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## **AC 2012-3410: UNDERGRADUATE CURRICULA IN ABET-EAC ENGINEERING MANAGEMENT PROGRAMS: WITH AN INTERNATIONAL TOUCH**

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# **Undergraduate Curricula in ABET EAC Engineering Management Programs**

## **Introduction**

Engineering Management programs are a very small population of undergraduate programs accredited by the Engineering Accreditation Commission (EAC) of ABET, Inc. Internationally there are currently 13 undergraduate programs accredited by the EAC in Engineering Management, compared to more than 2000 accredited undergraduate engineering programs. While the earliest engineering management program (EM) was accredited in 1936, seven of the 13 programs were accredited in the last decade and three of these in the most recent (2010-2011) accreditation cycle. Within this rapidly growing community, there are striking similarities and differences in program curricula. Some Engineering Management programs are accredited against more than one program area. This paper compares and contrasts the curricula in the seven programs that are ABET EAC accredited in the Engineering Management area alone in the United States and internationally, and relates those to the 2010-2011 ABET Engineering Management Program Criteria.

## **Institutions with ABET EAC Engineering Management Programs**

There are thirteen engineering management programs in the world that are currently accredited by the Engineering Accreditation Commission (EAC) of ABET, Inc.<sup>2</sup> These programs along with the year of their first accreditation are given in Table 1<sup>2</sup>. The programs are at institutions in four different countries. The addition of programs outside of the United States has happened only recently, only announced since 2008. (A program is listed as first accredited since the date of their first accredited graduating class. The length of the accreditation process means that the accreditation announcement and program listing takes place two years following the listed accreditation date.) As seen in Table 1, there are now accredited engineering management programs in the U.S., Kuwait, Egypt and Turkey.<sup>2</sup>

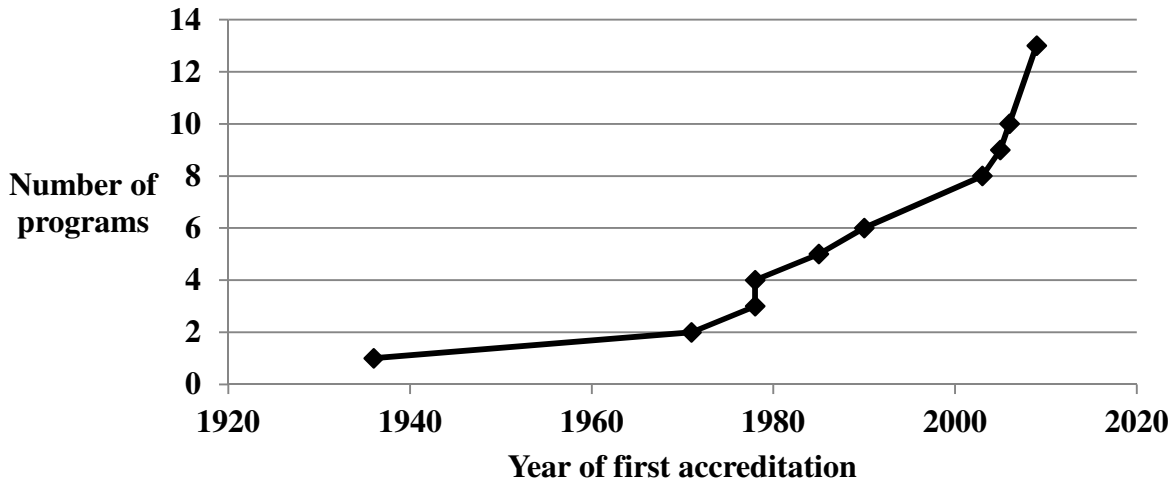
The first continuously accredited engineering management program was accredited in 1936 at Oklahoma State University. Growth in the number of program began slowly, with the next program appearing in the 1970s. The seven most recent additions to the list have taken place only in the last decade. Figure 1 displays the number of accredited EM programs accredited in any given year since 1936. The rapid recent rise in programs is readily apparent.

Many of the engineering management programs are accredited under more than one set of program criteria. Five of them are also accredited under the Industrial Engineering program criteria and one of them is also accredited under the Manufacturing Engineering program criteria. It is of interest that two of the ABET-EAC accredited programs are also accredited by the Association for the Advancement of Collegiate Schools of Business (AACSB)<sup>1</sup>. These are the Management and Engineering for Manufacturing program at University of Connecticut and the Engineering & Management program at Clarkson University.

**Table 1: Institutions with ABET-EAC accredited undergraduate programs**

<b>Institution (USA unless noted)</b>	<b>Program Name</b>	<b>Year 1<sup>st</sup> accredited</b>	<b>Other program criteria</b>
Oklahoma State University	Industrial Engineering and Management	1936	Industrial Engineering
North Dakota State University	Industrial Engineering and Management	1971	Industrial Engineering
Rensselaer Polytechnic Institute	Industrial and Management Engineering	1978	Industrial Engineering
Missouri University of Science & Technology	Engineering Management	1979	
U.S. Military Academy	Engineering Management	1985	
Stevens Institute of Technology	Engineering Management	1990	
University of Arizona	Engineering Management	2003	
University of the Pacific	Engineering Management	2003	
University of Connecticut	Management and Engineering for Manufacturing	2005	Manufacturing Engineering
Kuwait University (Kuwait)	Industrial and Management Systems Engineering	2006	Industrial Engineering
Arab Academy for Science, Technology & Maritime Transport (Egypt)	Industrial and Management Engineering	2009	Industrial Engineering
Clarkson University	Engineering & Management	2009	
Istanbul Technical University (Turkey)	Management Engineering	2009	

**Figure 1. ABET-EAC EM Programs by Year**



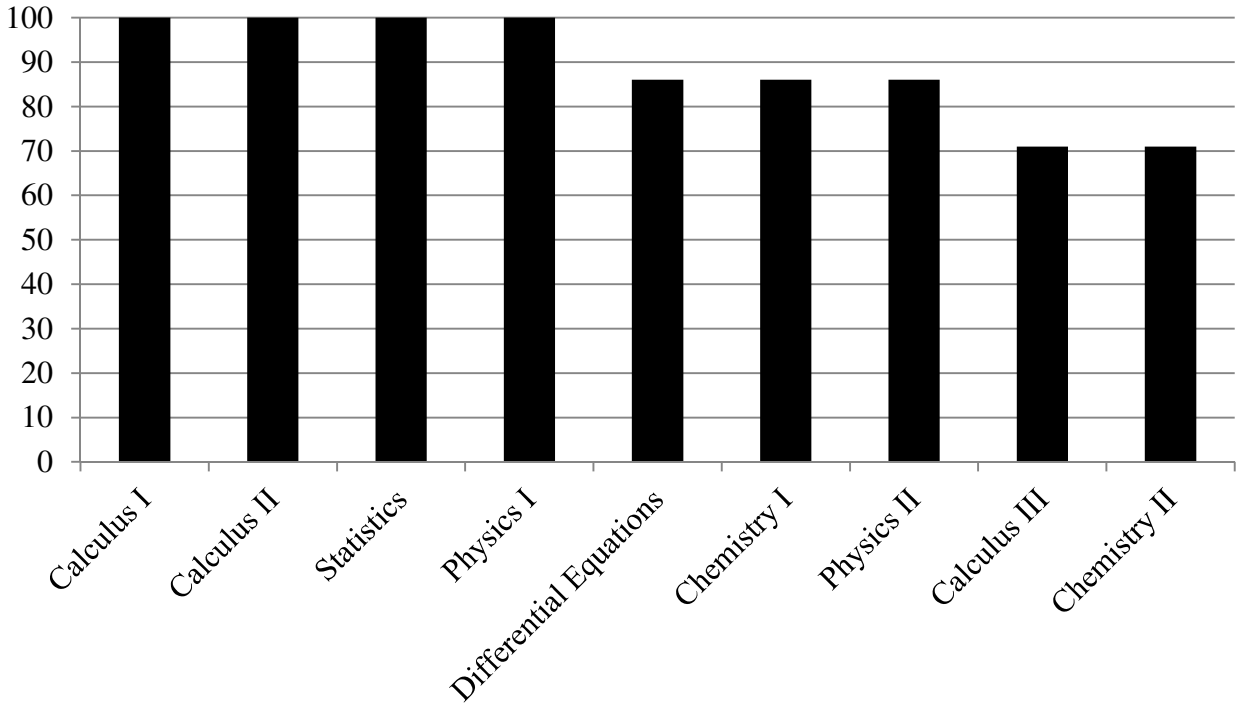
### Comparison of Program Curricula

Programs that are accredited under two program criteria can have attributes that are different from programs accredited under the Engineering Management program criteria alone. It is difficult to discern to which of the two program criteria the attributes are related. This is especially true of the required courses within a curriculum. For this reason this comparison of program curriculum contains only the seven programs that are accredited under the Engineering Management program criteria alone.<sup>3,4,5,6,7,8,9</sup>

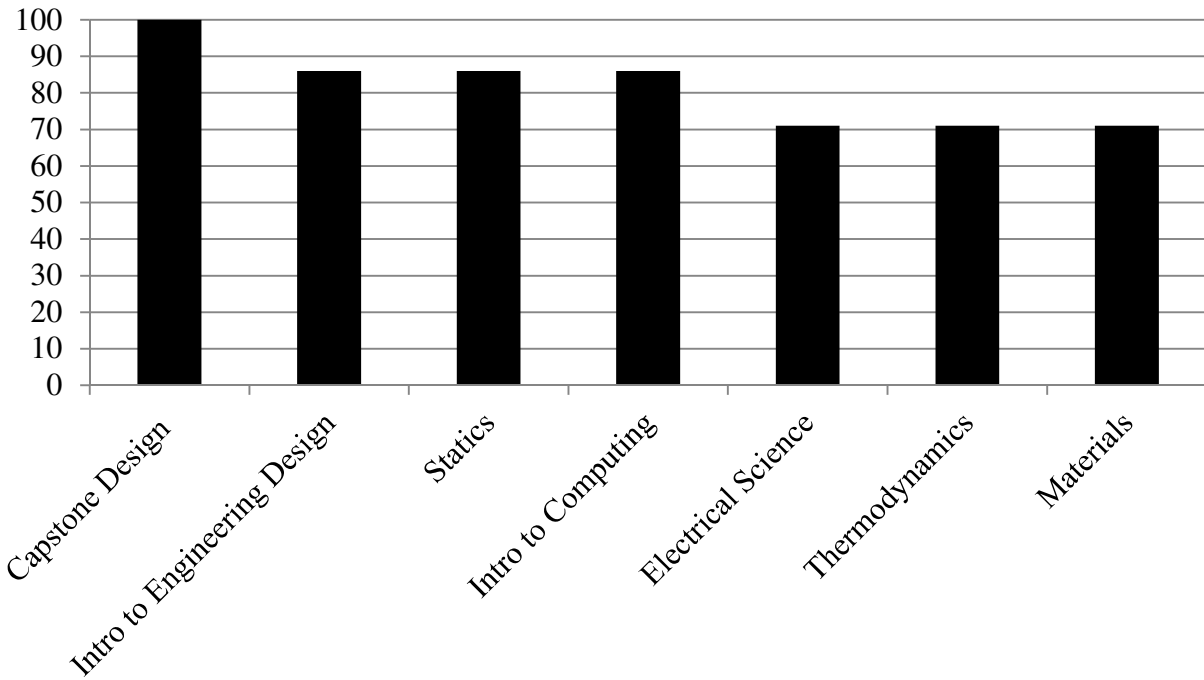
ABET criteria, in General Criteria 5, require a minimum number of credits (or minimum percentage of credits) in each of three areas: math and basic sciences, engineering topics and general education. In particular one year of a combination of college level mathematics and basic sciences is required. One year is defined as 32 semester credits or one-fourth of the credits required for graduation in the program. Basic sciences are defined as biological, chemical, and physical sciences. Most of the engineering management programs meet this criterion through a combination of math, physics and chemistry courses, some with laboratory experiences.

Figure 2<sup>3,4,5,6,7,8,9</sup> displays the most commonly required math and basic science courses and the percentage of the engineering management programs that require these specific courses. It can be seen that all programs require some calculus, some calculus-based physics and some statistics. Most also require some chemistry, differential equations and a second calculus-based physics course. Though not visible in Figure 2, all require laboratory experiences in these areas.

**Figure 2. Percent Requiring Math and Basic Science Courses**



**Figure 3. Percent Requiring Engineering Topics**



All accredited engineering management programs are also required to provide one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to engineering management. Figures 3 and 4<sup>3,4,5,6,7,8,9</sup> display the percent of accredited engineering management programs that require certain courses that fall in this category. Figure 3 contains courses that are generally considered more traditional engineering courses, while Figure 4 contains courses that are more naturally linked to engineering management. From Figure 3 it is clear that all of the programs contain a culminating capstone design experience, as is required by the ABET Criteria. Criterion 5 states:<sup>2</sup>

“Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints.”

Most also incorporate an introductory design course earlier in the curriculum. Statics, computing, electrical science, thermodynamics and a course in materials (either materials science or strength of materials) are the most commonly incorporated traditional engineering courses in the curriculum.

As seen in Figure 4, all of the engineering management programs require a course in operations and production management as well as a course in project management. A course in quality management is also a part of most of the curricula.

Most engineering management curricula also have required courses that are more traditionally considered to be business courses. The common business courses that are required are a course in economics, and also accounting (cost, managerial or financial) and marketing.

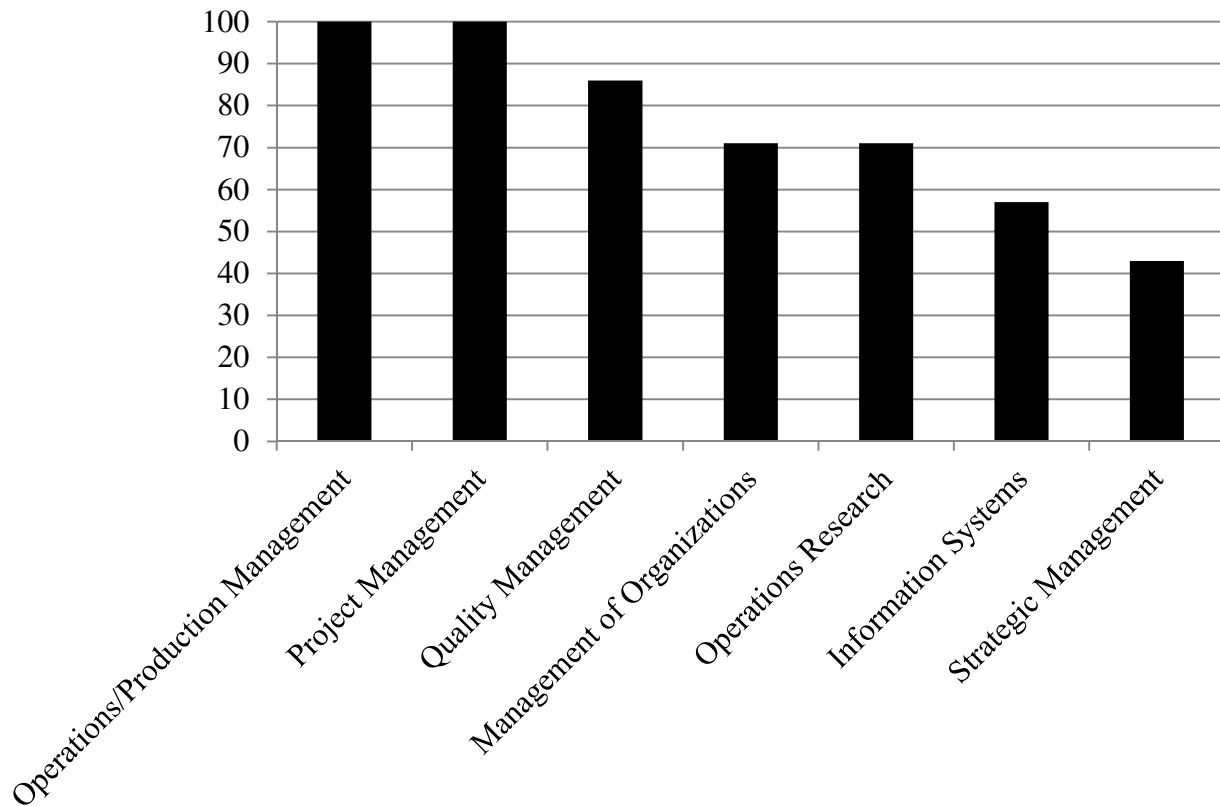
All schools also have a general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives. The general education component of the curriculum generally consists of one year of material.

### Common Curriculum

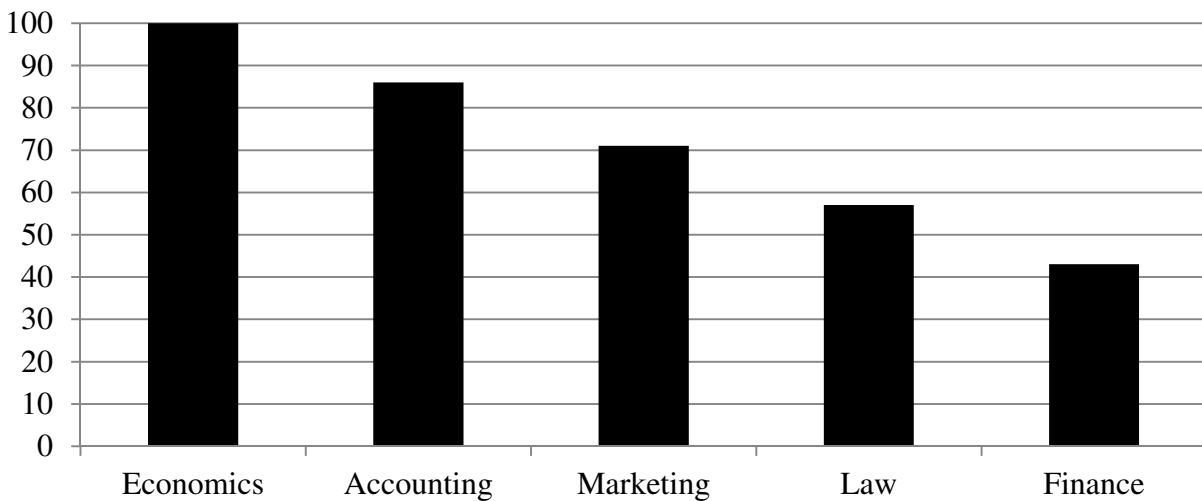
All seven schools which offer ABET EAC accredited engineering management programs have a common core of courses that make up the core of engineering management. That core is given in Table 2.<sup>3,4,5,6,7,8,9</sup>

Calculus I	Economics
Calculus II	Intro to Engineering Design
Differential Equations	Statics
Statistics	Intro to Computing
Physics I	Operations/Production Management
Physics II	Project Management
Chemistry I	Quality Management
Accounting	Capstone Design

**Figure 4. Percent Requiring Engineering Management Courses**



**Figure 5. Percent Requiring Business Topics**



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