AC 2010-92: A COMPARATIVE INVENTORY OF CORE COURSES IN SELECT GRADUATE EM PROGRAMS

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A Comparative Inventory of Core Courses in Select Graduate EM Programs

Abstract:

All educational programs should grow and change with the times. To be stagnant and accepting of the status quo will not move an educational program forward, and may end up leaving it way behind the leaders. With this in mind, an investigation into the current state of Engineering Management (EM) graduate education was undertaken. The study was intended to answer questions such as should there be a change in focus in Engineering Management education? Should the fundamental courses associated with an EM program be modified? Are there new or different concentration areas that should be focused upon? With a goal of striving to stay current with Engineering Management education, leading university graduate offerings in EM around the country were analyzed. Graduate programs chosen in this study tended to be ASEM certified, or have undergraduate programs that were ABET accredited. Trends among the programs were noted in this study, along with new courses or focus areas. Unique aspects identified in the study and lessons learned from the investigation were also discussed. Graduate schools can utilize the findings of this study as part of the process of improvement for graduate Engineering Management programs,

Keywords: Engineering Management, Benchmarking, Graduate Programs

Introduction

In the present day business environment characterized by constant changes in consumer behavior, organizations are rapidly reorienting the ways they do their business. In this context, the key to success of a firm lies in an effective management of their engineering and technology projects – thereby dramatically changing the roles of the technical organizations and engineering managers (Farr & Kotnour, 2005; Ganguly et al., 2009). Over the years, it has been repeatedly observed that most of the fresh graduate Engineering Managers generally enter an organization not just as a traditional hardcore engineer, but also as project managers, technical sales people, systems engineers, systems analysts, and so on (Abel, 2005; Farr and Kotnour, 2005). As a result, the competencies of a typical engineering manager should extend well beyond the traditional engineering skills to technical and managerial skills as well, and with the blurring boundaries between engineering/technology and management, these overlapping roles can prove to be very important for an organization to remain relevant in the modern economy.

The rapidly growing importance of engineering managers in the industry has in turn led to a growing importance of EM programs in the country. Furthermore, the constantly changing business environment, along with rapidly changing customer demands has ensured that the structure of EM programs should continually change with the times rather than be stagnant and accepting of a status quo. Over the past few years, the graduate EM program at Stevens has been closely monitored in order to make it more appealing to both the students as well as industry employers alike. However, since the key word in the phrase 'continually changing' is *'continuous'*, it was thought worthwhile to further investigate the current state of the graduate EM programs in the country and use the findings to further improve the current graduate EM program at Stevens, something that this research expects to shed some light on.

The purpose of this paper is to analyze the current state of leading graduate EM programs in the country in order to improve the quality and offerings of the EM program at Stevens Institute of Technology. Beginning with a review of the available literature on EM education, the paper goes on to enlist and analyze a set of graduate EM programs spanning across various parts of the country. The basis of selecting the EM programs to be investigated was ABET accreditation

and/or ASEM certification. The EM program at Stevens was then subsequently benchmarked against the other leading graduate EM programs and possible areas of further improving the graduate EM program at Stevens were noted based on the gathered data. The paper concludes with the advantages of implementing a change in the graduate EM program at Stevens.

A Brief History of Engineering Management

Engineering Management, as defined by the American Society of Engineering Management, is "the art and science of planning, organizing, allocating resources, and directing and controlling activities that have a technological component". Therefore, as seen from the definition itself, EM has its roots in both traditional engineering, as well as, the management disciplines, therefore making it important to both academicians, as well as, practitioners. EM as a formal degree has been present since the mid 1940s (Kocaoglu, 1984) and currently, there are probably more than 100 universities in the US offering an undergraduate and / or graduate programs in EM. EM programs are generally embedded within the departments of industrial engineering or systems engineering, depending on the universities (Farr and Kotnour, 2005). However, in order to reflect the gradual shift from manufacturing to turn-key systems integrators in a global economic environment, many universities have aligned their EM programs with their systems engineering program (Farr and Beude, 2003).

Research Model and Methodology

The objective of the research is to revisit and update the graduate EM program at Stevens in order to make it more appealing to both the students and the industry employers alike. In order to achieve the desired success of this research, the primary task performed was to identify the leading EM programs across the country. A review of literature indicated that currently there are over 100 graduate EM program in the United States. However, for the purpose of the current research, only a few accredited or certified graduate EM programs were chosen for analysis and subsequent benchmarking of the Stevens' EM graduate program. Two major and highly reputed accreditation / certification bodies of EM programs, the Accreditation Board of Engineering and Technology (ABET) and the American Society of Engineering Management (ASEM), were considered as a guideline for narrowing down the large list of EM programs in the country to a vital few. Only the graduate EM programs that were accredited / certified by ABET / ASEM

were chosen to be analyzed as a part of this research. Figure 1 provides the reader with a flowchart of the research model and methodology.

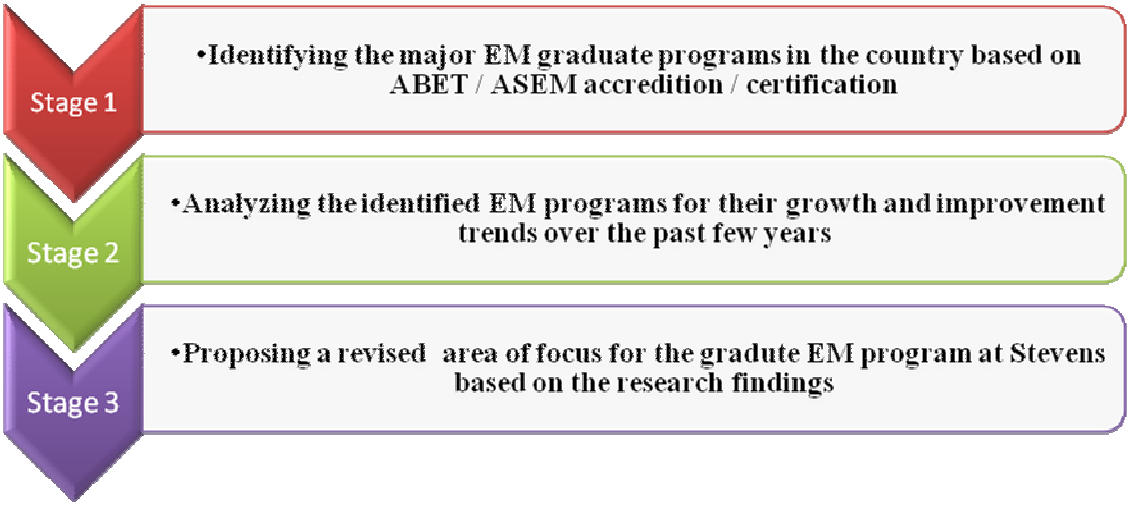

Figure 1. The basic research model

As previously mentioned, the criteria for selecting the EM graduate programs were based on ABET / ASEM accreditation/ certification. However, an exception was drawn in the case of one University – Western Michigan University (WMU). The rationale behind including the graduate EM program of WMU as a part of the analysis was because the graduate EM program on WMU was named the best in the country (WMU News, 2006), and therefore was thought worthwhile by the authors to be included in the study.

Research Findings

As mentioned in the previous section, the foundation of the research was to evaluate a set of leading EM graduate programs in the country and conduct a comparative study in order to improve the graduate EM program at Stevens. Furthermore, it was also mentioned that the EM graduate programs chosen were based on ABET accreditation and ASEM certification. Table 1 exhibits the findings of the research.

Categories	Courses	SIT	AFIT	MST	GWU	RPI	WMU	SCSU	ODU	OSU	UAH
Quantitative Techniques	Elements of operation research	X	X	X	X		X	X	X		
	Modeling and Simulation	X				X					
	Statistics for Managers		X			X			X		X
	Elements of Problem Solving and Decision Making for Managers				X						
Quality Management	Quality / Quality Systems management						X	X		X	X
	Continuous improvement in operations						X				
	Quality Systems Design								X		
Financial / Cost Analysis	Engineering Economics & Cost Analysis	X	X		X		X	X	X		
	Financial Decision Analysis (Accounting)			X						X	
Engineering and Strategic Management	Introduction to / fundamentals of Engineering Management		X	X			X	X		X	X
	Problems in Industrial and Manufacturing Engineering						X				
	Implementation of Technology										X
	Strategic Information Management		X							X	
	Designing and Managing the Development System	X									
Systems Engineering	Fundamentals of Systems Engineering	X			X						
	Organizational Systems Analysis and Dynamics		X						X		
Research Methods / Techniques	Approaches to Research / Design and Analysis of Experiments		X								X
	Critical Review of Literature		X								
	Capstone Project / Thesis		X					X			X
Others	Project management	X	X	X			X	X	X	X	X
	Business Process Re-engineering		X								
	Risk Analysis		X								
	Environmental Policy		X								
	Organizational Behavior		X		X					X	X
	Performance Management and Measurement									X	

Table 1. A Comparative Inventory of core courses in leading EM Graduate Programs in USA

Legends:

SIT = Stevens Institute of Technology
AFIT = Air Force Institute of Technology
MST = Missouri Institute of Science & Technology
GWU = George Washington University
RPI = Rensselaer Polytechnic Institute
WMU = Western Michigan University
SCSU = St. Cloud State University
ODU = Old Dominion University
OSU = Oklahoma State University
UAH = University of Alabama at Huntsville

It should be noted here that a list of schools, in spite of having an ABET accredited undergraduate EM program, were not considered for analysis since they did not have a graduate EM program (or even if they did, it was not ASEM certified). The lists of those schools are provided below,

- University of Arizona
- University of Connecticut
- North Dakota State University
- University of the Pacific
- United States Military Academy, West Point, NY

Table 1 provides the readers with a comparative study of the leading EM graduate programs in the country. In order to maintain the consistency of the research, only the core courses offered by the EM graduate programs were considered. As Table 1 exhibits, the courses were split in to domain areas for simplicity of analysis. Although some of the courses were offered by a majority of the schools, there were certain domains that were confined to certain university (ies) only. Therefore, it might be worthwhile to indulge in a further in-depth analysis of those courses and domains with the intention of implementing courses of similar nature as a part of the Stevens graduate EM programs.

Conclusion

Reviewing Table 1 in reference to the Stevens EM Program shows that all domain areas are covered except for Quality, Research Methods and Techniques, and a few courses listed in the "other" category. To address this lack of domain in the Stevens curriculum, Quality is high on the list of topics that will be added. In terms of the domain of Research Methods and Techniques, those courses are already offered as electives in the Stevens EM program and are thus part of the curriculum. In the category of 'other', the course that makes the best fit with the Stevens EM curriculum is Business Process Reengineering (BPR). As such BPR will be considered as a possible addition to the Stevens offerings.

The collection of the data in this paper and its organization into domain classifications (as seen in Table 1) was important in order to view leading U.S. EM programs in a larger, more collective way. As such, Table 1 was used to determine if Stevens EM program addressed the topics and domains relevant to the EM community. However, the analysis in this paper proved extremely useful as a starting point in determining the minimum core courses and domains that should be in any EM graduate program. Based on the findings of the current research, the graduate EM program at Stevens can be modified as a part of its improvement process. It is expected that the modified EM curriculum will prove to be more appealing to the academicians and practitioners alike, and in the process will further enhance the already highly valued graduate EM program at Stevens. Discussion with employers and other practitioners will also be part of the process in the modifications and implementations expected in the Stevens EM program over the coming year. It is expected that the findings of this research, coupled with constructive feedback / suggestions from employers and practitioners, will greatly aid in improving the quality of the graduate EM program at Stevens. Finally, other universities involved in graduate EM programs can also use the findings of this research to determine and design the optimal blend of courses as a part of their own graduate EM program.

References

Abel, K., "An analysis of Stevens Engineering Management Graduates, 1990 – 2004," *Stevens Institute of Technology*

Abel, K., "Growing an Engineering Management Program: Concentration Areas for the Future," 2008 *American Society of Engineering Education Annual Conference & Exposition,* June 2008, Pittsburgh, PA

Farr, John V., and D. Beude, "Systems Engineering and Engineering Management: Keys to the Efficient Development of Products and Services," *Engineering Management Journal,* 15(3), September 2003, pp. 3 - 11

Farr, John V., and T. Kotnour, "Engineering Management: Past, Present and Future," *Engineering Management Journal*, 17(1), March 2005, pp. 15 – 26

Ganguly, A., R. Nilchiani, J. V. Farr, "Identification, Classification and Prioritization of Risks Associated with a Disruptive Technology Process," *International Journal of Innovation and Technology Management,* **(Article in Press)**

Kocaoglu, D., "Strategic opportunities for Engineering Management," *PICMET '91 – Portland International Conference on Management of Engineering and Technology,* 1991, pp. 78-83

WMU News, "Engineering management Program is Best in Nation," *Accessed from* < http://www.wmich.edu/wmu/news/2006/12/014.html > on December 29, 2010