RE-ENGINEERING OF THE ENGINEERING MANAGEMENT'S OUTREACH GRADUATE PROGRAMS AT UMR

Bahador Ghahramani, Ph.D., P.E., CPE

206 Engineering Management
School of Engineering
University of Missouri-Rolla
Rolla, Missouri 65409-0370 (USA)
E-mail:ghahrama@shuttle.cc.umr.edu

INTRODUCTION

Rapid change is a feature of today's competitive environment in the technology driven Engineering Management (EMGT) academic programs. The EMGT outreach graduate programs have effectively responded to these technology driven changes by continuously re-engineering their initiatives. Success of these outreach programs are due to their evolutionary nature and their ability to adapt to industry needs. Therefore, it is accurate to state, the outreach programs have evolved by growing with industry, technology, and student demands. Fortunately, budgetary reductions and restricted fiscal constraints have not affected the quality of these programs and curricula. The University of Missouri in Rolla (UMR) outreach programs have been outstanding fiscally as well as academically. For years, they have been expanding and delivering high quality EMGT education at a low cost while satisfying demographic limitations. This paper will analyze and discuss each one of these programs and curricula. The outreach graduate programs that will be addressed consist of the following academic curricula: National Technological University (NTU), US Army Engineering School (USAES) at Ft. Leonard Wood, McDonnell Douglas Corporation, University of Missouri in St. Louis Engineering Education Center (EEC), and 3M Corporation.

UMR is internationally known for its quality programs. In 1996, UMR was awarded the Missouri Quality award; the only academic institution of higher learning with such an honor. UMR's engineering programs are accredited by the Accreditation Board for Engineering and Technology (ABET).

BACKGROUND

The EMGT graduate program began in 1965 with a master's degree (MS). The Engineering Management Department is part of School of Engineering at UMR. UMR is one of the four campuses of the University of Missouri (UM) system. The other campuses are located in Columbia (UMC), Kansas City (UMKC), and Saint Louis (UMSL). UMR is located about 100 miles southwest of St. Louis in the Ozark region of south central Missouri. UMR is affectionately known as the UM engineering school. UMR has an enrollment of about 5,000 students. EMGT outreach initiatives are part of the UMR graduate programs. UMR's graduate programs are governed by School of Engineering, School of Mines and Metallurgy, and College of Arts and Sciences.

EMGT outreach programs have a tradition of excellence and scientific achievements that began in 1967. From the outset, the primary goal of the graduate programs were to educate and prepare qualified engineering students for the highly competitive job market. The program was primarily designed to help students gain knowledge about the functional areas of technological enterprises. The graduate programs were evolved to train candidates for decision making positions in engineering, production, marketing, design, and research and development.

The EMGT outreach programs have reached cities and locations far beyond the Rolla demographic limits. Currently, these outreach graduate programs are successfully educating young scholars in a variety of disciplines. Besides NTU, EMGT faculty are conducting class at various Missouri locations, supporting a variety of other outreach programs. These locations include: St. Louis, Jefferson City, Columbia, Springfield, Ft. Leonard Wood, and McDonnell Douglas in St. Louis. To-date, these outreach programs have awarded more than 1,000 graduate degrees in EMGT.

ELIGIBILITY

To be accepted into the EMGT graduate outreach programs, candidates must satisfy UMR requirements. Admission to the graduate outreach program in EMGT requires a bachelor of science degree (BS) in one of the following fields: engineering, certain physical sciences, mathematics, or computer sciences. Candidates must have a 3.00 Grade Point Average (GPA) in the last 60 credit hours of their undergraduate bachelor degree. Candidates who have less than 3.00 GPA may be accepted as "special students", but they will be placed on academic probation. To be accepted to the gradate programs, candidates must have a Graduate Record Exam (GRE) score of 1050 in math and comprehension. Candidates may take their GRE exams at any time during the program, but prior to graduation. Those applicants whose native language is other than English are required to pass the Test of English as a Foreign Language (TOEFL). In all EMGT outreach programs, students must demonstrate evidence of skills in computer languages, basic engineering, and sciences.

GRADUATE DEGREES

Two types of graduate degrees are offered in the EMGT outreach programs: Master of Science and Doctor of Philosophy. Table 1 summarizes the MS requirements for thesis and nonthesis options.

TABLE 1, EMGT OUTREACH MASTER'S DEGREE REQUIREMENTS.

REQUIREMENTS	NONTHESIS HOURS	THESIS HOURS
TOTAL CREDIT HOURS	33	30
UPPER LEVEL COURSES	9	6
OUT OF DEPARTMENT	6	6
RESEARCH	None	6
COMPREHENSIVE EXAM	Yes	No

These two programs are as following:

1. Master of Science degree is further divided into three programs.

    - Thesis program - This program covers all aspects of management and technology. A thesis committee of at least 3 qualified faculty members (members of the graduate faculty) are appointed to monitor and advise the program, approve the written thesis, and conduct the oral defense of the thesis. This program requires a minimum of 30 semester hours including the following credits:

        - 18 credit hours in EMGT with at least six hours in approved upper level (400) lecture courses.

- 6 credit hours in the approved out-of-the-department courses.

- 6 credit hours in thesis work.

- Non-thesis program - This program requires a successful completion of a final comprehensive exam that is given about six weeks prior to the end of the last semester of course work. This program also requires a minimum of 33 semester graduate hours including the following credits:

    - 27 credits in EMGT with at least nine hours in the approved upper level (400) lecture courses.

    - 6 credit hours in the approved out-of-the-department courses.

- Second master's degree - This program applies to graduate applicants who have already completed an accredited master's degree in a technical field. The degree requirements are similar to the thesis and non-thesis programs. At least 24 credit hours of course work are required.

NATIONAL TECHNOLOGICAL UNIVERSITY

NTU was founded in 1984 as a private nonprofit academic institution. NTU is a Colorado-based consortium of 45 universities that offer courses to industry via satellite. The program serves and enhances the educational needs of today's competitive, and highly mobile, engineers, technical managers, and scientists. NTU's programs reach most locations in the US. This institution has successfully prepared and provided a variety of instructional television (multimedia) courses by 47 faculty members from the nation's leading academic and industrial organizations. These faculty members are known for their expertise in their fields and superb teaching skills. NTU is accredited by the Commission on Institutions of Higher Education of the North Central Association of Colleges and Schools.

Through its state-of-the-art satellite delivery systems, NTU trains and educates engineers and technical professionals. This process enhances students efforts to complete their MS degrees in EMGT through part-time study at their place of work and during their free time. Most graduate candidates are expected to complete the EMGT degree requirements in three years by registering for at least four courses per year and completing the capstone project as an additional course in the final year. Those candidates who have more hectic work schedules are able to satisfy a MS degree within five years.

UMR's program in EMGT was recognized and awarded as number one among all NTU university programs by students and site coordinators. In NTU, the MS degree in EMGT requires 33 semester credit hours covering two broad course categories. These two categories consist of Core Courses (including a Capstone Project course) and Elective Courses. Elective Courses in any graduate-level program must be approved by the graduate advisor. The majority

of the course credits earned must be at the 700 level. With the faculty advisor's approval, a maximum of 9 credit hours can be transferred from other accredited schools. Table 2 is a presentation of the NTU admission criteria and requirements.

TABLE 2, NTU ADMISSION CRITERIA AND REQUIREMENTS

ADMISSION CRITERIA	ADMISSION REQUIREMENTS
BS Degree in Engineering	ABET accredited Engineering Program from an institution in the US or a CEAB in Canada. • At least a GPA of 2.9 on a 4.0 scale. • Evidence of two years work experience in engineering. • Less qualified students may be admitted "Provisionally".
BS Degree in Sciences	Non-Engineering students in sciences must have a GPA of at least 2.9 on a 4.00 scale, and degrees from accredited programs from institutions in the US or in Canada in the following fields: • Chemistry; • Mathematics; • Physics; and • Computer Science.
Other Degrees	Other Non-Engineering degree candidates (e.g., Business, Engineering Technology, Liberal Arts, etc.) may apply if they can submit evidence of having passed the Engineer-in-Training (EIT) exam or registration as a Professional Engineer (PE).
International Candidates	Candidates whose last degrees are from a foreign institution are required to submit GRE scores from the General Test, and must have a US equivalent GPA of at least 2.9 from a 4.00 scale.

NTU's program is designed with a heavy emphasis on industry applications and inputs. The EMGT program is developed so that candidates become familiar with today's engineering and scientific breakthroughs. This program has been very successful among all qualified candidates, especially those candidates with a few years of experience. The programs heavily

emphasizes modern technical tools such as probability and statistics, operations research, accounting and finance, project management, and others.

The capstone project is designed to assist graduate candidates in integrating and synthesizing their work experience, academic background, and their graduate courses. The capstone project provides the candidate with a better understanding of EMGT in particular and engineering as a whole. Besides required courses, students are also encouraged to register for electives in management and technical areas that most effectively satisfy their personal and professional careers.

NTU students are assigned an academic advisor from the faculty. Advisors assist students in selection of the academic programs, planning their curriculum, registration, and other pertinent information. Students are responsible for interfacing with their advisors and addressing their academic problems and issues.

US ARMY ENGINEERING SCHOOL AND OTHER PROGRAMS

The US Army Engineering School at Ft. Leonard Wood (USAES) is located to the south of Rolla, Missouri. USAES is a training school for the Army's Engineering Officer Advanced Training Course (EOAC). UMR's EMGT graduate program is coordinated so that officers are able to complete their EOAC and satisfy their master's degrees at the same time. To be accepted in this program, officers must satisfy the same requirements (e.g., UMR and EMGT) as regular students. Qualified Active Component Officers accepted into the program can remain for additional 16 weeks after their EOAC graduations to complete their master degrees in EMGT. Active Component Officers are graduate students who are not permanent (party) Army officers (e.g., instructors or other regular officers stationed at the base) or civilian members. If qualified, other than Active Component Officers have to enroll as regular students for the graduate degrees.

During their EOAC training, the EOAC officers earn 15 credit hours of EMGT courses. These courses are taught at night, after officers EOAC training. Upon their EOAC graduations, they attend EMGT programs full time for two eight week sessions. To satisfy the graduate requirements, officers must complete 18 credit hours during the two eight week sessions, i.e., 9 credit hours each session. All courses are taught on site at Ft. Leonard Wood to accommodate EOAC training programs.

Cost of the program is about $250.00 per credit hour, or approximately $5000.00 for the entire program. This includes university fees but does not include books or other expenses. In comparison to other similar programs, this is considered a great bargain. Similar graduate programs awarded at other major accredited engineering schools can cost students a great deal more. Eligible EOAC officers can apply for tuition assistance of approximately 75% of the cost per credit hour for the courses they take during their 15 week advance training program. Those officers who are eligible for the Montgomery GI Bill can use its privileges to supplement their graduate programs. Local banks also provide student loans to those officers who need financial support to complete their programs.

Other EMGT outreach programs are located at: McDonnell Douglas Corporation, University of Missouri in St. Louis, and the 3M Corporation that are similar in their requirements. They all are based on five 8 week cycles sessions - 2 Winter, 2 Fall, and 1 Summer. Their requirements are similar to the non-thesis programs consisting of 33 semester graduate credit hours. These programs are mostly on site and convenient for the students to attend.

MULTIMEDIA INITIATIVES

EMGT has been a leader in transmitting and teaching its outreach courses through state-of-the-art multimedia technologies. These courses appear coast-to-cost via satellite TV, superimposed and projected against multimedia images. This multimedia technology relies on a revolutionary IBM Interactive Multimedia Classroom (IMMC). The IMMC system coordinates and integrates a variety of multimedia components and allows the faculty member to monitor the entire system with a user friendly remote control. This modern system includes the following items:

- IBM PS/2;
- Laserdisc player, with the IBM M-Motion computer/video interface;
- CD-ROM player;
- VHS VCR;
- Student keypad response system;
- Wireless remote control; and
- Document camera; and Large-screen video monitor.

The IMMC technology relies on special control software that permits the instructor to monitor and conduct a complete presentation independent of the system hardware. This transmission can be controlled by a hand held remote or an IBM 8516 Touch Display. EMGT has a close relation with the IBM Skill Dynamics - the education and training company that researched, designed, and developed the IMMC system.

Through the IMMC technology, the remote students are primarily on their own - working in their homes or offices studying via a television monitor. The IMMC system enables students to make conference calls to their classmates and other graduate students in remote locations.

The professor lectures in front of a plain blue wall, while controlling the IMMC that is positioned to one side. The IMMC transmits the information and video outputs to one of the video monitors positioned in the classroom. Meanwhile, the class students are observing the lessons on the other video monitors in the classroom. EMGT uses another technology, not part of the IMMC, called chrome-keying that transmits blue wall images to any receiving location. IBM PS/2 in the IMMC is often used to generate and project computer graphics for display. The

IMMC is also enhanced by an IBM M-Motion Video that interactively monitors both a Laserdisc player and a VCR. This system assists the EMGT professors by capturing still images from motion video, using the IBM Video Capture Adapter/A and including the images in their class presentations. In addition, IMMC includes a document camera that works in concept similar to an overhead projector. The document camera is capable of projecting images through transparencies as well as hard-copy documents and three-dimensional objects. To transmit information, the professor sets the information on the document camera stand, and the IMMC forwards the information, displays the image, and monitors the magnitude and size with a zoom control device.

CONCLUSIONS

Distance learning will have an increasing impact in EMGT outreach initiatives. It is expected that learning in offices and homes will strengthen the competitive advantage of the outreach programs. State-of-the-art electronic systems will be used, at home and at office, to educate engineering students.

This paper has analyzed the use of multimedia-based support system in EMGT's outreach initiatives. The study indicates that the EMGT programs are an highly effective medium for reinforcing student education and comprehension. The use of multimedia and modern educational techniques to enhance EMGT's curricula has evolved from its concept phase to a highly modern phase. The depth and content of the courses have significantly improved. Student satisfaction has increased while the student's cost of learning has decreased. Through outreach programs, students do not have to commute great distances to attend class. Most EMGT outreach courses are taught on site or near the student's work environments. How productive and effective are the EMGT outreach programs? More productive and effective than the regular programs.

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BIOGRAPHY

Dr. Bahador Ghahramani is an Associate Professor of Engineering Management in the School of Engineering at University of Missouri-Rolla (UMR). Prior to joining UMR he was a Distinguished Member of Technical Staff (DMTS) in AT&T-Bell Laboratories. His work experience covers several years of academics, industry, and consulting.

Dr. Ghahramani has presented and published numerous papers and is an active participant and officer of various national and international organizations and honor societies. He holds a patent, “Eye Depth Testing Apparatus”, has filed for two Bell Laboratories patents “A Method for Measuring the Usability of a System” and “A Method for Measuring the Usability of a System and for Task Analysis and Re-Engineering”.

Dr. Ghahramani received his Ph.D. in Industrial Engineering from Louisiana Tech University; MBA from Louisiana State University; MS in Industrial Engineering from Texas Tech University; MS in Applied Mathematics from Southern University; and BS in Industrial Engineering from Oklahoma State University.