional experience. Hence, practicing engineers generally do not require undergraduate prerequisites [5]. This program may be considered as preparation for a first professional degree in engineering.

A total of 36 credit hours are required at the graduate level. Included among these 36 credit hours are 12 hours of core courses required of all MEM students. These are shown below:

- Engineering Management
- Statistical Decision-Making for Engineers or Operations Research
- Engineering Organization and Management or Quality Control Systems
- Advanced Engineering Economics

Four courses are recommended to be taken in the graduate program offered by the College of Business. They include the following areas:

- Financial Accounting
- Managerial Accounting or Marketing
- Business Law or Collective Bargaining
- Foundations of Economics

In addition to the above, one-third of the program (12 semester hours) should be taken in the student's technical discipline such as structural engineering, environmental engineering, or a combination of civil engineering courses. Course work, in addition to the required core courses, is tailored specifically to the needs of the student. However, as a guide, approximately one-third of the courses are in the general area of technical management, one-third in business administration, and one-third in the student's technical discipline. The MEM program has been well received, although it is not as popular as the ME Degree. This may be due to the fact that it is not as flexible as the ME program. Nevertheless, MEM students comprise approximately 7% of the engineering graduating class at the master's level.

IV. Doctor of Engineering (DE) Program

In addition to medicine, law, and business, two other areas have recently increased the educational requirements for professional practice. For example, in many states, a Certified

Public Accountant (CPA) must have completed 30 semester credit hours in addition to the Bachelor's Degree in order to become licensed. Architecture generally considers the Master's as the first professional degree.

Pharmacy is in the process of requiring a six-year Doctor of Pharmacy (Pharm. D.) degree for professional practice. At Purdue University, effective Fall '98, pharmacy students can enroll only in the doctor of pharmacy program [6]. Not long ago a B. S. degree was considered adequate. The Pharm. D. is not considered a research degree. In the future, the engineering profession may follow pharmacy and require a six-year Doctor of Engineering (Engr. D.) for professional practice. This is not a great change since many B.S.C.E. students presently take roughly five years to complete their degree requirements. The additional credits could include courses in communications, management, and business which appear to be presently lacking. An internship could also be required. The Engr. D. should certainly be given sincere consideration.

V. Summary and Conclusion

The Board of Directors of ASCE has endorsed the master's degree for the practice of engineering. This paper reviews the requirements associated with two degrees, ME/M.Eng./MEng, and MEM, which may be utilized as the first professional degree in Civil Engineering. The ME program tends to be basically technical in nature and may require an engineering report or thesis. The MEM has a large management/business component and is designed for those who are interested in the non-technical aspects of engineering. Both the ME and MEM are not ABET accredited and do not generally include a research component. A six-year Doctor of Engineering program is also introduced leading to the Engr. D. Degree. The adoption of the Engr. D. as the first professional degree, though radical in nature, may be necessary for engineering to be recognized by the public as a true profession.

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Biography

Enno “Ed” Koehn is Professor and Chair of the Department of Civil Engineering at Lamar University, Beaumont, TX. Professor Koehn has served as the principal investigator for several research and development projects dealing with various aspects of construction and has experience in the design, scheduling, and estimating of facilities. In addition, he has authored/co-authored over 100 papers in engineering education and the general areas of civil and construction engineering. Dr. Koehn is a member of ASEE, AACE International, ASCE, NSPE, Chi Epsilon, Tau Beta Pi, and Sigma Xi and is a registered Professional Engineer and Surveyor.