AC 2009-208: PREPARING AN ABET SELF-STUDY: CONTINUOUS IMPROVEMENT THE SECOND TIME AROUND

Kathryn Abel, Stevens Institute of Technology

Dr. Kate Abel serves as the as the Director of Undergraduate Academics and Engineering Management in the School of Systems and Enterprises at Stevens Institute of Technology. She holds a Ph.D. in Technology Management and Applied Psychology. She has been both the President of the Engineering Management Division of ASEE and the President of Epsilon Mu Eta, the Engineering Management Honor Society. She teaches courses in Total Quality Management, Engineering Economics, Entrepreneurial Analysis of Engineering Design, Statistics for Engineering Managers, Engineering Management and Senior Design. Her research areas include knowledge engineering, as well as, knowledge and information management. She has published over 19 refereed journal articles, book chapters and conference papers.

Preparing an ABET Self Study: Continuous Improvement in the Second Time Around

Abstract:

ABET 2000 became the standard accreditation format for ABET almost a decade ago. As such, most universities have already been through their first accreditation cycle under the ABET 2000 format. Now colleges are preparing for and going through their second ABET visit under these new rules. The first Self Study for ABET 2000 took an immense amount of time and effort due to the enormous differences from the previous accreditation format. But now the change is continuous improvement? Now that universities need to show that they do not 'just' have an assessment system, but that it is used regularly and its' results are used to implement change on a continuous basis, how should colleges and universities address this aspect? How should continuous improvement be demonstrated and documented? This paper will address one college's approach to its second round with ABET 2000, and the aspects used to demonstrate the new ABET requirement of continuous improvement.

Introduction

Despite steady growth in undergraduate Engineering Management (EM) programs in the United States, only five EM programs have been accredited by the Accreditation Board of Engineering and Technology (ABET): Stevens Institute of Technology, NJ; United States Military Academy, NY; the University of Missouri Rolla, MO; University of Pacific, CA; and Arizona State University, AZ. Although there are only these five ABET accredited EM programs, there are estimated to be between 12 (Farr and Bowman) and

27 (Abel and Fernandez) EM undergraduate programs across the United States and each of these programs appears to be growing and potentially thinking about accreditation.

ABET accreditation adds credibility to an engineering program by providing endorsement of curricula, and facilitating university and external funding. However, achieving ABET accreditation can be a daunting task. This paper provides guidance to engineering programs considering accreditation or undergoing re-accreditation, by examining the experiences used for the new requirement of continuous improvement at an accredited Engineering Management Program at Stevens Institute of Technology during its year of record.

Population and Background of Stevens EM Program

The Engineering Management Program discussed herein is housed in the School of Systems and Enterprises at the Stevens Institute of Technology; a private university located across the Hudson River from Manhattan in Hoboken, New Jersey. It is a relatively large (15 fulltime faculty 10 of whom teach in the undergraduate program), well established Engineering Management (EM) Program receiving external recognition (seven awards from the American Society of Engineering Management, ASEM since 2000). The EM Program at Stevens was first ABET accredited in 1992, and successfully re-accredited in 1998 and 2004. Stevens has approximately 1500 undergraduate students, of which about 125 designated Engineering Management (EM) as their preferred discipline in the 2008 – 2009 academic year. Approximately 50% of Engineering Management students choose to participate in the five year Cooperative

Education program. Stevens graduates between 20 and 30 Engineering Management students a year with a Bachelor of Engineering Degree. Approximately 85% of these EM graduates have a job prior to graduation with a 2008 average starting salary of $63,100.

ABET: History and Role

ABET was formed in 1932 to fill the recognized need for a "joint program for upbuilding engineering as a profession" (ABET 2006). For over 80 years and in cooperation with both the engineering academic and practitioner community, ABET has been the recognized accreditation body for undergraduate engineering programs in the United States. This recognition adds to the credentials of ABET accredited college programs. In addition, without an ABET accredited undergraduate engineering program, states may refuse to issue professional engineering licenses to individuals. Thus, many colleges choose to accredit their undergraduate programs to satisfy professional licensing requirements for their graduates. Finally, accreditation inherently enhances the reputation of the Engineering profession overall and adds credibility to each university's individual engineering program.

In 1997, ABET modified its assessment processes and adopted a new set of criteria, the Engineering Criteria 2000 (EC2000). This new format of accreditation was an evaluation based on a process focusing on engineering program outcomes. ABET's accreditation criteria have molded engineering education in the past and is now molding the assessment processes used by educational institutions to determine if the institutions are succeeding at teaching what they think they are teaching.

Data Assessment and Continuous Process Improvement Documentation

Ever since EC 2000, engineering colleges have been attempting to document a process and method to quantify assessment and then display the data in a meaningful and easy to read format for ABET accreditation. Recently, however, ABET added an entirely new requirement on displaying Continuous Improvement, as well as, the assessment process itself. As most schools have gone through one accreditation cycle under ABET 2000, most schools have an assessment process in place and already have displays of the meaningful results. Thus, this new Continuous Improvement section is the main task daunting their upcoming reaccreditation cycle. There are many assessment methods used in order to be accredited under EC 2000 and many varied forms have been displayed since it began. This paper shows a few examples of the ways assessment concepts and data are used and implemented by the Engineering Management Program at Stevens Institute of Technology to show continuous improvement.

An online assessment system was adopted by Stevens Institute of Technology in the late 1990's to stream line the majority of the engineering department's assessment data collection and display the majority of its data in one easily accessible location. This system consists of surveys for students to assess learning in their classes [outcomes], and alumni to assess their satisfaction with the quality of their education, as well as, employers to assess their satisfaction with the quality of their employees (the Program's alumni) [objectives]. This assessment system produces indirect data. Thus, in addition to this, direct measures were also taken in more of a manual collection process.

It should be noted that how each engineering department chose to mold this data into the requirements of ABET's Self Study differed from program to program. In the 2003 accreditation cycle, many Stevens' programs liked what Engineering Management was doing and chose to have their Self-Studies reflect much of the format and data used by the Engineering Management Program. Although similarities between programs can be noted for 2003, it should be stated that several of Stevens' programs also had individual data displays and analyses of their own as well. Lastly, for 2009, additional data displays will be included to satisfy the requirement of documenting Continuous Improvement.

Summary of Successful Endeavors for showing Continuous Improvement

In the ABET Self Study, the new Criterion 4 requires demonstration of Continuous Improvement. Specifically ABET is looking for information used in program improvement and actions taken to improve the program. The following displays are used by the Engineering Management Program at Stevens Institute of Technology to demonstrate these concepts.

Different data displays are used for varying reasons. For example, data displays of average starting salaries are used to show that the Engineering Management Program was not standing still by having salaries stagnate, but was keeping pace with the nation by having graduates whose starting salary was comparable to those in the rest of the nation. Thus, Stevens Engineering Management graduates may be considered to be sought after and competitive in the marketplace. See Table 1.

Table I: Career Profile and Salary Report of EM Graduates+

Year	Average Stevens Starting Salary	National Average Engineering Management*
1990	$31,260	$29,571
1991	$33,050	$34,151
1992	$33,427	$35,150
1993	$33,805	$35,100
1994	$34,500	$34,000
1995	$36,826	$36,363
1996	$38,700	$40,200
1997	$43,100	n/a
1998	$43,600	n/a
1999	$46,800	$43,086
2000	$46,400	$45,600
2001	$53,300	$47,700
2002	$48,700	$47,900
2003	$47,700	$47,400
2004	$54,700	$48,800
2005	$52,900	$49,800
2006	$55,100	$51,960
2007	$55,600	$55,067
2008	$63,100	$58,252

+All results listed are distributed by the Office of Career Services at Stevens Institute of Technology.
*There is no national average for Engineering Management. The average for Industrial Engineering is used for comparative purposes.

To show evidence that assessment results were applied in the EM Program, an extensive listing was provided of changes made, an example of which is presented below. Each Program Outcome, which was associated with one of the ABET a through k, was broken down as shown below. Please see the text box below which contains data from the Stevens Engineering Management Self Study (2003).

Program Outcome 5 – (Design Assessment) Students will have the ability to develop and assess alternative system designs based on technical and non-technical criteria.
ABET Criteria 3h – the broad education necessary to understand the impact of engineering solutions in a global and societal context

EVALUATION AND PLAN OF THE EM PROGRAM

Electives contributing to this outcome include E 355, E 421, EM 301, EM 322, EM 345, EM 350, EM 357 and EM 380.

Senior Exit Survey

ABET h: Rank of Stevens vs. "All School" comparison group increased somewhat from 2000 to 2002.

Course-level

General – All items scored were adequate to high on the Student Performance Assessment Forms. Ranges from some to great and significant in learning were reported in the Student Surveys.

EM 345 – Propose adding more professional software to the Schacht Management Laboratory.

EM 357 – Change some exercises into cases.

E355 – SEED worksheets were revamped to more closely align with E 421.

Mgt 243 – The wording for this outcome's APCs was modified to more accurately reflect the content of the course.

Program-level

EM 322 will add energy conservation modules to make up for the loss of "Energy Conversation" credit in the third semester.

The EM program decided it would assess Mgt 243 in a paper format since electronic surveys were not yet available for classes outside to SoE.

Suggested changes to Outcomes or Assessment

No changes are proposed at this time.

CORE: The core *Design Spine* courses contribute to this outcome. Difficulty of handling open-ended problems was noted in the assessment of the freshmen core course E 126 Mechanics of Solids. Specific steps are being undertaken in E 126 to provide more guidance.

It was also deemed necessary to demonstrate that the Engineering Management program is continually monitored and changed as appropriate to better meet the program's objectives. Continuous process improvement is, as it states, continuous. Thus a list of specific improvements and modifications made to the EM Program and their supporting rationale was created. See Table II for an example of the data presented.

Table II – Improvements Made to the EM Program

Item	Improvement	Impetus	Date Proposed	Date Implemented
27	EM 301 was changed from Engineering Cost Management to Engineering Cost Estimation –	Advisory Board, Faculty	Spring 2005	Fall 2005
28	EM 450 was changed from Operations Management to Logistics and Operations Management	Advisory Board, Faculty	Spring 2005	Fall 2005
29	E421 was changed to have different analytical models for different disciplines or tasks. (Contractors, consultant, project, process, etc.)	Faculty, students	Spring 2005	Fall 2005
30	TG 401 and TG 501 were added to the EM section of the ACE assessment website	Faculty	Fall 2004	Fall 2005
31	As part of the process of combining EM 366 with EM 365, space was opened up in the curriculum for a new course. The new course EM 351 Management of Information Networks was first offered in the Spring 2006. It was subsequently moved to a fall course offering in Fall of 2006. (See #19 above for initial details of process.)	Advisory Board, Faculty	Spring 2005	Spring 2006
32	All course outcomes were rewritten for all courses during the 05-06 academic year, to be shorter, clearer and more succinct. Outcomes were also renumbered according to the new numbering system created by SoE. This was done to reduce ambiguity with ABET's a-k and ensure that our students were assessed on items being taught in class.	SoE, Faculty, Students	Fall 2005	Spring 2006
33	Completely reformatted the EM curriculum (what was offered when, content of courses) starting Fall 2006. This was the culmination of the process that began in 2002 (See item #11, 12 and 19 above). A total of five new courses were added or modified as part of this process (EM 365, EM 351, EM 380, EM/SYS 402 and EM 435)	Advisory Board, Faculty, students, work place	Fall 2002	Spring 2007

Finally to show longitudinal assessment over time, the overall assessment results from each outcome were compared on a yearly basis. This does require a rubric that is consistent over several years which is not often possible with a new assessment system that may be changing. However, once the assessment system is more firmly in place, a longitudinal assessment such as the one shown below is possible. In addition, although the scores cannot be expected to continually increase, verifying that the scores are not decreasing or trending in a particular direction shows that the Engineering Management Program was under constant review and not deteriorating over time, but rather keeping pace with the changing world around it. See Table III for an example. As mentioned, Table III displays assessment results for each ABET criteria over a number of years. These results vary only slightly from year to year and do not show any significant deterioration. Thus, the Stevens EM Program demonstrates through this table a longitudinal, continuous assessment and as would be hoped, a maintenance of quality in an acceptable range over several years. (Note that between 2005 and 2006 the scale changed for the indirect results from 0 to 6, to 0 to 4.)

Table III: Longitudinal Assessment of The EM Program

Stevens Program Outcomes (associated with ABET A-K)	2005 (direct/ indirect)	2006 (direct/ indirect)	2007 (direct/ indirect)	2008 (direct/ indirect)
1(a)	2.7/3.8	2.5/2.9	2.6/3.1	
2(e)	3/3.6	3/3	3/2.6	
3(b)	3/4.2	2.6/2.9	2.7/2.5	
4(c)	3.3/4.6	3.1/2.9	3.1/2.8	

Etc.

Conclusion

In summary, assessment of the Engineering Management Program Outcomes provides appropriate coverage of the EM program's Objectives. In addition, Engineering Management Program Outcomes also provide adequate coverage of the ABET Criterion outcomes a through k. And finally, the overall assessment can demonstrate that the assessments are not simply filed away but are reviewed and used to continually assess the program and assist in making changes necessary to keep the program current.

This deliberate longitudinal and continuous process ensures that successful completion of the courses results in achievement of the desired program outcomes. Since the program outcomes are constantly reviewed, any deficiencies or lack of coverage of an outcome within the survey data would indicate a deficiency and need for action. Moreover, the assessment process described above provides the opportunity for annual review ensuring that the Program Outcomes are continuously consistent with the needs of our constituencies and that they are not forgotten.

This assessment system generates specific assessment data which are collected and evaluated at the course level by individual faculty, at the program level by the Program Curriculum Committee, and finally at the School of Engineering level by the Education and Assessment committee. The cycle is completed annually and results are fed back into the long-term cycle of assessment. After completion of each cycle, the Program Assessment Committee and representative members of the program's constituency

including representatives from the Students, the Workplace, Advisory Board and Alumni evaluate the data from the reports. The Committee then makes recommendations to the Department Faculty for maintaining, modifying, or otherwise improving the curricula, programs, and the assessment process including modifications to Program Objectives. The process iterates, resulting in continuous improvement of the engineering program's education and support processes.

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