

## **AC 2007-121: ENGINEERING MANAGEMENT AND THE PROFESSIONAL SCIENCE MASTERS (PSM) PROGRAM**

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# **Engineering Management And the Professional Science Masters (PSM) Program**

## **Abstract**

The Professional Science Masters (PSM) degree has become very popular around the United States for working scientists seeking both additional specialization training in their field and a foundation in business and management to enable them to move into supervisory and leadership positions. Engineering Management has participated with the science and mathematics departments at UMR to create a PSM degree in which Engineering Management courses provide a portion of the foundation courses in management. The development and structure of this new degree at UMR is discussed along with the role Engineering Management has played in its creation.

## **Background**

The Professional Science Master's (PSM) degree program was initiated in 1997 by the Sloan Foundation with grant funds available to universities for program development.<sup>1</sup> The motivation for this degree is based on the fundamental problem that science and mathematics based companies need individuals not only with technical backgrounds but with business acumen. Individuals are needed who can manage research teams and interface with the business side of the organization including marketing, finance and legal departments. Traditionally, advance degrees in science are too academic, and MBA degrees often focus just on management skills in non-technical disciplines.

A Master's degree with a mix of advanced technical courses and business/management courses was originally proposed by the Sloan Foundation and targeted at individuals holding science or mathematics Bachelor's degrees and either now working in or preparing for professional careers in industry. This idea gained rapid acceptance as there are now over 100 PSM programs at about 50 universities in 26 states.<sup>1,2</sup> California seems to have the largest concentration of these degree programs with seven different locations in the state providing PSM degrees.<sup>2</sup> As an illustration of the discipline focus of these degrees, Table 1 contains a list of PSM programs in the Midwestern U.S. This region was of particular interest to the University of Missouri-Rolla in its initial investigation of the potential for offering this degree. The entries in this table are representative of the diversity of disciplines in PSM program around the U.S. and demonstrate how universities can leverage their areas of expertise through this degree. In reviewing the national list of programs, it became clear that biology-related PSM programs are very popular. There are 30 biology-related PSM degree emphasis areas with a heavy concentration in biotechnology and bioinformatics.<sup>2</sup>

**Table 1**  
**PSM Programs in the Midwestern U.S.<sup>3</sup>**

University	PSM Program Areas
Case Western Reserve	Biology, Chemistry, Mathematics, Physics, or Statistics for Entrepreneurship
Dayton	Financial Mathematics
Eastern Michigan	Bioinformatics
Grand Valley State	Bioinformatics, Biotechnology, Biostatistics
Illinois Institute of Technology	Materials and Chemical Synthesis, Analytical Chemistry, Health Physics, Biology
IUPUI	Laboratory Informatics
Michigan State	Industrial Microbiology, Industrial Mathematics, Zoo and Aquarium Science Management
Michigan	Bioinformatics
SIU Edwardsville	Environmental Risk Management, Biotechnology Management
Wisconsin	Environmental Monitoring, Remote Sensing, Spatial Information Management

### **The UMR PSM Program**

The PSM degree first came to light at UMR in the context of competition for the non-thesis MSEM offered by the Engineering Management and Systems Engineering (EMSE) department. An evaluation of the PSM programs clearly showed that the target market was primarily and almost exclusively science and mathematics majors. To be admitted to the MSEM degree program at UMR an applicant must have a B.S. in engineering, applied mathematics, computer science, or a physical science.<sup>4</sup> The EMSE department does occasionally receive applications from individuals with computer science, physics, or applied mathematics degrees, but these are usually individuals that are already working in engineering positions of some kind. These individuals are seeking to continue their professional careers while accessing the MSEM degree via distance education. Therefore, the PSM degrees do not directly compete with the MSEM degree. However, the concept of the PSM degree on the UMR campus would potentially offer the possibility of collaboration between the EMSE department and the science and mathematics departments.

The EMSE department in the School of Engineering, the School of Management and Information Systems (SMIS), and the science and mathematics departments in the College of Arts and Sciences (CAS) formed a task force to study the potential opportunity for PSM degrees on the UMR campus. Surveys of competitive programs in the region and of alumni and student interest in such a program were conducted. An explanation of the PSM degree program was provided to the participants of the latter survey. The study of regional competitive programs revealed only two PSM programs at one nearby university, Southern Illinois University at Edwardsville (St. Louis metro area), as shown in Table 1. The findings from the alumni and student survey of

individuals in science and mathematics undergraduate degree fields, conducted by the EMSE department, revealed several interesting results.

- 53% of alumni and 45% of current students surveyed were not at all familiar with the PSM program
- 74% of alumni and 96% of current students plan to pursue graduate education at some point
- 63% of alumni and 77% of current students would choose a PSM degree over a graduate degree in their field of study
- 63% of alumni and 83% of current students would choose a PSM degree over an MBA
- 79% of alumni and 92% of current students felt a PSM degree would be valuable to their careers.

The option of taking the courses by distance education was mentioned by a considerable number of respondents as a desirable characteristic of any PSM program.

The work of the taskforce resulted in a recommendation that UMR pursue the PSM degree with options in physics, chemistry, biological sciences, mathematics, and computer science with the business/management courses to be supplied by the EMSE department and the departments in SMIS. Initially, the program would be on-campus but would eventually expand to offer it also through distance education as well. Conservative enrollment projections indicate annual gross revenues of about \$170K by year 5 of the program with modest annual investments of \$15k-\$25K for marketing and administration.

### **The Role of Engineering Management**

As indicated earlier the EMSE department will be supplying some of the graduate courses that will satisfy the business/management component of the degree. The general structure of the PSM program at UMR is shown in Table 2.

**Table 2  
Major Requirements for the UMR PSM Degree**

Component	Credit Hours
Business/management courses (One course each from categories 1-4)	12
1. IST 351 Leadership in Technology-Based Organizations EMGT 314 Management for Engineers and Scientists	3
2. IST 361 Information Systems Project Management EMGT 361 Project Management	3
3. EMGT 352 Financial Decision Analysis	3
4. EMGT 420 Technical Entrepreneurship FIN 250 Corporate Finance I BUS 260 Business Operations BUS 270 Human Resource Management	3
Science/mathematics emphasis courses by specific program in each participating department	18

There are five specific PSM science/mathematics options for the UMR PSM degree: biological sciences, chemistry, physics, computer science, financial mathematics, and statistics. The degree will be awarded as the Professional Science Masters degree with an emphasis in one the five listed areas of emphasis.

As can be seen in Table 2, EMSE department courses, indicated by the EMGT designation, are an integral part of the program. Students could select all 12 hours of the business/management courses from the EMSE components. These four courses, EMGT 314, EMGT 361, EMGT 352, and EMGT 420, already exist and are offered as both on-campus and distance courses by the EMSE department. So, EMSE is already positioned to participate in the evolution of the PSM program when it moves to a distance offering as well as on campus. Currently, the Information Systems and Technology (IST) courses are available via distance education, but none of the Business (BUS), Finance (FIN) or the science/mathematics department specific courses are ready for distance delivery.

### **Value to the EMSE Department**

The decision to participate in the development and delivery of the PSM program was based on three factors:

- In the short term, it will provide more on-campus students in several of our graduate courses now dominated by remote synchronous students. This will enhance in-class activities such as discussions and case evaluations which are difficult with small in-class enrollments
- When the program does go to a distance format, the EMSE department will share in the distance education tuition revenue (40% per student) which becomes part of the department operating funds
- Participation in the program will provide visibility into graduate programs and professional graduate certificates offered by the EMSE department. Graduates and corporate education officials will be exposed to Engineering Management as a field of study resulting in potential referrals of engineering colleagues and employees
- Participation by the EMSE department in this UMR multi-department endeavor creates opportunities for future collaborations on interdisciplinary education and research endeavors. This will become more important in the years to come with the pending elimination of schools and colleges at UMR.

### **PSM Program Status and Implementation**

The program has been approved by the UMR campus and now is going through the approval cycle at the University of Missouri system level. The program is expected to be officially launched in August of 2007 with first graduates in May of 2009. Initial students are expected to come from UMR BS science and mathematics graduates who remain on-campus to complete the PSM degree. Marketing in the major Missouri metro areas of Kansas City, St. Louis, and Springfield is expected to attract working scientists and

mathematicians in sync with the gradual development of the remaining courses as distance education courses. It is expected that a few of these currently employed individuals may choose to come to UMR full time to complete the degree. Not all of the science and mathematics emphasis area courses will be evolved into distance courses simultaneously, so there will be a gradual phase-in of the emphasis options for remote accessibility. As the program matures, the marketing will be expanded beyond the state into the general Midwestern region. With its long history of offering and marketing distance education programs, the EMSE department is expected to play an important role in assisting the other departments in transitioning to distance-capable courses and in marketing the program to the corporate community.

### **References**

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