Engineering Management: University-Industry Partnerships Create Business-Savvy Scientists

Saeed Foroudastan
Middle Tennessee State University
Saeed.Foroudastan@mtsu.edu

Dianna J. Prince
Middle Tennessee State University
djp3a@mtmail.mtsu.edu

Abstract

National organizations such as the National Academies of Science have warned that there is a strong disconnect between the abilities of the American workforce and the capabilities Americans need to stay competitive in today's world economy. Recommendations to fill this disconnect often focus on programs involving science, technology, engineering, and management (STEM) [1]. The Professional Science Master's (PSM) is a nationally recognized interdisciplinary degree program that educates students in the STEM disciplines while simultaneously introducing them to the basics of business. At Middle Tennessee State University (MTSU), the PSM degree takes form as the Master of Science in Professional Science (MSPS) degree.

The MSPS program was the first of its kind in Tennessee and has been the most successful and expansive program. At its inception, the program housed two concentrations: biotechnology and biostatistics. After receiving recognition for its success both locally and nationally, the program has expanded to include four additional programs: actuarial sciences, health care informatics, geosciences, and most recently engineering management.

The goal of the engineering management (EM) concentration is to create individuals with a mind for business and a heart for engineering. When designing the curricula for the EM concentration, the creators of the syllabi worked closely with local industry partners to ensure the future EM graduates would be prepared for the competitive job market. With the integration of the College of Engineering Technology and the College of Business, students are taught the importance of leadership, management, and engineering skills needed for success in manufacturing, industry, and business. Students are required to take courses that focus on project management, safety planning, research methods, and technology trends. Additionally, at the core of this MSPS degree is a 250-hour internship that enables students to gain real-world experience in an industry setting.

Introduction

According to the Council of Graduate Schools, interdisciplinary studies are crucial to maintain America's competitiveness in an evolving nation. In the 21st century, various issues confronting the nation will be addressed by a workforce comprised of individuals with

interdisciplinary skills. Many U.S. graduate schools offer programs in collaboration with industry that will produce the future workforce that America needs in order to stay competitive. Businesses and government will need to collaborate with universities to develop and expand professional master's programs, which produce graduates with interdisciplinary skills [1].

In response to the changing workplace needs, the Professional Science Master's (PSM) degree is being implemented at various universities and becoming a staple in the graduate school environment. This nationally-recognized two-year interdisciplinary degree allows students to pursue advanced training in science, technology, engineering, and mathematics (STEM) while simultaneously training them in the management and workplace skills such as communication, teamwork, financing, and marketing. This interdisciplinary program fills the demands for a workforce that possesses not only technical and scientific training but also "soft" skills.

The MSPS degree at Middle Tennessee State University (MTSU) is part of a national movement of PSM programs. When established in 2005, the program housed concentrations in biotechnology and biostatistics. Due to its tremendous success, the program expanded the subsequent skills sets available to incoming students to include actuarial science, engineering management, geosciences, and health care informatics.

A major attribute of the MSPS program is a 250-hour internship at an industry related to the students' field of study. The internship enables students to put their skills obtained within the classroom to the test and gain real-world experience within the industry. At the conclusion of the internship, students must prepare a portfolio and give a professional presentation regarding their experiences as an intern. Approximately 75% of the students gain employment from the company that hosted their internship.

The MSPS program at MTSU has been recognized both at the local and national level. With a retention and graduation rate of 95 percent, it is the fastest growing program at MTSU. In 2010, the program was recognized by the Tennessee Board of Regents for its promotion of math and science and received the "Academic Excellence Award" [3]. In addition, the Council of Graduate Schools uses MTSU's MSPS program as a national model for traditional PSM degrees [4].

Program Created through Partnerships

Among the many successes of MTSU's MSPS program is the model collaboration of three colleges and over 30 faculty members. The program was created by a collaboration of the College of Basic and Applied Sciences, College of Behavioral and Health Sciences, and the Jennings A. Jones College of Business. The interdisciplinary program has been pivotal in the renowned success of MTSU. The success of the program has brought recognition not only to the university, but also to the staff involved in its creation and the state of Tennessee.

When the program's curriculum was created, an advisory board was set up. This advisory board contained members the academic society and local industry within a 200-mile radius of

the university. The board meets to discuss how to form the curriculum in order to meet the needs of both the students and industry. Furthermore, the advisory board still holds meeting once or twice a year to mold and manipulate the current curriculum in order to produce the most viable graduates for the demanding workforce. The scientific and business industries cross paths every day; by educating new graduates in both sides, new partnerships can be formed and better trades can be made. This degree establishes a knowledge base that propels the scientific and business industries into the future. As engineering technology programs advance, the model for industry-based and practical research opportunities for undergraduate students are expanding. The rationale for active collaboration between undergraduate programs and the industry is extremely clear. The research opportunities afforded by such relationships help the students to gain real world experiences while preparing them for their career. The partnership is both beneficial to the students and the industry leaders [5].

Engineering Management

The most recent addition to the MSPS program is the EM concentration. This degree is also a new program in terms of the PSM also. The MSPS-EM degree was developed to meet the demand for professional leaders in manufacturing. This degree teaches students the interpersonal, management, and engineering skills required for success in manufacturing, industry, and business.

When engineering management was introduced as a concentration in the MSPS degree, the hope was to continue the renowned success of similar programs at universities such as Duke University, George Washington University, Cornell, and many others. The creators of the curriculum considered the needs of industry and partnered with local industry to design a curriculum strong in both science and business. The resulting curriculum requires students take courses that focus on project management, safety planning, research methods, and technology trends; as a part of the business core, students are taught valuable business skills through courses such as Probabilistic and Statistical Reasoning, Accounting and Legal Perspectives for Managers, Leadership and Motivation, and Managerial Communication.

In addition to gaining advanced training in science and business, students gain certifications as a result of taking certain concentration courses. A Green Belt certification is awarded to students after completion of a business/industry Green Belt project. Through the Green Belt project, students gain hands on experience in an industry/business. With business becoming increasingly complex, the demand for executives, managers, and other professionals who have the skills to eliminate waste, reduce defects, shrink inventory, and make other critical business process improvements has increased dramatically. Individuals who obtain a Six Sigma certification are a very attractive asset to companies seeking employees.

An additional certification gained through the EM coursework is a certification in lean manufacturing. Having a lean certification benefits both the student and his or her future employers. Lean certification is becoming a pre-requisite for employees and organizations. With a Lean Manufacturing Certificate, future employees are able to help companies develop lean standards, learn techniques for improving processes and they develop the abilities that

are highly portable and internationally recognized. By having this certification, the student's career prospects and earning potential are enhanced.

The MSPS-EM degree prepares students for future careers in the management of technology and engineering in diverse occupations such as technology managers for manufacturing operations, healthcare, food production, governmental research initiatives, etc. The interdisciplinary coursework this two-year degree provides prepares the students for high pressure, high paying jobs; it also teaching them the skills they need to manage others while simultaneously managing a job site.

To conclude the intensive course work laid out for EM, students they must complete a 250-hour internship. The internship is designed to replace the thesis work required of other master's programs. During the internship, the students have the chance to gain highly valued industry experience. They also get the chance to engage in comprehensive research projects that prepares them for the complex issues that arise in the workplace. Students have completed their internships at companies such as Tennessee Valley Authority, Nissan, and Asurion. These students were either promoted or received employment at another company immediately after graduation.

Conclusion

As the worlds of science and business merge, the workforce will need a new "type" of scientist in order to maintain America's competitive edge in an ever-changing world economy. The key to attaining this new breed of scientist is through the creation of interdisciplinary programs such as Middle Tennessee State University's Master of Science in Professional Science program.

The MSPS program at MTSU provides students with advanced scientific training in biostatistics, biotechnology, geosciences, healthcare informatics, actuarial sciences, and engineering management while simultaneously introducing them to the fundamentals of business. The program's goal is to produce graduates that have the ability to serve dual competencies within the same job, which is greatly beneficial for career placement. Graduates of the MSPS-EM program are highly capable and able to fill the wide gap between science and business. These individuals will be able to create, innovate and problem solve while at the same time coordinate and communicate fluidly with upper-level business personnel.

More importantly, the MTSU MSPS program addresses the current national need for a workforce with more master's level graduates who are highly skilled and well educated in the STEM disciplines. The MSPS program at MTSU serves as the national model of PSM programs because it is not only the fastest growing program at MTSU but also the fastest-growing PSM program in the nation.

References

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Biographies

SAEED D. 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.

DIANNA J. PRINCE is currently obtaining her Master's of Science of Professional Science degree with a concentration in Biotechnology at Middle Tennessee State University. Prince is completing her graduate assistantship with director of the Master of Science in Professional Science program and associate dean of the College of Basic and Applied, Dr. Saeed Foroudastan. Prince assists with the preparation and submission of grants and publications among other duties. Prince is also involved with the Master of Science of Professional Science club.