Engineering Technology Masters Program: Thesis Required!

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Abstract

Not a single Engineering Technology doctoral degree-granting program could be located in the United States by the authors. Therefore, it could be argued, and has been, that the master's degree is the terminal degree for Engineering Technology. In many programs located at doctoral granting institutions, a doctoral degree is either implicitly or practically required for tenure and promotion. Two recent national studies, conducted by the authors, indicate a near drastic shortage of Engineering Technology faculty for four-year colleges and universities. As a result, some institutions are "solving" this problem by requiring only a masters degree - knowing that most individuals who posses only a masters degree have not completed a thesis - and, in many situations, are expecting these people to compete in a university's research-dominated environment. For those graduates that enter or remain in industry, degree requirements that are based solely on completion of courses without the requirement for the student to conduct and report on a meaningful applications-oriented project may result in graduates that are not representative of the mission of engineering technology. A possible solution is to require a thesis that emphasizes application research in every masters degree program in Engineering Technology. Beginning in 1994, the Engineering Technology Department faculty at the University of North Texas approved a thesis-only masters program.

I. Industrial Influence

The knowledge and skills required for functioning in industrial organizations are changing. In order to remain on the cutting edge of the profession, graduate curricula must be constantly reviewed. Today's business administration programs do not focus on the development of technical competencies, and engineering programs place little emphasis on management skills[1]. However, to make informed and intelligent decisions, managers must understand technology and be able to analyze available technological information[2]. One of the definitive characteristics of engineering technologists is the ability to plan, implement, interpret, and report on technical projects involving the application of existing or developing technology for solving industrial problems.

II. The University Environment

According to Curtis and Latif[3], degree programs are identified in a university's mission statement according to the following criteria: program priorities, instruction enhancement, collaborative ventures, efficiency and effectiveness, and service and research functions. While a university's primary focus may be on teaching and learning, the university is committed to offering training, applied research and other services that support local business and industry.

According to Gerhardt[4], university research is both a process and a product that serves to create an environment that enhances classroom teaching in terms of relevance so students can gain important insight into research as applied to real life problems. Some universities are starting to establish Internet connections to instruments in laboratories so that students can access real research data that relates to their courses[5].

As the need for graduate education increases, the need for qualified faculty also increases. A good teacher is often the most active researcher and an increasing number of educators are integrating research into teaching. Research is traditionally conducted by graduate faculty who bring research grants to the university and use graduate students to assist in conducting the research[4]. Advances in electronic communications have improved the opportunity and quality of conducting research. Research projects provide opportunities for graduate students to work with faculty members in their respective fields of specialization[6].

Faculty members in engineering and the sciences often concentrate their energy on research. More professors are merging teaching and research activities, creating a synergy that benefits both them and their students. Incorporating research into their curricula and collaborating with students on research projects, yields more and better research. By conducting applied research and developing intellectual competencies, graduates will contribute to the development of the engineering technology discipline[5].

In a recent survey of advertised faculty positions in Engineering Technology, Kozak[7] found that 48 percent either require or prefer a Ph.D. Without Ph.D. programs in Engineering Technology to serve as faculty sources, most programs rely on graduates from Engineering, Computer Science, or related science programs to meet their needs. However, new Ph.D. graduates in Engineering are decreasing. Is it any wonder that only 37 percent of those advertised positions were filled[7]. An objective may be to overcome the resistance of traditional university faculty who do not accept the master's degree in engineering technology as a terminal degree. However, with this objective comes the responsibility of graduate engineering technology programs to produce research-competent graduates[8].

The increase in the number of graduate engineering technology programs in the United States is placing pressure on faculty to engage in applied research in order to be a responsive instructor[4]. These applied research projects focus on the solution of problems in the workplace[6].

III. Engineering Technology

The modern master's degree, based on completion of a prescribed course of study, was first offered at Harvard in 1869. There are approximately 270 types of MS degrees. The first university to confer a Master's degree in engineering technology was the University of Houston at Clear Lake in 1966[9].

During the 1950s, accreditation requirements of the Engineering Council for Professional Development phased out skills and management courses from engineering curricula to make room for mathematics and science courses[1]. As engineering technology has matured as a separate discipline, the need for master's degree programs has increased.

The Master of Science in Engineering Technology program at the University of Memphis was changed in the 1980s from a Master of Science in Technical Education. The Tennessee Higher Education Commission requires that either a project or thesis be part of the Masters program. Students who successfully defend a thesis are still given an oral exam[10].

In 1995, twelve institutions offered a graduate degree in Engineering Technology. This number increased to fourteen by 1997. Current economic and societal factors should favor the development of additional master programs in Engineering Technology[11]. However, according to Brauchle[12], if a graduate student takes only more technical courses, then what value is added?

Accrediting agencies are putting pressure on Engineering Technology programs to make teaching more industry-oriented. One way in which this can be accomplished is through collaborative research and development between faculty and industry to improve products[4].

Collaborative applied research work by the faculty at the State University of New York Institute of Technology, in cooperation with local businesses, helped to increase the students' technical knowledge relating to the quality and productivity of operations and helped the faculty develop professionally, enrich their curricula and enhance the image of the institution[4].
According to Depew and Herrick[6], as the number of students completing an undergraduate degree in technology related programs continues to increase, the demand for graduate education opportunities for this growing population will continue to increase.

Effective graduates of Engineering Technology undergraduate programs must be life-long learners if they are to be effective employees and advance into executive positions[11]. Results of a survey conducted by Zargari[1] in which respondents were asked to prioritize statements of content for a technology masters program, "Development of research skills" was one of only six statements listed as "very important content." The research component, recommended for 12 semester hours, could include courses in statistics and research methods in addition to a thesis. Thesis topics should focus on applied industry-related technical research[1].
Many students conduct applied industrial research in their field of interest through industry sponsorship[3].

Contrary to predictions by some faculty, master's degree credit hours at the University of North Texas has steadily increased since the thesis became a requirement with the largest increase being 50 percent in 1995. This has occurred in an environment of gradually declining graduate student enrollment[11]. Student feedback indicates overall satisfaction with the experience and supports its continuation.

IV. UNT Model

The Department of Engineering Technology at the University of North Texas initiated the thesis requirement for a master's degree in 1993. The experiences and accomplishments earned by faculty involved in the graduate program will assist in the long term goal to establish a doctoral degree program. However, since the faculty desired to keep the requirements consistent with the character of engineering technology, students are encouraged to pursue industrially sponsored projects implementing new or existing technology. The thesis element of the degree program

requires students to enroll in a thesis course for a minimum of six credit hours. The industrially sponsored research project must include data and analysis from actual or simulated systems. A graduate committee oversees the thesis with one appointment to be from the sponsoring or related industry. All other requirements follow the same procedures and must meet the same requirements as theses submitted to the Graduate College from other departments.

Table 1 summarizes both completed and in progress thesis. All those involved in these projects are supportive of the concept and satisfied with the results. The experience has been especially beneficial to students with little actual experience at a management level in industry. As a result of the accomplishments thus far, the concept of offering a doctoral degree in the future is a real possibility at the University of North Texas.

V. What Should be Done

As Engineering Technology programs continue to evolve, it is imperative that graduate education be considered as an important element. The need for appropriate graduate education will become a priority in remaining competitive in the international market place[6]. Institutions of higher education should facilitate the transfer of new technologies from laboratory to the workplace not only by developing a strong base of technological knowledge and skills but also through directing research[13]. A masters degree program must be designed to prepare individuals with advanced technical, management, and research skills, enabling graduates to meet the needs of technology-intensive industrial corporations[1].

Engineering Technology must provide graduate education for future professors at two- and four-year colleges and universities. Many existing faculty require an appropriate advanced degree to meet regional and professional accreditation requirements. Additionally, a thesis required master's degree will provide experience in the experimental method for those graduates that pursue doctoral degrees in related fields. This direction will become critical in delivering high-quality education for future generations of engineering technologists. Should Engineering Technology programs consider thesis-only master degree graduate programs to serve this growing need[6]?

Bibliography

1. Zargari, A. (1997, Spring). Identification of Curriculum Content for the Master of IT: A National Survey. Journal of Industrial Technology, 13(2), 42-45.
2. Drucker, P. F. (1992). *Managing for the Future*. New York: Truman Talley Books.
3. Curtis, K. & Latif, N. (1999, Spring). Design, Development, and Implementation of a Graduate Program in Technology. *Journal of Engineering Technology*, 16(1), 18-22.
4. Qazi, S. & Ishaq, N. (1998). Impact of Applied Research in Engineering Technology. *ASEE Annual Conference Proceedings*. Washington, DC: American Society for Engineering Education.
5. Coppula, D. (1997, December). Integrating Teaching and Research. ASEE Prism, 7(4), 18-22
6. Depew, D. R. & Herrick, R. J. (1997). The Future of Graduate Education in The School of Technology. *ASEE Annual Conference Proceedings*. Washington, DC: American Society for Engineering Education.
7. Kozak, M. R. (1999). Engineering Technology Faculty Recruitment: Do we get What we Want? *ASEE Annual Conference Proceedings*. Washington, DC: American Society for Engineering Education.
8. Kozak, M. R., Plummer, M. C., Watt, G. W. & Paudar, S. (1995). MSET! ETD? *ASEE Annual Conference Proceedings*. Washington, DC: American Society for Engineering Education.

9. Deighton, L. C. (1971). *The Encyclopedia of Education* (Vol. 3). New York: Macmillan.
10. Smith, D. L., Douglas, R. & Day, R. (1999). A Computer Engineering Technology Concentration for a Master of Science in Engineering Technology. *ASEE Annual Conference Proceedings*. Washington, DC: American Society for Engineering Education.
11. Kozak, M. R. (1998). Partner With Industry to Increase Enrollment and Update Curriculum. *ASEE Annual Conference Proceedings*. Washington, DC: American Society for Engineering Education.
12. Brauchle, P. E. (1998, Winter/Spring). Program Review Produces Dynamic Results: A Case Study of the Evolution of a Master's Program. *The Journal of Technology Studies*, 24(1), 2-5.
13. Beach, D. (1991, Summer/Fall). Development of a curriculum model for a Doctor of Philosophy Degree in Technology. *Journal of Epsilon Pi Tau*, 17(2), 39-42.

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Table 1: List of Theses
Engineering Technology Department
University of North Texas

Theses Completed Prior to 1999

1. A Computer-based Control System for a Target Station in a LINAC Facility
2. A Data Acquisition System Experiment for Temperature and Pressure Measurements on a Liquid-Nitrogen Powered Vehicle
3. Design of a Monitoring System for a Plasma Cleaning Machine
4. Development of a Simplified Fracture Toughness Tool for Polymers
5. Feasibility of Using X-ray Diffraction Linewidth for Non-destructive Evaluation: A Study of Brass
6. Fracture Toughness Testing of Plastics Under Various Environmental Conditions.

Theses That Should be Completed during 1999

1. Comparison Study of a Photovoltaic Panel With By-pass Diodes
2. Linearity and Monotonicity of a 10-bit, 125 MHz, Segmented Current Steering Digital to Analog Converter
3. Using a Quality Control Perspective for Prototyping the Doppler Ultrasonic Directed Nerve Stimulator

Theses in Progress

1. Development of Spectrum Band Alarms to Reduce Vibration Analysis
2. Evaluation of Sound in an Acoustic Tank for Reverberation
3. Metallic Coating of Elastomeric O-Rings to Reduce Damage
4. A Plan for Implementing a DSP Course at UNT: A Trade Study
5. System Design for a Generalized Traffic Data Acquisition System
6. Upgrade of Computerized Model for the Analysis of Containment Performance Following Severe Reactor Accidents at Comanche Peak Steam Electric Station
7. Use of the Magion Process of Ion Deposition to Reduce Internal Friction in Valves

Proposed Theses

1. Analysis of Instrument Deviation Due to Calibration Period
2. Automobile Accident Data Acquisition
3. Fastener Reduction and Standardization in the Assembly of Class 8 Trucks
4. Implementation of a Flexible Manufacturing System to an Assembly Process
5. Laser Cutting Machine: Justification of Initial Costs
6. Study of Oxidation Rates as Influenced by an Absolute Pressure Controller During Atmospheric Changes