Eastern Michigan University
Mechanical Engineering Technology
Continuous Improvement Plan

Prepared by Prof. M. Brake
June 2013
Eastern Michigan University offers a bachelor’s 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 and program policies and requirements. The program objectives and student outcomes are defined to be in compliance with the Accrediting Board of Engineering and Technology (ABET). 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

For the purpose of this document, the following definitions are used (from the ABET 2011 - 2012 Guidelines).

“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.”
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 non-technical 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

<table>
<thead>
<tr>
<th>Program Educational Objectives</th>
<th>Supporting Student Outcomes</th>
</tr>
</thead>
</table>
| 1. 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. | a) Ability to apply modern tools to broadly-defined engineering technology activities  
    b) Ability to apply math & science  
    c) Ability to design and conduct experiments/analyze data  
    d) Ability to design solutions for broadly defined ET problems  
    e) Ability to function on teams  
    f) Ability to analyze and solve broadly defined problems  
    g) Ability to communicate effectively  
    l) Technical expertise in materials, statics, dynamics, fluids, thermodynamics, and electronics.  
    m) Technical expertise in CAD, manufacturing, analysis of data and machine design  
    n) Technical expertise in analysis, design, development, and implementation of advanced mechanical systems. |
| 2. Graduates will be effective in working in teams of diverse professionals of varied technical or business positions. | c) Ability to design and conduct experiments/analyze data  
    e) Ability to function on teams  
    g) Ability to communicate effectively  
    m) Technical expertise in CAD, manufacturing, analysis of data and machine design |
| 3. Graduates will be able to effectively communicate in written and oral formats.                 | g) Ability to communicate effectively  
    l) Technical expertise in materials, statics, dynamics, fluids, thermodynamics, and electronics.  
    m) Technical expertise in CAD, manufacturing, analysis of data and machine design |
| 4. Graduates will engage in lifelong learning activities with a commitment to continuous improvement in their professional and personal lives. | h) Engage in continuing professional development  
    k) Commitment to quality, timeliness, and continuous improvement. |
| 5. Graduates will exercise an understanding of diversity, ethical and social responsibilities in their professional lives and in community service. | i) Commitment to professional and ethical responsibilities including diversity.  
    j) Knowledge of the impact of engineering technology solutions to society and the world. |

Review of Program Outcomes and Student Objectives

The program outcomes will be periodically reviewed (every third 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

<table>
<thead>
<tr>
<th>Course</th>
<th>ET</th>
<th>CET</th>
<th>MET</th>
<th>MET</th>
<th>MET</th>
<th>MET</th>
<th>MET</th>
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<th>MET</th>
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<th>MET</th>
<th>MET</th>
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<tbody>
<tr>
<td>I = Introduce; R = Reinforce:</td>
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</tr>
<tr>
<td>E = Emphasize</td>
<td>100</td>
<td>151</td>
<td>211</td>
<td>312</td>
<td>313</td>
<td>314</td>
<td>316</td>
<td>319</td>
<td>411</td>
<td>437</td>
<td>470</td>
<td>435</td>
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</tbody>
</table>

1. Ability to apply modern tools to ET activities
2. Ability to apply math & science
3. Ability to design and conduct experiments/analyze data
4. Ability to design solutions for broadly defined ET problems
5. Ability to function on teams
6. Ability to analyze & solve broadly defined problems
7. Ability to communicate effectively
8. Engage in continuing professional development
9. Commitment to professional & ethical responsibilities including diversity
10. Knowledge of the impact of ET solutions to society and the world.
11. Commitment to quality, timeliness, and continuous improvement.
12. Technical expertise in materials, statics, dynamics, fluids, thermo, & electronics
13. Technical expertise CAD, manuf., analysis of data and machine design
14. Technical expertise in analysis, design, devel., implem. of adv. mech. systems.

1. I = introduce, R = reinforce, and E = Emphasize; **BOLD** indicated assessed outcomes
Program Outcome Review

- The program outcomes will be evaluated every three years first by the faculty and then by the Industrial Advisory Board. Informal review of the program outcomes will occur in conversations with alumni.

Summary of Student Outcomes Assessment Techniques

- Alumni survey
- 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 is given every year in the senior design capstone class to determine how well students feel they have achieved the student outcomes.
- 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 MET course on a three year cycle. Not all student outcomes are evaluated in every single class but a representative sample is chosen. This is accomplished by assessing 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.
- Analysis of student data will be performed every five years to get an idea of ‘the big picture’ in terms of enrollment, graduation data, success in terms of grades in key MET courses to name a few.
Table 3. Summary of Assessment and its link to Student Objectives

<table>
<thead>
<tr>
<th>Course Embedded Assessment</th>
<th>Alumni Survey</th>
<th>Survey of Co-op Employers</th>
<th>Student Co-op Survey</th>
<th>Senior Exit Survey</th>
<th>Student Data Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Ability to apply modern tools to ET activities</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Ability to apply math &amp; science</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>c) Ability to design and conduct experiments/analyze data</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
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<tr>
<td>d) Ability to design solutions for broadly defined ET problems</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>e) Ability to function on teams</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>f) Ability to analyze &amp; solve broadly defined problems</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>g) Ability to communicate effectively</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>h) Engage in continuing prof. development</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>i) Commitment to professional &amp; ethical responsibilities including diversity</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>j) Knowledge of the impact of ET solutions to society and the world.</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>k) Commitment to quality, timeliness, and continuous improvement.</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>l) Technical expertise in materials, statics dynamics, fluids, thermo. electronics</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>m) Technical expertise in CAD, manuf., analysis of data and machine design</td>
<td>X</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>n) Technical expertise in analysis, design, devel., implem. of adv. mech. systems.</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
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</tbody>
</table>

Schedule for Assessment

- Course embedded assessment will follow, Table 4.
- Alumni survey will take place every five years starting with 2008.
- Survey of Co-op Employers data will be compiled every other year starting Fall 2011.
- Survey of Student Co-op Survey data will be compiled every other year starting Fall 2011.
- Senior Exit Survey data will be compiled every year.
- Student data will be compiled every five years starting 2018. The next compilation will be during the 2013 – 2014 academic year.
Table 4. Embedded Assessment Schedule

<table>
<thead>
<tr>
<th>Student Outcomes</th>
<th>AY 11 - 12</th>
<th>AY 12 - 13</th>
<th>AY 13 - 14</th>
<th>AY 14 - 15</th>
<th>AY 15 - 16</th>
<th>AY 16 - 17</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Ability to apply modern tools to ET activities</td>
<td>X</td>
<td>X</td>
<td></td>
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<td>X</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>d) Ability to design systems or processes for broadly-defined ET problems</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>h) Engage in continuing professional development</td>
<td>X</td>
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<td>j) Knowledge of the impact of ET solutions to society and the world.</td>
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<td>k) Commitment to quality, timeliness, and continuous improvement.</td>
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<td>l) Technical expertise in materials, statics, dynamics, fluids, thermo, &amp; electronics</td>
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<td>X</td>
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</tbody>
</table>
Schedule for Review of Program Educational Objectives

April  Meet with the Industrial Advisory Board (IAB) on the day of the Senior Design Presentations.

May  Assessment Committee meets to evaluate program educational objectives.

Late May  Email contact with the IAB to give report of the Assessment Committee. If needed, another face-to-face meeting will be scheduled. Otherwise, email will be used to modify the program educational objectives.

June  If changes are made, the link to the pdf file on the MET page will be updated in June.

Schedule for Review of the Student Outcomes

January  Program Coordinator will go to the ABET website to find the most recent student outcomes as defined by ABET. The link for 2012 – 2013 is:  http://abet.org/criteria-engineering-technology-2012-2013/

February  Inform faculty of any changes to the student outcomes. Make suggestions to modify the MET specific student outcomes.

April  Meet with the Industrial Advisory Board (IAB) on the day of the Senior Design Presentations. Updates in the student outcomes will be presented along with discussion of repercussions for the MET program. Modifications to the student outcomes will be presented and discussed.

May  Assessment Committee meets to evaluate assessment of student outcomes and design an action plan to remedy any deficiencies. Also, the Assessment Committee will review the student outcomes and discuss how to implement any changes suggested by the IAB. Committee will come up with additional plans for the assessment to stay current with the relevant student outcomes.

Late May  Email contact with the IAB to give report of the Assessment Committee. If needed, another face-to-face meeting will be scheduled. Otherwise email will be used to decide on action plans.

Academic Year  Assessment is collected

Sept. – Dec.  Small action plans will be emailed to the IAB for input

Sept. – Dec.  The School of Engineering Technology meets at least once per month. Curriculum issues will be presented to the Instructional Committee and then sent to the SET faculty for review.

Sept. – Dec.  Changes to program or courses will be submitted to the School of Engineering Technology (SET) for approval.

Oct. – Dec.  Changes will be submitted to the College for approval

Sept. – Dec.  If changes are approved, they will be sent to the University Input System for approval.

Sept of following year  Changes will be made the following academic year.
Table 5. Timeline of Continuous Improvement Process starting with January of each year.

Table 5 is a timeline of the review of not only the student outcomes, but the program in general, when changes to the outcomes and the program in general are proposed and the process for implementing the changes.
Targeted Benchmarks

The Target for Program Educational Objectives are:

- 75% of our graduates will be employed within one year of graduation (PEO1).
- 85% of our graduates will be employed within three years of graduation (PEO1).
- 85% of our graduates will be effective in working in teams of diverse professionals within three to five years of graduation (PEO2).
- 85% of our graduates will report that they are effective at written and oral forms of communication within three to five years of graduation (PEO3).
- 85% of our alumni will be engaged in professional development and/or show a commitment to continuous improvement in their professional and personal lives (PEO4).
- 85% of our graduates will report that they exercise and understanding of diversity, ethical and social responsibilities in their professional lives and in community service (PEO5).

The Target for Student Outcomes are:

- An average score of 80% or greater, as determined by the instructor for any individual embedded assessment, is the target for an acceptable outcome. Anything lower 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.

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 the 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 bringing 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, will ensure that the changes are implemented.

Data Collection and Analysis

1) Direct assessment data
   - Data will be collected following the schedule above.
   - 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 above.
   - 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 shared via email, as will requests for input.

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 on the following page.

To show how the MET program at Eastern Michigan University ‘closes the loop’ Appendix B is a reproduction of Section “Criterion 4 Continuous Improvement” of the self-study report and an update of the planned actions which were a results of the assessment analysis (see red ink). Appendix C is the assessment report for the year and one-half since the ABET team visit and the plans of action based upon the assessment results.
The continuous improvement process

Assessment Tools
- Co-op Employer Survey
- Co-op Student Survey
- Senior Exit Survey
- Course Performance
- Graduation Trends
- Student Data

- Alumni Survey
- Employer Survey
- Employment trends
- IAB input

Program Objectives
- Assessment Summary
- Program Objectives Evaluation
- Action Plan

Co-op Employer Survey
- Co-op Student Survey
- Senior Exit Survey
- Course Performance
- Graduation Trends
- Student Data

Embedded Course Assessment

Student Outcomes
- Assessment Summary
- Student Outcome Evaluation
- Action Plan

Student Outcomes

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2 Patterned after Bloomsburg University,