

Continuous Improvement Plan  
Mechanical Engineering Technology  
Eastern Michigan University  
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## **Introduction**

Eastern Michigan University offers a bachelors of science degree in Mechanical Engineering Technology. A comprehensive assessment program to evaluate the program objectives and the student outcomes to improve the program on a continuous basis has been initiated. This document outlines the procedure with which the outcomes and objectives are assessed and the results are evaluated and then benchmarked against targeted goals and how the curriculum and/or program requirements are changed to meet these goals. The continuous improvement process is based upon the assessment, evaluation and comparison to targeted levels of performance and then feedback to changes in the curriculum. The program objectives and student outcomes are defined to be in compliance with the Accrediting Board of Engineering and Technology (ABET).<sup>1</sup> Note this process is documented on the MET website <http://www.emich.edu/cot/progsites/met/> for review. Comments and suggestions should be sent to [mbrake@emich.edu](mailto:mbrake@emich.edu)

For the purpose of this document, the following definitions are used.<sup>1</sup>

“While ABET recognizes and supports the prerogative of institutions to adopt and use the terminology of their choice, it is necessary for ABET volunteers and staff to have a consistent understanding of terminology. With that purpose in mind, the Commissions will use the following basic definitions:

**Program Educational Objectives** – Program educational objectives are broad statements that describe what graduates are expected to attain within a few years of graduation. Program educational objectives are based on the needs of the program’s constituencies.

**Student Outcomes** – Student outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students attain as they progress through the program.

**Assessment** – Assessment is one or more processes that identify, collect, and prepare data to evaluate the attainment of student outcomes and program educational objectives. Effective assessment uses relevant direct, indirect, quantitative and qualitative measures as appropriate to the objective or outcome being measured. Appropriate sampling methods may be used as part of an assessment process.

**Evaluation** – Evaluation is one or more processes for interpreting the data and evidence accumulated through assessment processes. Evaluation determines the extent to which student outcomes and program educational objectives are being attained. Evaluation results in decisions and actions regarding program improvement.”

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<sup>1</sup> <http://abet.org/Linked%20Documents-UPDATE/Program%20Docs/abet-tac-criteria-2011-2012.pdf>

## **Program Educational Objectives**

- PEO1.** Graduates will be gainfully employed in careers where they will continue to build upon their technical knowledge using modern tools for the design and improvement of products, processes and new technologies.
- PEO2.** Graduates will be effective in working in teams of diverse professionals of varied technical or business positions.
- PEO3.** Graduates will be able to effectively communicate in written and oral formats.
- PEO4.** Graduates will engage in lifelong learning activities with a commitment to continuous improvement in their professional and personal lives.
- PEO5.** Graduates will exercise an understanding of diversity, ethical and social responsibilities in their professional lives and in community service.

## **Student (Program) Outcomes**

ABET has 11 general student outcomes as well as several outcomes related to MET programs, listed below:

- a. an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities;
- b. an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies;
- c. an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes;
- d. an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives;
- e. an ability to function effectively as a member or leader on a technical team;
- f. an ability to identify, analyze, and solve broadly-defined engineering technology problems;
- g. an ability to apply written, oral, and graphical communication in both technical and nontechnical environments; and an ability to identify and use appropriate technical literature;
- h. an understanding of the need for and an ability to engage in self-directed continuing professional development;
- i. an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity;
- j. a knowledge of the impact of engineering technology solutions in a societal and global context; and
- k. a commitment to quality, timeliness, and continuous improvement.

We have added additional student outcomes based upon ABET's criteria for a mechanical engineering technology program.

- l. Technical expertise encompassing the areas of materials (including strength of materials), statics and dynamics, fluid mechanics, thermodynamics and electronics.
- m. Technical expertise in computer-aided drafting/design, manufacturing, experimental techniques/procedure, analysis of engineering data, and machine/mechanical design.
- n. Expertise in the analysis, design, development, implementation, or oversight of more advanced mechanical systems.

Table 1. Relationship between Program Objectives and Student Outcomes

	Student Outcomes (ABET a - k, and l – m)	Program Objectives				
		1	2	3	4	5
<b>SO1</b>	An ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities (ABET 3B.a)	X				
<b>SO2</b>	An ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies (ABET 3B. b)	X				
<b>SO3</b>	An ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes(ABET 3B. c)	X	X			
<b>SO4</b>	An ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives (ABET 3B. d)	X				
<b>SO5</b>	An ability to function effectively as a member or leader on a technical team (ABET 3B. e)	X	X			
<b>SO6</b>	An ability to identify, analyze, and solve broadly-defined engineering technology problems (ABET 3B. f)	X				
<b>SO7</b>	An ability to apply written, oral, and graphical communication in both technical and nontechnical environments; and an ability to identify and use appropriate technical literature (ABET 3B. g)	X	X	X		
<b>SO8</b>	An understanding of the need for and an ability to engage in self-directed continuing professional development (ABET 3B. h)				X	
<b>SO9</b>	An understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity, (ABET 3B. i)					X
<b>SO10</b>	A knowledge of the impact of engineering technology solutions in a societal and global context (ABET 3B. j)					X
<b>SO11</b>	A commitment to quality, timeliness, and continuous improvement (ABET 3B. k)				X	
<b>SO12</b>	Technical expertise encompassing the areas of materials (including strength of materials), statics and dynamics, fluid mechanics, thermodynamics and electronics (ABET 9. l)	X		X		
<b>SO13</b>	Technical expertise in computer-aided drafting/design, manufacturing, experimental techniques/procedure, analysis of engineering data, and machine/mechanical design (ABET 9. m)	X	X	X		
<b>SO14</b>	Expertise in the analysis, design, development, implementation, or oversight of more advanced mechanical systems (ABET 9. n)	X				

## Review of Program Outcomes and Student Objectives

The program outcomes will be periodically reviewed (every other year) with the engineering technology faculty and the industrial advisory board. The student objectives will follow the ABET guidelines and the program coordinator will update the student outcomes on a yearly basis depending upon what if anything has changed. These changes may result in changes of specific assessments, particularly embedded assessments as well as the senior exit survey and the alumni survey.

The student outcomes are related to the curriculum in the following table.

Table 2. Required Courses and Their Relationship to Student Outcomes

Student Outcomes	cr	1	2	3	4	5	6	7	8	9	10	11	12	13	14
ET 100 Intro to E.T.	2		x		x	x		x					x		
ETE 101 Intro to ET Computing	1	x					x							x	
CHEM 121/122* Gen. Chem. I	4		x	x											
PHYS 221 or 223Mech, Sound*	4/5		x	x											
PHYS 222 or 224 Electricity & Light	4/5		x	x											
ELEC 200 Circuits	3				x								x		
ELEC 218 Motors	3				x								x		
MATH 105/107 algebra/trig	5		x												
MATH 120 Calculus I* or MATH 140 Applied Calculus I*	4		x												
MATH 121 Calculus II or MATH 141 Applied Calculus II	4/3		x												
SET 350 Writing for Engineering	3							x							
MET 211 Statics	3		x	x			x			x			x		
MET 312 Dynamics	3		x				x			x			x		
MET 313 Mech. of Materials	3		x	x		x	x						x		
MET 314 Thermo/Heat	3	x	x	x		x	x	x		x			x	x	
MET 316 Design for Manufacture	3	x			x	x								x	x
MET 319 Fluid Mechanics	3	x	x	x		x	x	x		x	x		x	x	
MET 387 Co-op Ed	3	x			x	x		x				x			
MET 411 Machine Design	3	x	x			x	x						x	x	x
MET 437 Kinematics Machines	3	x	x			x	x						x	x	
MET 470 Vibrations	2		x	x			x			x					
MET 492 Senior Design I	3	x			x	x	x	x	x	x	x	x	x		x
MET 493 Senior Design II	3	x			x	x	x	x	x	x	x	x	x		x
PDD 111 Materials	3	x					x						x		
PDD 122 Eng. Graphics	4	x					x							x	
PDD 123 Manufacturing Processes	4	x					x							x	
PDD 435 Finite Element	3		x				x	x					x		

Program Outcome Assessment Techniques

- Survey of Alumni will be implemented every five years starting with the 2008 - 2009 academic year alumni survey.
- Industrial Advisory Board, made up of employers, industrial representatives who work with the senior design course and at least one alumnus will meet at least once per year in a face-to-face meeting and several times per year via email. Their input will be solicited regarding changes to both the program outcomes as well as the specifics of the program.
- Employment trends of our graduates will be tracked, e.g. place of employment and job title, every year.
- Survey of Employers of Graduates will be given at least every other year to determine if the program objectives are still relevant to the employers of our graduates.
- The program outcomes themselves will be re-evaluated every few years first by the faculty and then with the Industrial Advisory Board. Informal review of the program outcomes will occur in conversations with alumni.

Table 3. Summary of assessment and its link to program educational objectives (PO)

<b>Assessment Technique</b>	PO1	PO2	PO3	PO4	PO5	PO6	
Survey of Alumni	x	x	x	x	x	x	Every 5 years
Industrial Advisory Board	x	x	x	x	x	x	annually
Employment Trends	x						annually
Employer Survey	x	x	x	x	x	x	biannual

Summary of Student Outcomes Assessment Techniques

- Alumni survey as described above but a portion that addresses the student outcomes.
- Co-op Employer evaluation data is obtained at the end of the student co-op experience from co-op employer surveys regarding student performance.
- Student Co-op evaluation data is obtained from students at the end of their co-op experience regarding the students' perception of their performance.
- Senior Exit Survey are given every year in the senior design capstone class to determine how well students feel they have achieved the student outcomes.
- Summary of Student Performance is gathered in the form of final grades for each of the MET courses.
- Evaluation of student data, specifically of transcripts for each graduate, is analyzed for time to graduation and retention rate as well as performance in MET courses.
- Embedded Assessment is performed in every class, every year. Not all student outcomes are evaluated in every single class but a representative sample is chosen.

This will be accomplished by assess student assignments, quizzes, exams, lab reports, projects and presentations.

- The student objectives will follow the recommended outcomes by ABET. The program coordinator will check the ABET website every fall to look for upcoming changes. These changes may impact specific assessments, particularly embedded assessments.

Table 4. Summary of Assessment and its link to Student Objectives

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14
Alumni Survey	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Survey of Co-op Employer					x			x			x			
Student Co-op Survey					x			x			x			
Senior Exit Survey	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Student Performance	x	x	x	x	x	x	x		x	x	x	x	x	x
Student Data Evaluation		x		x		x								
Embedded Assessment	x	x	x	x	x	x	x		x	x	x	x	x	x

### Targeted Benchmarks

- 75% of our students will be employed within one year of graduation
- 85% of our students will be employed within two years of graduation
- 80% of our alumni will be engaged in professional development and/or show a commitment to lifelong learning.
- An average score of 70% or less of the acceptable level as determined by the instructor on any individual embedded assessment will result in an action item for improvement.
- On all surveys, at least 80% of the response will be ‘strongly agree’ or ‘agree’, or the response will result in an action item for improvement.
- A majority vote of the Industrial Advisory Board (IAB) for a considered action will result in implementation of that action. Items recommended by any individual member of the IAB will be put to the entire Board for their input and vote.
- 80% of all students will receive a B- or better in the MET courses.
- Majority of students will perform satisfactorily or above on embedded assignments. Types of embedded assessment vary from instructor to instructor and depend on the class. So it is up to the instructor to determine ‘satisfactory’ for their particular assessment.

### Responsibilities of Assessment, Evaluation, and Continuous Improvement Process

Faculty who teach the core MET courses are responsible for writing the rubrics for embedded assessment and for determining level of acceptable performance. These faculty are responsible for keeping track of the assessment and for offering changes to the program, if needed based upon the results of assessment. Currently the faculty includes Professors

Mary Brake, Harvey Lyons and Tony Shay. The program coordinator, currently Professor Mary Brake, is responsible for data collection of all other assessments and for correspondence with the Industrial Advisory Board.

The MET Assessment Committee has been formed to perform a yearly internal audit of the continuous improvement process. This committee is currently made up of the MET faculty who will meet after the Winter semester each academic year. Action plans resulting from this annual meeting will be presented to the Industrial Advisory Board (IAB) and depending upon the action plan, the entire School of Engineering Technology faculty.

The program coordinator is responsible for communicating the results of the assessment (when appropriate) with MET faculty, with School of Engineering Technology (SET) faculty, with the Industrial Advisory Board, and with students and parents. The program coordinator is responsible for implementing continuous improvement by filling out appropriate paperwork and following it through the 'input process'. The input process includes bring proposed changes to the Instructional Committee and then the SET faculty for a vote. The program coordinator will keep track of the changes as they proceed through the University system and, when adopted, ensures that the changes are implemented.

#### Data Collection and Analysis

- 1) Direct assessment data
  - Will be collected during each semester and analyzed during May of each academic year.
  - Analysis will be discussed by faculty involved in teaching MET courses for suggested action.
  - IAB input will be sought after the initial analysis of data by faculty, depending upon the level of action.
- 2) Indirect assessment data
  - Will be collected on the timescale mentioned in the above table.
  - The analysis will be performed by the program coordinator.
  - Analysis will be discussed with the faculty, the IAB, and depending upon the situation, students, and suggested action will be solicited and implemented.

#### Action plans can take the form of the following:

1. Make modifications to a course curriculum.
  - Add or remove review of specific topics and/or
  - Add or remove additional topics and/or
  - Add, modify or remove experiments or projects and/or
  - Add, modify, or remove specific assignments.
2. The following actions would ultimately require approval from the University Input System.
  - Modify course content in a major way such that course description is changed
  - Change course prerequisites
  - Add or remove required courses
  - Change program requirements

## Dissemination

After any action has been taken, the action will be assessed with the most appropriate assessment tools listed above and a review of the action will be discussed with faculty, the IAB and with students.

Changes that are approved by the Input Process will be added to the University Catalog, which will be the source of information for all other publications and websites in the near future.

Students – the websites that describe the curriculum and program will be updated with any and all actions that take place. Emails will be sent to all MET students with the changes to the curriculum along with a discussion of how the changes impact current students.

Industrial Advisory Board – will have at least one face-to-face meeting per year. In between times, information will be solicited via email.

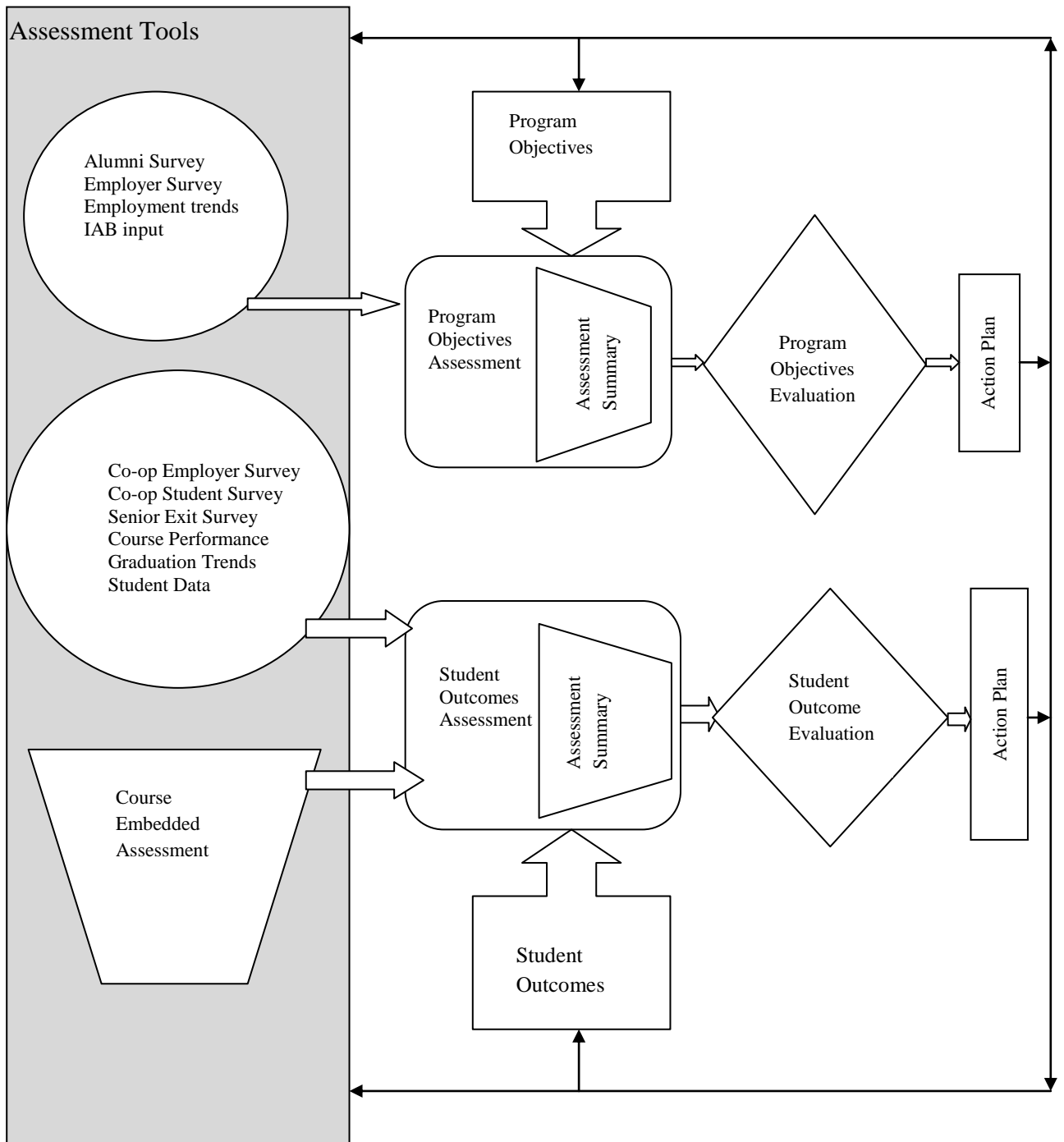
Faculty – will be informed of assessment results and subsequent changes via faculty meetings, emails, and written memos.

Alumni – will be informed of changes to the program objectives and the program itself via email and phone calls.

Members of the Engineering Technology Community – major changes based upon detailed assessment will be presented at ASEE regional and national meetings as well as publications.

A summary of the continuous improvement process is given in the schematic that follows.

The continuous improvement process<sup>2</sup>



<sup>2</sup> Patterned after Bloomsburg University,  
[http://departments.bloomu.edu/physics/physicsWebsite/document/Web\\_Program%20Assessment%20and%20Continuous%20Improvement%20Plan.pdf](http://departments.bloomu.edu/physics/physicsWebsite/document/Web_Program%20Assessment%20and%20Continuous%20Improvement%20Plan.pdf)