



## **Engineering Management Creating Individuals with a Mind for Business and a Heart for Engineering**

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Saeed Foroudastan is the Associate Dean for the College of Basic and Applied Sciences (CBAS). The CBAS oversees 10 departments at Middle Tennessee State University. He is also the current Director for the Master's of Science in Professional Science program and a professor of engineering technology at MTSU. Foroudastan received his B.S. in civil engineering, his M.S. in civil engineering, and his Ph.D. in mechanical engineering from Tennessee Technological University. Additionally, he has six years of industrial experience as a Senior Engineer and 17 years of academic experience as a professor, Associate Professor, and Assistant Professor. Foroudastan's academic experience includes teaching at Tennessee Technological University and Middle Tennessee State University in the areas of civil engineering, mechanical engineering, and engineering technology. He has actively advised undergraduate and graduate students, alumni, and minority students in academics and career guidance. Foroudastan has also served as Faculty Advisor for SAE, Mechanical Engineering Technology, Pre-engineering, ASME, Experimental Vehicles Program (EVP), and Tau Alpha Pi Honors Society. In addition to Foroudastan's teaching experience, he also has performed extensive research and published numerous technical papers. He has secured more than \$1 million in the form of both internal and external grants and research funding. Foroudastan is the faculty advisor, coordinator, and primary fundraiser for EVP teams entering national research project competitions such as the Formula SAE Collegiate Competition, the Baja SAE Race, the SolarBike Rayce, the Great Moonbuggy Race, and the Solar Boat Collegiate Competition. For his concern for and dedication to his students, Foroudastan received MTSU awards such as the 2002-03 Outstanding Teaching Award, the 2005-06 Outstanding Public Service Award, and the 2007 Faculty Advisor of the Year Award. He received the Excellence in Engineering Education Award and Faculty Advisor Award from the Society of Automotive Engineers (SAE). He was also nominated for the MTSU 2005 and 2009-11 Outstanding Research Award. He received two Academic Excellence awards from the Tennessee Board of Region in 2010-11. Foroudastan has also won many College of Basic and Applied Science awards. In addition to this, Foroudastan also reviews papers for journals and conference proceedings of ASEE, ASEE-SE, and ASME, and he has been a session moderator for several professional conferences.

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I hold a Bachelors degree of Biological Science from East Tennessee State University and am currently obtaining my Masters of Science in Professional Science with a concentration in Biotechnology at Middle Tennessee State University. I am completing my graduate assistantship with Dr. Saeed Foroudastan the Director of the Masters of Science in Professional Science program and Associate Dean of the College of Basic and Applied Sciences; I assist with the preparation and submission of grants and publications among other duties. Along with my assistantship duties, I am a highly active member of the Masters of Science in Professional Science club at Middle Tennessee State University.

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## **Abstract**

The Professional Science Masters (PSM) is an up and coming interdisciplinary graduate degree that is nationally recognized. A PSM degree educates students in Science, Technology, Engineering, and Mathematics (STEM) while introducing them to the logistics of the business industry behind the science. At our institution this degree takes form as the Masters of Science in Professional Science (MSPS) program. This is one of the fastest growing graduate degree programs at our institute. At its inception the program housed concentrations in biotechnology and biostatistics. Due to the great success of the program and its graduates the program has expanded the subsequent skill sets available to incoming students including concentrations in actuarial sciences, geosciences, and health care informatics. One of the most recent and arguably the most beneficial additions to the program has been that of the Engineering Management concentration.

The goal of the Engineering Management program is to create individuals with a mind for business and a heart for science. The Engineering Management degree is oriented to Engineering Systems and Manufacturing undergraduate students and those with a related STEM degree. The Engineering Management concentration requires students to take core courses such as Managerial Communications, Leadership and Motivation, and Accounting and Legal Issues for Managers. In addition, at the heart of the professional science degree is the 250-hour internship that students are required to perform at the end of their course work. This internship allows students to gain real-world working experience in an industry setting while performing a company specified project. It also gives students the opportunity to network with future employers. The MSPS program and the internship process have garnered recognition both at the local and national level. The success of the program is further illustrated by the fact that the program has a 95% graduation rate and more than 70% of its graduates are employed by the companies where they completed their internship.

Along with its sister subsets the Engineering Management concentration is designed to reinforce the ideal of the symbiotic relationship between science and industry. Engineering Management, as an integration of two colleges and several departments teaches students the interpersonal, leadership, management, and engineering skills needed for success in manufacturing, industry, and business. The program requires students to take courses focusing on project management, safety planning, research methods, and technology trends. Additionally through the coursework offered by the Engineering Management degree the students gain credit towards their Project Management Institute (PMI) and also have the ability to gain full certification in both Lean and Six-Sigma

methodologies. Certifications which are highly sought after in today's ever competitive job market.

## **Introduction**

Interdisciplinary research has been deemed necessary by the Council of Graduate Schools for the future competitiveness of America, because “knowledge, creation, and innovation frequently occur at the interface of disciplines.”<sup>1</sup> In the future, various issues confronting the nation in the 21<sup>st</sup> century will be addressed by a workforce comprised of individuals working across disciplines.<sup>1</sup> Some problems facing our society have become so complex that they are no longer able to be solved by a single academic discipline.<sup>1</sup> Businesses, governments, and nonprofits will increasingly need to collaborate with universities to develop and expand professional master's programs which produce graduates with interdisciplinary skills.<sup>1</sup>

Throughout the nation, the “Professional Science Masters” (PSM) is being implemented at various universities. The PSM is an innovative graduate degree designed to provide advanced training in science without a Ph.D, as well as training in business without an MBA<sup>2</sup>. Supported by the Alfred P. Sloan Foundation, the Professional Science Masters (PSM) is an up and coming two-year interdisciplinary degree that is nationally recognized. A PSM degree allows students to pursue advanced training in Science, Technology, Engineering, and Mathematics (STEM) while simultaneously introducing them to the logistics of the business industry behind the science. A PSM degree prepares students for a science career in industry, academia, business, government, or non-profit organizations. The PSM program culminates in a real-world internship in a business or public sector enterprise, where students will apply what they have learned in the classroom to a scientific industry project.

At MTSU this degree takes form as the Masters of Science in Professional Science (MSPS) program and was established in 2005. The MTSU MSPS program serves as the national model for PSM degrees and is the fastest growing program at the university. At its inception the program housed concentrations in Biotechnology and Biostatistics. Due to the great success of the program and its graduates the program has expanded the subsequent skill sets available to incoming students including concentrations in Actuarial Sciences, Engineering Management, Geosciences, and Health Care Informatics. The goal of the MSPS degree is to enhance the interface between science and business by providing strong degrees which emphasize expertise in the areas of business and science.<sup>3</sup>

The MSPS degree is an exemplary program designed to promote the professional development of students through its interdisciplinary education. The program is a partnership among the College of Basic and Applied Sciences, College of Behavioral and Health Sciences, and the Jennings A. Jones College of Business. As part of the business core students are introduced to highly valued skills through courses in Probabilistic & Statistical Reasoning, Business Law: Legal Issues for Managers, Accounting, Management and Leadership, and Managerial Communications.

The interdisciplinary nature of the MSPS program fills a niche in industry management by bridging the gap between the business and science cultures. By having experience in both the science and business disciplines, the career prospects for the students doubles. The MSPS degree is an essential step for those students pursuing a career in a science-related industry or academia. Classes involving advanced knowledge of scientific principals and research experience are required to ensure a solid educational foundation. By being able to analyze, understand, and present scientific data in a business setting, the MSPS graduate provides a valuable asset to the professional scientific community.

The last requirement of the MSPS program is an internship which polishes the student's professional preparation. The students must complete a 250-hour internship at an industry in his or her chosen field of study. The internship is at the heart of the PSM degree because it provides the student with a "real-world" experience and helps them to gain a full grasp of the knowledge they gained within the classroom. Throughout the internship the students are responsible for completing assignments assigned to them by their employer. At the culmination of their internship, the students compile a portfolio and give a professional presentation of their experience at the company.

The MTSU MSPS program has been recognized both at the local and national level. In 2010 the program received the Tennessee Board of Regents' (TBR) *Academic Excellence Award* for its promotion of math and science and for its unique contributions to the community and state. Moreover, the Council of Graduate Schools in Washington, D.C. recognizes MTSU as a signature program and uses MTSU as a model for traditional PSM programs. Currently the program has a 95% retention and graduation rate; and as a further testament to the strength of the program approximately 75% of MSPS students have gained employment from their place of internship.

### **Creating an Interdisciplinary Program**

One of the greatest successes of the MSPS program at MTSU is the model collaboration of three colleges and over thirty faculty members. The MSPS program is a partnership among the College of Basic and Applied Sciences, College of Behavioral and Health Sciences, and the Jennings A. Jones College of Business. The success of this massive collaboration is due in large part to the MSPS Program Director, Dr. Saeed Foroudastan.

Through the approach Dr. Foroudastan, the program director, took when initially enlisting faculty for the new interdisciplinary degree he was able to promote a sense of respect and understanding between the multiple colleges. Due to the initial program success a sense of pride and accomplishment was felt among the initial faculty involved. Through the success of the program, the students, and that of the professors involved in the MSPS program has been able to expand with a growing number of faculty wanting to become involved with this cutting edge, award winning degree program.

As part of the MSPS initiative, courses such as Probabilistic & Statistical Reasoning, Business Law: Legal Issues for Managers, Accounting, and Managerial Communications were reworked in order to give the classes a scientific emphasis. For instance the Accounting class now includes student projects concentrated on performing profit-margin analysis, completing income statements, statements of cash flow, and balance sheets for companies such as Sarah Cannon Institute, Eli Lilly, Fisher Scientific, Johnson and Johnson, and State Farm. The Managerial Communications course focuses on presenting scientific information in a business format as well as how to write appropriate documents such as letters, memos, and public announcements; this class has proven to be especially beneficial. Due to the fact that most graduates of this program will enter management positions upon entering the workforce these reworked MBA courses are advantageous for STEM students as they have not encountered these subject matters in previous undergraduate coursework. To further promote comrade among the MSPS faculty, Dr. Foroudastan was able to provide incentives and recognition for everyone involved; with the most recognition going to those faculty that act as program coordinators.

### **Engineering Management**

The bridge between Engineering and Management has been a successful one with long standing Masters in Engineering Management degrees being offered by such universities as Duke University, George Washington University, Cornell, and many others. MTSU hopes to continue this success with the introduction of the Masters of Science in Professional Science: Engineering Management (EM) concentration. The EM degree at MTSU is designed to reinforce the ideal of the symbiotic relationship between science and industry.

Engineering Management, as an integration of two colleges teaches students the interpersonal, leadership, management, and engineering skills needed for success in manufacturing, industry, and business. The program requires students to take courses focusing on project management, safety planning, research methods, and technology trends. The MSPS Engineering Management degree is oriented to Engineering Systems students and those with a related undergraduate degree.

The Engineering Management concentration prepares students for careers in the management of technology and engineering in such diverse occupations as: Technology Managers for Manufacturing Operations in assembly & fabrication, Healthcare, Food Production, and Governmental research initiatives. Additionally EM students will prepare to work as Project Managers for the Concrete and Construction Industries, Process Control Companies, and Automotive Industries.

Additionally as part of the program students are trained in Project Management gaining thirty-nine hours from PMI allowing them to sit for their PMP exam upon completion of the course. A further draw to the MTSU EM degree is the ability to gain certifications in both Lean and SIX SIGMA methodologies. Due to the restricted time available in a semester MTSU is not able to provide the students with means for achieving an American Society of Quality (ASQ) Black Belt certification. However the institution is able to

provide the education and skillsets needed to pass the exam and further provides the support for completing these projects outside the auspices of MTSU. While MTSU is not able to provide the Black Belt certification, students are able to perform projects through their coursework that achieve them the lower Greenbelt certification.

The goal of the Engineering Management program is to create individuals with a mind for business and a heart of a scientist. The concentration requires students to take core business courses such as Managerial Communications, Leadership and Motivation, and Accounting and Legal Issues for Managers. In addition, at the heart of the PSM degree is the 250-hour internship which allows students to gain real-world working experience in an industry setting.

### **Other MSPS Concentrations**

In addition to the Engineering Management concentration the MSPS program also offers degrees in Actuarial Sciences, Biostatistics, Biotechnology, Geosciences, and Health Care Informatics. It is also the programs hope to add an additional concentration, Forensic Science, in the near future.

The Actuarial Sciences concentration trains students to make practical use of probability theory and statistical analysis for managing risks and solving problems in insurance business. Students take required courses such as Construction and Evaluation of Actuarial Models, Actuarial Models for Life Contingencies, and Actuarial Models for Financial Economics. The graduates then take twelve hours of their chose f credits from within the concentration. Graduates of this concentration are positioned to fill the growing need for individuals with this highly specialized training in the financial services and consulting industries in addition to the traditional insurance and health care industries.

The Biostatistics concentration provides training in statistical methods that can be applied to biomedical and health-related fields. These methods involve using mathematics and statistics to solve real-world problems that influence health. Statistical areas of study include clinical trials, experimental design, categorical and longitudinal data analysis, and survival analysis. Students take required courses such as Advanced Mathematical Statistics I and II, Biostatistical Methods, and Advanced Biostatistical Methods. The graduates then take an additional six hours of credits of their own choosing from within the concentration. Biostatistic graduates are prepared to work in health care agencies, governmental agencies such as the National Institutes of Health, the Centers for Disease Control and Prevention, and the Environmental Protection Agency, and the pharmaceutical industry.

Biotechnology studies prepare students for careers in the management of bioscience firms and organizations. Students take two required courses Biotechnology and Issues in Biotechnology. The students then choose sixteen additional credit hours from courses such as Advanced Virology, Advanced Plant Biotechnology, Advanced Animal Development, Advanced Cell and Molecular Biology, Transmitting Electron Microscopy, and Experimental Immunology. Graduates have opportunities as research scientist in

laboratories applying biotechnology to problems in medicine, industry and agriculture and management positions in the biotechnology and pharmaceutical industries. With the growth of positions in the biotechnology industry nationwide, the demand for persons with training in both biological science and management is expected to grow significantly.

The Geosciences concentration provides the knowledge, skills, and experiences for students seeking careers as geoscientists in private industry and government agencies, as well as working professionals seeking advanced training in the geosciences. There is a high demand for well-trained and experienced geoscientists in areas such as geographic information systems and environmental geology. Students in this concentration elect to complete specializations in either Geographic Information Systems or Environmental Geosystems, or may elect to complete a general Geoscience program of studies. Geoscience graduates take courses such as Geoscience Colloquium, Geospatial Systems and Applications, Advanced GIS, Engineering Geology, Environmental Geoscience, and Advanced Hydrogeology.

The Health Care Informatics discipline combines computer science, information science, and the healthcare sciences in order to manage and communicate data, information, and knowledge in the healthcare environment. The Health Care Informatics concentration is aimed at healthcare professionals who have strong computer skills and an interest in technology integration within the healthcare environment. Students take courses such as Health Care Information Systems and Technology Integration, Project Management in the Design and Analysis of Health Care Information Systems, Project Management in the Implementation & Evaluation of Health Care Information Systems, and Health Care Data Analysis and Evidence-Based Practice. Graduates of this concentration fill the growing need for healthcare leaders with training in the application and design of information technology to health care to continue to improve patient care delivery.

## **Conclusion**

At MTSU, the MSPS program gives students an advanced scientific background in Biostatistics, Biotechnology, Geosciences, Healthcare Informatics, Actuarial Science, and Engineering Management while introducing them to the backbone of business. The program's goal is to train graduates to serve dual competencies within the same job, which is an increasingly advantageous quality for career placement. Perhaps most importantly, MSPS addresses the current national need to develop a workforce with more master's level students that are highly skilled and well-educated in the critical areas of science and engineering. The MSPS program at MTSU serves as a national model, as it is not only the fastest growing degree program at the university but also the fastest growing PSM program in the nation.

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