Engineering Management Program Re-evaluation

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Abstract

The University of Arkansas is in the process of re-evaluating the content, structure, and focus of the Master of Science in Engineering Management program offered within the Industrial Engineering department. An evaluation of 17 prominent Engineering Management programs is conducted to identify consistencies in core courses, degree hour requirements, program course content, and availability of degree program to off-campus students. In addition to the benchmarking study of Engineering Management programs at other universities, a market survey is in development to determine the potential student population size and student diversity.

Introduction

The Industrial Engineering Department at the University of Arkansas is currently striving to redesign its Master of Science in Engineering Management (MSEM) program. This degree program will be integrated into the existing MSOM (Operations Management) program and will be offered both on campus and as part of the College of Engineering's Distance Education program. It will target those individuals who hold a Bachelor of Science degree in any discipline of engineering. The purpose of this paper is to present the results of a benchmarking study conducted on other MSEM programs in a variety of universities, do comparisons to identify trends and specialties, and design a MSEM program that meets the needs of a targeted group of engineers.

The first section of this paper examines the process of evaluating other programs already offering a Master of Science in Engineering Management degree. Of interest in these programs are the admission requirements, graduation requirements, and courses offered. Also of interest will be any core course requirements, as well as if a thesis is required, optional, or not available. The programs evaluated include a mix of those offering distance education and others not. Most are in the Southeast region of the United States, and are of similar size as the University of Arkansas.

After these programs are reviewed, the next portion of the paper offers a comparison that looks for common threads in the various programs. This will be compared to the existing MSOM

program in the department to determine the necessary components that would need to be added. Basic degree requirements and core courses are also discussed.

The conclusion section of this paper outlines the planned structure of a new MSEM program. Discussed are the identification of a target audience, admission and degree requirements, and potential core and elective courses. These factors will take into consideration what is typical for other programs and special circumstances more unique to a specific target audience.

Benchmarking Process

A benchmarking study is conducted to gain insight into other MSEM programs. In all, 17 programs are analyzed and results compiled. These programs vary in their size and scope, but the criteria for selecting the EM programs are based on geographic and demographic region, mission of the institution, state support, and engineering-based degrees. The Internet is used to collect data about the selected EM programs. The following questions were considered for this report:

- Who is the target audience and what criteria should they meet? Some programs allowed admission to students just finishing a Bachelor's Degree in Engineering while others required a minimum number of years of industry experience. Also, some programs required a degree in engineering while others were more flexible allowing persons with a degree in math or hard science acceptance into an MSEM program.
- How many hours are typical for this type of program? The number of hours required varied slightly and sometimes depended on if a thesis was being incorporated into a person's degree.
- Should a thesis or capstone project be required? The incorporation of a thesis or capstone project offers students an opportunity to research a subject in further depth or integrate their skills in an industry project.
- Should a certain number of core courses be required? The inclusion of a set of core courses tends to add more structure to a degree program, but can remove some of the flexibility that students tend to enjoy.
- Is the degree also available through distance education? More degree programs are now offering their classes to non-traditional students located away from the local campus. This allows students to continue working at their jobs while pursuing a higher education.

Limitations

Many other programs were looked at, but are not included in this report because the program varied significantly from the University of Arkansas' MSOM program and a thorough evaluation would not add value to this comparison. Also, some programs did not seem to be notable for benchmarking against. Even though these programs were not included in the study it does not indicate that these were not appropriate programs to benchmark under different circumstances.

Comparison

In all, 17 programs were evaluated for this report. Half of these offer a distance education program while the other half do not. The reason some traditional on-campus programs were also

included is to provide a better balance to a potential MSOM program here so that it would be an attractive alternative to the MBA program for recent graduates of other engineering disciplines at the U of A.

The programs also varied in their actual degree requirements. The number of hours required typically ranged from 30-36, except for Portland State which requires 52 hours; however, they use a quarter system, rather than the semester system used by the other programs evaluated. The degree requirements also varied in the number of core courses required. A few required no core courses, giving their students a wide breadth of options, while others offered few or no electives.

Some programs offered a thesis-option, but only one required a thesis. Several programs required a capstone project which is usually industry-related. The information is presented in Table 1 for easier comparison.

Table 1 - Comparison of program details

	Florida Institute of Technology	Florida International University	George Washington University	Oklahoma State University	Portland State University	Southern Methodist University	Texas Tech University	University of Massachusetts	University of Michigan – Dearborn	University of Minnesota – Duluth	University of Missouri – Rolla	University of South Florida	University of Tennessee – Chattanooga	University of Tennessee Space Institute	University of Texas at Arlington	University of Wisconsin - Madison	Vanderbilt University
number of hours	36	36	36	32	52	30	36	36	36	30	30	36	36	33	36	30	30
#of core hours	0	24	21	26	28	21	15	18	30	15	0	21	12	21	30	30	18
thesis required?	n	n	n	n	y	n	n	n	n	n	n	n	n	n	n	n	n
capstone project?	n	y	n	y	y	n	n	n	n	y	n	n	n	y	n	n	y
distance education?	n	n	y	y	y	n	y	y	n	n	y	y	n	y	n	y	n
require experience?	n	n	y	y	n	n	n	n	y	n	n	y	n	y	y	y	n

Target Audience

One of the first questions that must be addressed would be that of a target audience. Nearly all of the reviewed programs require an engineering degree for admission, although a few will consider accepting students with a hard science or math degree. The other common thread in several of the programs is that of a number of years of engineering or technical work experience is required. Slightly more than half of the programs that offer distance education require work experience, but only one of the traditional programs requires it. If it is determined that this redesigned degree at the U of A should be primarily an off-campus program, then the work experience requirement would be in line with many other similar programs. However, if the

department wants to attract recent BS graduates from other engineering disciplines on campus who are considering an MBA, then the work experience requirement would prevent most from entering the program immediately after graduation.

Degree Requirements

When looking at the other programs featured in this report, there are 2 major differences (other than the course offerings) between the other programs and our Master's programs (OM, IE, and OR). First, most of the other programs require more hours to graduate. Second, only 2 of the 17 other programs do not require a certain number of core courses. Most of the others require 15-21 of the hours to be in a core set of courses which are typically balanced between engineering and management basics.

Although some of the featured programs have a thesis option, only one requires it. Several of the programs have a capstone project, but few of the distance education programs require it. This is likely because the target audience is usually holding down a full-time job and would not be attracted to a program that required a thesis. Also, most of the programs have more of a practical, people-focused curriculum rather than the research type of program that is more common in a traditional Master's degree in a particular discipline of engineering.

It is recommended that the MSEM program at the U of A require a minimum of 36 hours of coursework. 24 of these hours would consist of core courses (described later). The other 12 hours would consist of approved electives from within the IE department and the College of Business. This list also appears in a later section.

Course Offerings

A comparison of courses offered in other programs is also done. It should be noted that the course offerings varied widely between institutions, so not every course from all 17 programs is included. However, the ones that were seen in several programs are included. Table 2 shows many of the courses offered in other programs. In programs where core courses are required, these are noted with a "c" and the others with an "e" for elective. In programs where there are no required courses, all are indicated with an "x".

Many of the courses that are offered in the MSEM programs reviewed closely match some of those in the University of Arkansas' IE department. The following courses from the IE department are already part of the MSOM program:

- Occupational Safety and Health Standards
- Automated Production
- Production Planning and Control
- Administrative Analysis
- IE in the Service Sector

Table 2 – Course offerings

	Florida Institute of Technology	Florida International University	George Washington University	Oklahoma State University	Portland State University	Southern Methodist University	Texas Tech University	University of Massachusetts	University of Michigan – Dearborn	University of Minnesota – Duluth	University of Missouri – Rolla	University of South Florida	University of Tennessee – Chattanooga	University of Tennessee Space Institute	University of Texas at Arlington	University of Wisconsin - Madison	Vanderbilt University	**Total**
Activity Based Accounting											x							**1**
Advanced Engineering Economics			c		c			c			x		c	c	c	c		**8**
Benchmarking				x				e										**2**
Cost Accounting and Decision Making											x							**1**
Decision Making/Theory			c	x	c	c	c	c			x	e						**8**
Design of Experiments				x	e		e							e			x	**5**
Engineering Accounting		c				c			c	e	x				c			**6**
Engineering Finance		c				c			c	e	x			e				**6**
Engineering Management		c	c		c	c	c		c	c	x	c	c	c	c		x	**13**
Engineering Modeling/Design	x																	**1**
Human Factors/Industrial Psychology								c				e		e				**3**
Human/Labor Relations											x	e		e				**3**
Information Systems		c		x					c	e	x	e		e	c	c		**9**
Legal Aspects of Engineering				x	e			c	c	e	x	e	e					**8**
Logistics	x							e										**2**
Marketing	x	e			c				c	e		e					x	**7**
Optimization					c		c	e				c	e	c				**6**
Organizational Behavior		e	c						c									**3**
Performance/Production Management				x	c	c	e	e	c		x	c		e	c			**10**
Probability/Statistics						c		c				c		c		c		**5**
Project Management	x	c	c	x	c					c	x	e	e	c		c	x	**12**
Reliability/Quality Engineering	x			x				c			x	e	e	e		c	x	**9**
Safety							e				x	e		e				**4**
Simulation					e		c							e				**3**
Systems Engineering	x		c		e				c									**4**
Technical Management			c						c			e	e	e	c		x	**7**
Total Quality Management		c		x	e		c		c	c	x			e			x	**9**

- Safety and Health Standards Research
- Quality Engineering and Management
- Cost Estimation Models
- Engineering in Global Competition

It can easily be seen that these courses are not sufficient to incorporate an MSEM degree into the MSOM program. However, a number of IE courses that are already being offered in the department are identical or similar to courses included in many of the MSEM programs. Courses that are currently listed in the U of A catalog that could be incorporated include:

- Intermediate Engineering Economy
- Engineering Management
- Productivity Improvement
- Decision Models
- Reliability
- Transportation Logistics

Other courses in the current curriculum could also be added over time to the MSEM program, but the ones listed above would be the most beneficial.

Many of the courses listed would require fundamental knowledge in Engineering Statistics and Engineering Economic Analysis. These courses would need to be prerequisites to admission into the program. Students could also be given the option of taking a test to prove their proficiency in these areas.

Several courses that are included in many other programs are not currently offered at the U of A. Two of the most common ones are Total Quality Management and the Legal Environment of Business. It is noted that there is an OMGT course called TQM that is co-listed as the Quality Engineering and Management course. However, the TQM course in other institutions focuses on benchmarking, global competitiveness, and strategic management tools. Adding a separate course to the IE department in this area would benefit the MSIE degree program as well as the MSEM program. Also, the department already teaches a Law and Ethics course on the under-graduate level, but either restructuring the current course to be taught on a graduate level, or adding an additional course on the graduate level would also be valuable.

Two other courses that would be valuable additions to the department would be Project Management and Technology Forecasting & Commercialization. The Project Management course can be found in the majority of the programs evaluated. Technology Forecasting & Commercialization is a combination of several courses taught at Portland State University. This and other related courses in the area of technology should be developed if this program is to remain competitive.

Another course that is currently taught in the department on the under-graduate level is Data Processing Systems Engineering. Several other programs teach a similar course on the graduate level. Restructuring this course and adding it to the graduate curriculum would also be a valuable addition to the MSEM program.

Core Courses

As discussed earlier, most other programs require a certain number of core courses to add more structure to the degree. This should be kept in mind for the redesigned MSEM program. The courses that would be likely candidates for this include:

- Engineering Management
- Intermediate Engineering Economy
- Productivity Improvement
- Cost Estimation Models
- Decision Models
- Production Planning & Control (Analysis of Inventory Systems for BSIE graduates)
- Project Management
- Technology Forecasting & Commercialization

These courses represent 24 hours of coursework.

Electives

The other 12 hours of coursework for the students can come from a number of sources. At least 6 hours of this should be 5000- or 6000-level MSEM courses.

Any course listed in the Graduate Catalog for the IE department (that was not taken for credit for another degree) would be suitable as a technical elective. Several of them are currently included in the MSOM program and are readily available. Other courses would have to be videotaped over time to increase the elective options for the students. The current MSOM courses include:

- Occupational Safety and Health Standards
- Automated Production
- Administrative Analysis (Organization and Control can be taken in place of this course. Credit cannot be given for both)
- IE in the Service Sector
- Safety and Health Standards Research
- Quality Engineering and Management
- Engineering in Global Competition
- Introduction to Operations Management
- Operations Systems Design
- Public Personnel Administration
- Public Financial Administration
- Contemporary Issues in Human Resource Management
- Health Care Policies and Issues
- Human Factors Analysis

The following courses are not currently listed in the Catalog, but were previously mentioned as potential additions to the program as electives.

- Total Quality Management
- Legal Environment of Business

- Data Processing Systems Engineering

Several courses have been identified within the College of Business. Unfortunately, these courses would likely be available only to on-campus students unless an agreement was reached with the College of Business where these could be video taped.

- New Venture Development and Small Business Management
- Intra/Entrepreneurship of Technology
- Managerial Communication
- Labor Legislation
- Marketing Concepts
- Marketing Problems
- International Marketing
- Business Logistics Systems
- Strategic Issues in Transportation
- Global Logistics Strategies
- Supply Chain Management
- Transportation & Logistics Modeling

Several other courses within the College of Engineering are being reviewed for inclusion in this degree program.

Conclusions

It is determined that an MSEM program at the University of Arkansas' Industrial Engineering department should require a Bachelor's degree from an accredited engineering program, but that work experience should not be required. Even though much of the targeted audience is an off-campus group that would have that experience, it would prohibit many of the University of Arkansas' recent graduates from qualifying. Therefore, a multi-faceted approach to program delivery should be considered.

For distance education students, it is recommended that the MSEM program not include a thesis. Without the resources located on campus, it would be difficult for many off-campus students to complete this requirement. Instead, a minimum of 36 hours of coursework would be necessary. Of this, 24 hours would consist of core courses, as described earlier, and the other 12 hours would come from a list of approved electives.

On-campus students in the MSEM degree program would have the opportunity to conduct engineering management related research in the thesis option. This degree plan would require a minimum of 30 hours with 6 hours for the thesis. The core courses for this degree plan may be altered so that some flexibility can experienced in the program.

Finally, a market study is the next logical step in the MSEM program re-evaluation. Currently, a market study is in progress to determine potential interest in this degree program, both on and off campus. This is necessary, in part, so as to appropriately allocate resources to these different

arenas. This survey is still being undertaken, thus, results are not available at time of publication.

Biographical Information

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