Internship and Program Outcomes

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Abstract

Many educators have attended workshops on preparing their school’s Engineering Technology programs to meet the proposed General criteria for Accrediting Engineering Technology Programs, Technology 2004-2005 Criteria. These workshops typically focus on the “how-to” of setting program goals, assessing them, evaluating the results, and using this process to establish continuous quality improvement (CQI) within the program. This paper provides a concrete example of implementing the ABET outcomes based process defined within the ABET Criteria using an internship course. This course is offered in a Mechanical Engineering Technology (MET) program. Discussion is directed at how the course is linked to its course outcomes, the MET program outcomes, and the MET program objectives. The paper demonstrates how an existing curricular element can be reviewed and modified within the context of program objectives and outcomes. It also explains how the ABET outcome based process has enhanced the MET program through just this course. Finally, the paper describes the added value of using the internship experience to further the delivery and assessment of program outcomes.

Introduction

Faculty within the MET program has spent considerable time preparing for the ABET outcomes based assessment. During this time, efforts were directed at identifying program constituents, involving constituents in the development of program objectives, and determining program outcomes that deliver to the program objectives. Additional effort was spent on identifying the following:

- Individual courses where each program outcome was being delivered.
- The methods to be used for assessing each outcome. First, this included gathering selected student examples of how they were acquiring the knowledge or skills expected by the outcome. Also, this included gathering the information necessary for other specified methods that shows proof that the students were acquiring the knowledge or skills expected by the outcome. The school’s goal was to have at least three methods for assessing each outcome and each program objective.
- The performance measures that were to be employed during the evaluation of assessment data.
- The monitoring of needed improvements.
One of the individual courses considered during this period was an internship course that is taken by students for credit during the summer months of their senior year. In this course, students are responsible to create the internship opportunity, to establish all initial contacts, and to conduct the internship according to established program procedures. All information concerning the internship regulations and procedures is available to students on a school website. The internship is conducted under the supervision of a coordinating faculty member and an onsite technical supervisor.

The internship course was specifically selected for this paper because of its inherent advantage in providing an additional vehicle for assessment of program outcomes not normally available in traditional resident instruction. Since industrial personnel are involved with the student during work experiences, they are used to help assess the program outcomes. Thus the sometimes-sparse input obtained by conventional contact with an industrial advisory board or by employer surveys is expanded upon. This assessment of designated program outcomes by external constituents is particularly valuable for the hard to assess “professional skills” outcomes of h-k (ABET Criterion 2, Program Outcomes). These are as follows:

h. a recognition of the need for, and an ability to engage in lifelong learning,
i. an ability to understand professional, ethical and social responsibilities,
j. a respect for diversity and a knowledge of contemporary professional, societal and global issues, and
k. a commitment to quality, timeliness, and continuous improvement.

Therefore, the internship course allows unique assessment opportunities that may be worthy of consideration by other academic institutions because of its inherent and continuous cooperation with industry.

Merging Outcomes of Internship Course with Existing Capstone Project Course

ABET requires a senior capstone experience (2004-2005 ABET Criteria, Criterion 4, Program Characteristics). The MET program had an existing senior capstone project course that fulfilled this ABET criterion. The question was raised, was there a second option for the seniors that would include a senior internship experience? If this was to be accomplished, it was essential that the course learning outcomes of each of the two-capstone courses be reviewed to assure an equivalent achievement of program outcomes. Also, they both had to satisfy the requirements of a capstone as required by ABET. By defining the two course outcomes as part of the ABET outcome based process, the courses were recognized as each being a valid capstone experience, although two totally different ways to accomplish the same outcomes. Seniors now have two capstone options within the program; they can complete either the internship course or a senior project course to fulfill their capstone experience as required by ABET criterion. (Nitterright et al, 2002) A direct comparison of course learning outcomes for both capstone options is shown in Table 1.
TABLE 1
Equivalent Course Outcomes
For Capstone Project Course and Internship Course
(Outcome 1 is modified to be appropriate to the particular course)

1. (Capstone project) Realize the importance of a vigorous and continued effort to search for employment throughout my senior year.

(Internship) Realize the importance of Professionalism in the workplace; that is, career development of you and your colleagues, remaining competent, working well with others, etc.

2. Realize the benefits of continuous learning, both formally and informally, throughout my career. Also, realize the benefits of graduate school, whether or not I’ve chosen to accomplish a Master’s Degree.

3. Realize the importance of a PE license, whether or not I’ve chosen to accomplish the license.

4. Realize the need of continuously adapting my career to a “changing” workplace, and of staying current and competent throughout my career.

5. Realize what professional ethics is, and its importance to the public, my colleagues, my employer, and to me.

6. Realize the need for diversity and an appreciation for competing in a global society.

7. Realize the importance of social, economic, safety, quality, and reliability issues in product realization.

8. Gain more experience in accomplishing a long-term project, and managing the progress throughout the year.

9. Gain more experience at giving formal oral presentations.

10. Gain more experiences at informal inter-personal communications with colleagues associated with this project.

11. Gain more experience in working in a professional team, with colleagues who have different views, talents, and backgrounds.

12. Gain more experience at being a team member in our goal to abide by our industrial sponsor view, concerns, and special interests in accomplishing our project.

13. Gain more experience at identifying the necessary technical and non-technical methods needed to solve an industrial problem.

Relation of the Internship Experience to Program Outcomes

The thirteen course outcomes shown above in Table 1 need to be accomplished as part of meeting the goals of the thirteen MET program outcomes as shown in Table 2. These MET program outcomes were identified to describe the knowledge and skills students are expected to acquire from the program so they are properly prepared to achieve the five
program objectives. These MET program outcomes were mapped against those of a-k in ABET Criterion 2 to show compliance. Of the program outcomes established, all MET program outcomes except 2, 4 and 10 are to be specifically assessed during the internship experience as seen in Table 2. Since this is a capstone experience, it is reasonable that most of the program outcomes are addressed in this course. However, some of the school’s program outcomes are not to be assessed within this course because there are more appropriate courses by which to assess them. In addition, several of the outcomes assessed by the internship are also assessed within other courses as well - particularly at earlier points in the student’s academic career. The specific outcomes addressed by the internship are shown in Table 2.

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<td>MET Program Outcomes</td>
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**Program Outcome 1**
Students should be able to identify, analyze, and solve technical problems in the areas of materials, manufacturing processes, mechanics, strength of materials, and in the fluid and thermal sciences.

**Program Outcome 3**
Students should be able to integrate the basic CAD systems, manufacturing knowledge, and design techniques needed for successful product realization.

**Program Outcome 5**
Students should be able to identify and use appropriate methods to validate solutions to engineering problems.

**Program Outcome 6**
Students should be able to demonstrate that a manufacturing requirement has been met.

**Program Outcome 7**
Students should be able to identify which appropriate engineering technology methods apply to a given problem.

**Program Outcome 8**
Students should be able to understand and apply the engineering design process to solve open-ended problems.

**Program Outcome 9**
Students should be able to identify social, economic, safety, quality, reliability, and ethical issues in an engineering technology problem and demonstrate that their solution to the problem addresses these issues.

**Program Outcome 11**
Students should be able to demonstrate an ability to work as a professional in a team environment.

**Program Outcomes 12**
Students should be able to recognize the need for life-long learning, be prepared to continue their education through formal or informal study, and be able to adapt to a continuously changing work environment.

**Program Outcome 13**
Students should have respect for diversity, and knowledge of global issues.

**Evidence of Achieving Program Outcomes**

ABET requires that each program utilize multiple assessment measures in a process that proves documented results demonstrate that the program objectives and outcomes are being met (2004-2005 ABET Criteria, Criterion 3, Assessment and Evaluation). The
school has gained many insights into the assessment process through available literature such as that published by Rose-Hulman Institute of Technology (Rodgers, 1996). The school has elected to use a minimum of three forms of assessment for each program outcome and objective.

For the internship experience, the first form of assessment is the faculty intern coordinator’s review of their required written responses. The student is expected to provide a written report containing documentation on how each outcome was addressed. By example, this could include calculations performed (outcome #1), CAD drawings or process specifications developed (outcome #3), discussion of rationale for and results of validation methods used such as testing, hand calculations (outcome #5), an evaluation of the level of conformance achieved by the design or process to specification (outcome #6), a discussion on why the solution approach was taken (outcome #7), a description on why the problem is open-ended and what alternative paths were considered (outcome #8), a discussion how various society issues related to their work (outcome #9), a description of their team interactions including a self-assessment of their contributions to the team effort (outcome #11), a description of their interaction with industrial colleagues for insights into life-long learning (outcome #12), and a discussion relating to advantages of various types of diversity such as education, job experience, and age (outcome #13). It should be noted that the report and presentation allows a further assessment of the students ability to communicate effectively as required by Criterion 2, g, and Criterion 4, Program Characteristics, Communications, of the ABET Criteria.

The second form of assessment involves the intern providing his/her self-assessment of accomplishing the individual outcome coupled with their responses on a senior exit survey required by all graduates and the assessment by the faculty invited to review the intern’s oral presentation given to their classmates and freshmen in the program. And finally, of great significance, the third form involves the industrial supervisor who, as an outside constituent, rates student preparedness against the prescribed outcomes.

Inherent in the internship experience, the intern has the opportunity to directly observe professional skills in the workplace. It is advantageous that they share the experience with others in the program. Therefore, each intern is required to present his internship to his peers and to freshmen within the program with specific emphasis to be given to the ‘professional skills’ outcomes identified in ABET Criterion 2, h-k. These presentations are made to students who have not completed the internship and to freshmen as part of their freshmen orientation. Thus non-participants directly benefit from the lessons learned by the intern and can identify the value of developing professional skills in these Criterion 2, h-k outcomes as they matriculate through the program. Though not done presently, these non-participants will provide written responses elaborating the value of gaining knowledge within each of ABET Criterion 2, h-k areas as further evidence that the program is addressing these particular outcomes.

After the assessment data was collected, an evaluation of the relevant program outcomes for the internship course was needed. A rating scale was chosen consisting of 1-5 (with 1 being strongly disagree to 5 being strongly agree that the outcome was accomplished).
This scale was used for the evaluating the outcomes addressed by the internship experience. The desired performance measure was to achieve a minimum of 4.0 out of 5.0 in all categories with an aggregate average score of 4.5. If any score below 3.0 was given in any category, a recommendation was requested from the reviewer on what was needed to bring the score to 5.0. The program chair, internship coordinator, and the Continuous Quality Improvement Committee (CQI) evaluated these results and made recommendations at the conclusion of the internship (usually at the end of the summer for the report and by the end of the fall term for the presentation) to identify any required corrective action.

Advantages of Internship Experience in Predicting Success in Program Objectives

By ABET’s definition, program objectives are to define what graduates of the program should be able to accomplish “during the first few years following graduation” (2004-2005 ABET Criteria, Criterion 1). Under this definition, the MET program has established five program objectives that are perceived as being accomplished by the MET recent graduates. These are listed in Table 3.

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<td>1.</td>
<td>Prepare graduates with a broad knowledge of mechanical engineering technology practices applicable to many different industry types.</td>
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<tr>
<td>2.</td>
<td>Prepare graduates with key knowledge and skills in applied design, analysis, manufacture, test, and assembly of mechanical systems.</td>
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<tr>
<td>3.</td>
<td>Prepare graduates to be productive contributors in professional practice, graduate school, or some other career path.</td>
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<tr>
<td>4.</td>
<td>Prepare graduates who know how to act in a professional manner, can continue to learn, and are capable of adapting to a continuously changing work environment.</td>
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<tr>
<td>5.</td>
<td>Prepare graduates who can communicate effectively and who can contribute as members of a team.</td>
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Since the internship experience serves as a capstone experience and occurs near the end of student matriculation through the program, its assessment is well suited to predict the success of the MET program objectives that should be accomplished by graduates in their first few years following graduation. Therefore, this “outside-of-academia” assessment of the level of student preparedness by the industrial supervisor for each of the MET program objectives is a good indicator as to whether the program is headed in the right direction, or has need for immediate improvement. This “outside-of-academia” assessment has the additional advantage of independent industrial reviews of the relevance of the chosen MET program objectives. This assessment is intended to supplement but not replace the employer satisfaction surveys targeting student performance after a first few years of experience.

ABET recognizes the importance of employer satisfaction as part of the assessment process (2004-2005 ABET Criterion 3, Assessment and Evaluation). Given the fact that
the school has extreme difficulty in obtaining feedback from employers (or potential employers), this internship course offers added input into the school’s assessment process. The number of interns in a given summer of their senior year (at least 40% of the class) allows a greatly increased rate of assessment return by potential external employers then by the school’s normally less than 10% derived by employer surveys. In addition, the interns comprise a statistically significant sampling of the class population and the results can be reasonably extrapolated to apply to the whole program by both the CQI Committee and the ABET evaluators. Finally, since the internship occurs in the summer prior to the senior year, the results of assessment can be used to immediately correct any noted deficiencies prior to graduation of the class.

Closing the Loop

The role of the internship course in the process of program continuous improvement is shown in Figure 1. The goal is to provide any needed improvements in the delivery of outcomes within the class represented by the internships. The assessment and evaluations that occur have been described previously.

![Figure 1 - Continuous Improvement Cycle](image_url)
Conclusions

The internship experience has been discussed in this paper as an example of how an existing curricular element; namely, the internship experience, can be reviewed and modified within the context of a school’s program objectives and outcomes. Advantages of the ABET outcome based process facilitated and gave credibility to two separate capstone options to achieve a capstone experience as required by ABET. The internship experience had several advantages to the ABET outcome based process; namely, an improved number of program assessment responses by external employer constituents, a valuable early predictor of success rates in graduates accomplishing the school’s program objectives, and the valuable demonstrating of professional skills of ABET Criterion 2 to non-participants such as freshmen within the program. It is hoped that the discussion of this example might aid other institutions in the restructure of their curricular elements to derive similar benefits.

Bibliographic Information


Bibliographical Information

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