William Danley, Drexel University
William Danley, Drexel University Dr. William Danley, Clinical Assistant Professor Applied Engineering Technology in the Goodwin College, Drexel University, taught and developed undergraduates courses in thermodynamics, thermal system design, fluid mechanics, thermal, pneumatics and hydraulics laboratories, materials engineering, analytical chemistry and engineering economics. Prior to returning to academia, he worked in industry for a number of Fortune 500 companies and was granted four patents relating to spectrometers and electrochemical sensors used in industrial control.

Vladimir Genis, Drexel University
Vladimir Genis, Drexel University Dr. Vladimir Genis, Associate Professor and Program Director of Applied Engineering Technology in the Goodwin College, Drexel University, taught and developed graduate and undergraduate courses in physics, electronics, nondestructive testing, biomedical engineering, and acoustics. His research interests include ultrasound wave propagation and scattering, ultrasound imaging, nondestructive testing, electronic instrumentation, piezoelectric transducers, and engineering education. He serves as a member of the Drexel’s Faculty Senate.
Continuous Quality Improvement Process for Applied Engineering Technology Program at Drexel University

Abstract

The Applied Engineering Technology (AET) Program at Drexel University recognizes the need for periodic assessment and evaluation to ensure that AET is achieving its mission. This paper describes how the assessment and evaluation of Program Educational Objectives and Program Outcomes leads to an annual “Continuous Quality Improvement (CQI) Report” for the AET Program. The presented methodology demonstrates how assessment data is compiled, how the data is analyzed, and how the analysis is translated into an understanding of the program, including required actions to improve the program. The recommended actions are incorporated into the program’s future assessment and evaluation procedures to validate the program’s improvement. Useful templates for collecting and storing assessment data are described and examples of histograms are presented that demonstrate the assessment results. The information is summarized in a series of standard “Student Learning Outcomes at the Program Level” that present the evaluated results with any needed actions that were taken. This information is also tied to the next cycle of the evaluation process.

Introduction

The undergraduate Applied Engineering Technology (AET) Program started at Drexel University in 2002. The program prepares students for high-level employment in an industrial environment. The program is comprised of three concentrations: Electrical Engineering Technology, Mechanical Engineering Technology, and Industrial Engineering Technology. The students learn in a hands-on environment by using state-of-the-art laboratories that replicate real-life industrial processes and techniques. Students learn to work on multidisciplinary teams and solve technical problems by applying principles and theories of science, engineering, and mathematics.

This paper describes how the assessment and evaluation of Program Outcomes are conducted to validate that students are achieving the Program Educational Objectives (PEO)\(^1\). In the first section, an internal process is presented in detail, which leads to an understanding of how program outcomes are translated into measurable performance criteria with assessment rubrics. Students and facilities are assessed to validate the program educational practices and strategies based on the collected assessment evidence accumulated for analysis\(^2\). This evidence is interpreted to gain an understanding of the program and results in a continuous quality improvement of the program through specific implemented actions\(^3,4\). In the second section, the process for establishing and maintaining Program Educational Objectives is presented. The major constituents’ role in this process is to assess and evaluate these PEOs and approve any changes.
Continuous Quality Improvement Process

The CQI process is based on Program Outcomes that are consistent with the AET Mission and the Program Educational Objectives. A list of outcomes from a through k is designated by the Accreditation Board of Engineering and Technology (ABET). The Drexel’s AET program is relatively new, so the ABET list of outcomes was adopted unchanged. In general, the CQI process requires collection of assessment information from all aspects of the program that are scored to measure performance criteria\(^6,7\). The assessment information is evaluated and a CQI of the program report is produced annually, which implements program improvements through recommended actions\(^8\). The program’s goal is to score an overall average of 3.0 or better (in scale from zero to five) which indicates that students meet all Program Outcomes (See Figure 2). A flow chart titled Continuous Improvement of the Program (Figure 1) depicts the details of this process.

![Continuous Improvement of the AET Program](image)

Figure 1. Continuous Improvement of the AET Program.

The CQI report may recommend changes to the Program Outcomes\(^9\) consistent with ABET requirements. As recommended by this report, the AET Curriculum Committee may change the
Performance Criteria and the corresponding assessment rubrics\textsuperscript{5, 6, 7, 10}. In a like manner, changes can be made to each successive block in the CQI flow chart (Figure 1).

At the end of each term, the assessment information in the form of scored documents relating to individual student performance is collected from course instructors and CO-OP employers. A typical Assessment Sheet for a course is presented in Figure 2. This information is summarized in Course Assessment Summary Sheets and Survey Assessment Summary Sheets. Samples of these summary sheets are presented in Figure 3 and Figure 4.
# MET 209 - Fluid Power – Goodwin College - Drexel University

## Performance Criteria Assessment

**Student Name:** Joe Student  

**Instructor:** Dr. Robert Instructor  
**Term:** Winter 200825  
**Campus:** Drexel

**Instructions:** Circle one description that best represents your evaluation of each Outcome/Performance Criterion. Descriptions are found in either the Exceeds, Meets, Minimally Meets, or Fails to Meet columns.

<table>
<thead>
<tr>
<th>Outcome/Performance Criteria</th>
<th>Exceeds</th>
<th>Meets</th>
<th>Minimally Meets</th>
<th>Fails to Meet</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome k. /Performance Criterion 2.</strong> Manages time and specifically plans for general review of work to improve results.</td>
<td>(5)</td>
<td>(3)</td>
<td>(1)</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Manages time effectively and specifically plans for general review of work to improve results. Implements an improvement plan.</td>
<td>Manages time well and specifically plans for general review of work to improve results.</td>
<td>Sometimes fails to manage time well or sometimes does not set time for general review.</td>
<td>Manages time poorly and often does not set time for general review of work to improve results.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Figure 2. Course Assessment Sheet
Outcome Letter: a

Course Type: EET  Course Number: 202
Section Number: 701  Campus Taught: Drexel University
Term: Fall  Academic Year: 07-08

Performance Criterion Assessed: Demonstrates mastery of the skills of their discipline.

Assessment Method: Locally developed examination (Locally developed examinations may include quizzes, mid-term examinations and final examinations)

Educational Practices / Strategies: Coursework and Curricular Patterns

![EET 202 - A1 - Drexel](chart)

Average Score = 3.25  One Standard Deviation = 1.42

Figure 3. Sample of the Course Assessment Summary Sheet (These assessments are scored by each faculty member for a particular Scoring Rubric for all students).
Outcome Letter: a

Academic Year: 07-08

Survey type: 2. Example CO-OP Employer Survey

Performance Criterion Assessed: Demonstrates mastery of the skills of their discipline.

![Bar Chart]

Average Score = 4.00  One Standard Deviation = 1.10

Figure 4. Sample of the Survey Assessment Summary Sheet.

Figure 3 and Figure 4 have pull down menu features that allow selection of all items ending in a colon so the basic information is easily entered. Student’s scores are used to produce histograms for each assessed performance criterion to visualize the distribution of results. The average and one standard deviation are also posted. The histograms and averages identify areas where improvement needs to be made. During the 2007-2008 and 2008-2009 academic years, 206 Assessment Summary Sheets were collected representing 170 students. All Program Outcomes were assessed in this period and presented to the ABET evaluators during their visit in October 2009. In the future, all Program Outcomes will be evaluated on a three-year cycle as described in our program’s Self-Study report. This information forms the basis for evaluation of each Program Outcome and is documented using the format “Student Learning Outcomes at the Program Level”. Figure 5 and Figure 6 show the Program Outcome a, “An appropriate mastery of the knowledge, techniques, skills and modern tools of their discipline”, displayed with all relevant information required by ABET and in a form useful for AET Program improvement and follow up. The format for these figures is patterned to the example suggested in the “Faculty Workshop on Assessment and Program Outcomes” conducted in 2006. The information presented in this format summarizes what was reviewed, the assessment methods used, and general information about the evaluator and evaluation time period. Further, the results of the evaluation are discussed with included histograms to summarize the findings and recommended actions. All assessment components are compiled and used to produce an annual CQI report.
<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>Strategies</th>
<th>Assessment Method(s)</th>
<th>Context for Assessment</th>
<th>Time of data collection</th>
<th>Assessment Coordinator</th>
<th>Evaluation of Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstrates mastery of the skills of their discipline.</td>
<td>EET202, MHT222, MET421, MET422, MET423, EET404, MHT224, MHT405</td>
<td>Locally developed exams, external examiner, oral examinations, scoring rubrics</td>
<td>EET 202 MET 423</td>
<td>Start of academic year 07-08 on a three year cycle</td>
<td>William Danley</td>
<td>Department Assessment and Evaluation Committee</td>
</tr>
<tr>
<td>Applies techniques used in their discipline.</td>
<td>MHT205, MHT402, MET422, MET423, EET402</td>
<td>Locally developed exams, behavioral observations, scoring rubrics</td>
<td>MHT 205 MET 422</td>
<td>Start of academic year 07-08 on a three year cycle</td>
<td>William Danley</td>
<td>Department Assessment and Evaluation Committee</td>
</tr>
<tr>
<td>Demonstrates mastery of knowledge in their discipline.</td>
<td>EET206, MET421, MET422, MET423, EET407, MHT380</td>
<td>Locally developed exams, external examiner, scoring rubrics</td>
<td>EET 206 MET 423</td>
<td>Start of academic year 07-08 on a three year cycle</td>
<td>William Danley</td>
<td>Department Assessment and Evaluation Committee</td>
</tr>
<tr>
<td>Employs modern tools used in their discipline.</td>
<td>MET100, MET310, EET324, MET422, MET423, MHT314</td>
<td>Locally developed exams, performance appraisal, scoring rubrics</td>
<td>MHT 314 MET 422</td>
<td>Start of academic year 07-08 on a three year cycle</td>
<td>William Danley</td>
<td>Department Assessment and Evaluation Committee</td>
</tr>
</tbody>
</table>

Figure 5. Learning Outcome a. An appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines.
Results (date): It was observed that students achieved an appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines. The presented results demonstrate that 91%, 88%, 93% and 100% of scores from the Context for Assessment for courses and surveys met the Applied Engineering Technology goal. The included histograms show the results graphically. These results and some other capstone results from courses and surveys are presented. All performance criteria for this Program Outcome were assessed using triangulation from a variety of Assessment Methods. They encompass the Educational Practices/Strategies as detailed in program’s CQI. The assessment summaries indicate agreement that the outcome was met through third party assessment.

![Histograms for Outcome a1, a2, a3, a4](image)

Actions (date): Based on the analysis of these results, no action is recommended at this time.

Second-Cycle Results (date): Since no actions were recommended, the evaluation process as outlined in Continuous Improvement – Process Timetable for Assessment and Evaluation of Applied Engineering Technology Program of our self-study will be reviewed as indicated in the schedule.

Figure 6. Description of Results and Actions with Histograms for Outcome a.
Program Educational Objectives

The information collected and documented in Survey Assessment Summary Sheets from recent graduates and their employers indicates how well AET meets the Program Educational Objectives (PEO). Program objectives are broad statements, which describe the career and professional accomplishments that our program is preparing our graduates to achieve. Program Educational Objectives are listed and discussed in self-study reports provided to ABET prior to evaluation visits. It is important to note that PEOs are consistent with the program mission and with the program outcomes as indicated in Figure 1. This information is included in the CQI report and is made available to AET Industrial Advisory Committee. These results are reviewed during the biannual meetings and may be used to improve or update Program Educational Objectives.

Summary

The AET Program at Drexel University has developed an effective methodology for assuring that the program is meeting the program mission. The students’ data are collected and used for preparing an understandable CQI report that accurately portrays how well the program is meeting the Program Outcomes and Program Educational Objectives. The format is consistent with the methodology suggested by ABET, so the program is assured to meet ABET requirements and the needs of industry. The collected information is useful to the program constituents and to the public, so that they can form opinions about the program and understand the value of the program to the students. Examples of the documents used during the CQI process to help in the extensive task of accumulating and storing data are discussed. Visual tools, such as histograms and performance statistics are presented. The recommended actions are incorporated into the program and evaluated in future assessments to validate program improvement.

Bibliography:


