Institutional Effectiveness

Academic Year: 2011-2012
Department/Unit: Mechanical Engineering
Submission Date: December 14, 2012
Contact: Dr. Darrell Hoy

I. Department Mission:
The Mission statement of the Mechanical Engineering Department / Program is given below, and is also published on the ME Dept’s website at: http://www.tntech.edu/me/mission/

“The Mechanical Engineering (ME) Department, within a regional and global context, will prepare its students for productive life and livelihood in a competitive, dynamic, technologically-based society; will advance the knowledge of mechanical engineering principles and applications; and will serve the public.”

II. Program Goals and Student Learning Outcomes:
The Program Goals for the BSME program are shown below and are published on the ME Department’s Strategic Planning and Assessment website and can be accessed by clicking on “Program Educational Outcomes” at the following link: http://www.tntech.edu/me/program-educational-study/

Program goals for the department are established according to the professional and career accomplishments of program graduates at intervals of 1-2 years, 5-7 years, and 10 years following their graduation from the ME program at TTU, as well as goals which apply to all stages students’ careers; summarized as follows:

Program Goal 1: Within the first one to two years following graduation students should be:
- Productively employed or in good academic standing in a program of postgraduate studies;
- Participating at some level, in both organizations that serve their profession, as well as the public; and
- Are confident and optimistic about their future.

Program Goal 2: Building upon these, five to seven years beyond graduation, we wish to see:
- Evidence of career advancement;
- Evidence of assumption of positions and roles of greater responsibility to their employer/employees and the public, and;
- Evidence that they are recognized as being professionally competent.

Program Goal 3: Ten years and beyond, those graduates who have set and pursued long term goals with exhibit:
- Sustained productivity in their career field; and
- Visibility and recognition as leaders in their profession and community.

Program Goal 4: At all stages in their careers, our graduates will be:
- Engaged in activities that demonstrate a commitment to and appetite for ongoing personal and professional growth and learning.

The Student Learning Outcomes are for the BSME program are listed below. These are reviewed on a six-year, end-of-cycle basis to ensure that they are consistent with the ME Program’s Educational Outcomes. The review is first done by the ME Department Goals & Assessments
committee, followed by reviews by the ME Faculty, ME Chairperson, and ME External Advisory Board for discussion and approval.

Upon graduation, students will demonstrate:

1. An ability to apply knowledge of mathematics, science, and engineering
2. An ability to design and conduct experiments, as well as to analyze and interpret data
3. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturing, and sustainability.
4. An ability to function on multidisciplinary teams
5. An ability to identify, formulate, and solve engineering problems
6. An understanding of professional and ethical responsibility
7. An ability to communicate effectively
8. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
9. A recognition of the need for and ability to engage in lifelong learning
10. A knowledge of contemporary issues
11. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
12. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
13. An ability to transition from engineering concepts and theory to real engineering applications

III. Assessments

- **Alumni Surveys** (Sent out to graduates of the TTU ME program at intervals of 1 yr, 5yrs, and 10+ years (recently discontinued) after graduation)—Program Goals 1-4; Student Learning Outcomes 4-10 & 12
- **Employer Surveys** (Annually)—Program Goals 1-4; Student Learning Outcomes 4-10 & 12
- **External Review of Senior Design Projects** (Each Semester) Student Learning Outcomes 1-11
- **FE Exam** (Each Semester) Student Learning Outcomes 1, 2, 5, & 6
- **Mini-FE Exam** (Each Semester) Student Learning Outcomes 1 & 5
- **Senior Exit Interview Written Survey** (Each Graduation period) Student Learning Outcomes 1, 3-12
- **ME External Advisory Board** (Annually) Student Learning Outcomes 3 & 11
IV. Rationale for Outcomes and Assessments (Process for Data Analysis)

- **Alumni Surveys:** (Sent out to graduates of the TTU ME program at 1 yr and 5 yrs after graduation) –Program Goals 1-4. Similar in nature to the employer surveys, the alumni surveys contain questions directly related to the attainment of Program Educational Goals and Student Learning Outcomes. Written comments are also collected and coded as strengths or weaknesses.

- **Employer Surveys:** (Annually) –Program Goals 1-4. These Surveys contain questions related directly to the attainment of Program Educational Goals and Student Learning Outcomes. Written comments are also collected and coded as strengths or weaknesses.

- **External Review of Senior Design Projects** (Each Semester) Student Learning Outcomes 1-11. External evaluators are used to accessing the quality of the Senior Design Projects and providing feedback on the capstone design course, and by extension of the ME Program itself. The evaluators ask questions of the group members and provide feedback on the quality of the projects and oral presentations. In addition, the evaluators are given copies of each group’s reports (Project Proposal, Design Analysis Report, Engineering Drawings, and the Final Written Report). The external evaluators are requested to review and evaluate the project reports in a two-to-three week time period after the oral presentations.

- **FE Exam** (Each Semester) Student Learning Outcomes 1, 2, 5, & 6. While not a complete assessment tool in itself, the Fundamentals of Engineering (FE) exam does provide an objective, nationally-normalized testing of certain engineering, math, and science topics, as well as the ability to analyze, formulate, and solve engineering problems. Consequently, the FE exam can be a useful measure of Student Learning Outcomes.

- **Mini-FE Exam** (Semester) Student Learning Outcomes 1 & 5. The purpose of this mini-FE Exam is also twofold, i.e.: (1) to help students be better prepared for the actual FE exam, and (2) to investigate the use of the mini-FE Exam as a possible assessment tools for selected Program Outcomes.

- **Senior Exit Interview Written Survey** (Each Graduation period) Student Learning Outcomes 1,3-12. The survey provides the opportunity for student feedback (anonymously) about specific aspects of the ME Department, the ME curriculum, and the student’s experiences while at TTU. In addition, a number of survey questions are directly related to specific Program Outcomes.

- **ME External Advisory Board** (Annually) Student Learning Outcomes 3 &11. The ME External Advisory Board consists of approximately 10-15 members, selected primarily for employers of our students and other related industries. The main purpose of this board is an advisory one: it is not intended as a fund-raising mechanism. Specifically, the board provides input and feedback on various curricular and accreditation matters (ABET, SACS, THEC Graduate Program Review). Board members also regularly serve as the External Evaluators for the Senior Design Projects.

- **Informal Feedback** is regularly solicited and received from various constituencies of our program, including the ME External Advisory board, employers of our graduates, and program alumni. While not an exact measure of educational objective attainment, this type of feedback is still useful in gauging how our program graduates are perceived in terms of academic preparation, technical capabilities, and overall quality, as well as what determines the demand for our students from an employment perspective.
V. Results

Alumni Surveys:
Analyzing the results of the Alumni Survey, it is observed that the ratings received in all questions both at 1-yr and 5-yr post-graduation, ME alumni indicated that they were overall satisfied with the education they received while at TTU and their subsequent success in their careers.

Written comments suggest improvements are needed in the following areas: “Need to better relate academics to industry,” and “need more real-world hands-on experiences.”

See Appendix A for more details.

Employer Surveys:
Analyzing the results of the Employer Survey, it is observed that the ratings received on all questions are fairly high overall, ranging from a low score of 3.59 to a high of 4.62, with an average of 4.13. The relatively high average rating received for each of the survey questions indicates that at a minimum, at least a level of attainment of "Satisfactory" has been reached on all Student Learning Outcomes (1-, 5-, and 10-yr (discontinued)) and the Program Goals addressed in the Employer Survey. This is also consistent with the fairly high degree of satisfaction frequently expressed by employers with the ME program graduates from TTU, as per ad hoc feedback from employers and the ME External Advisory Board members.

In the case of the Employer Surveys, the relatively small number of written comments received and the variation in the responses made it difficult to draw any statistically significant conclusions from the written comments received. A chart for Employer Survey Data is included as Appendix B.

Because of the increasing reluctance of employers to respond to these surveys (often citing legal concerns), it is likely the Employer Surveys will be dropped as an assessment tool, due to a lack of a statistically significant number of responses from employers. This issued will be brought to the M.E. Faculty in Spring, 2013 for their input and vote.

Senior Design Projects: External Evaluators:
In examining the feedback received from the External Evaluations of Senior Design Projects, the following strengths were commonly noted by the evaluators:
- Technically strong, challenging projects with real-world constraints
- Good hands-on type projects
- Includes both Energy Systems and Mechanical Systems stems of the curriculum
- Projects address many of the ABET 3a-l items

Areas of concern / weakness observed at different points in time include:
- Oral presentations need improvement
- Contemporary manufacturing improvement methods such as six-sigma and lean manufacturing needs to be covered in the course
- Manufacturability needs to be emphasized more
- Costing needs to be covered more

FE Exam:
Examination of the FE data presented in Appendix C indicates that the overall performance on the FE exam by TTU ME students is clearly high enough to reach, at a minimum, an attainment level of
“Satisfactory” in the relevant Program Goals. However, there are some subjects that were identified by the ME Goals & Assessments Committee as areas of possible concern and future improvement in the next assessment cycle:

- Statics (consistently below the national average)
- Dynamic systems (downward trending)
- Electrical engineering (downward trending)

**Mini-FE Exam:**

The results obtained from administrations of the Mini-FE Exam are shown in Appendix D - Mini-FE Exam, by percentage of correct answers in each topical area. While it is difficult to compare these percentages directly to the National results, due to the differences in the administration of the exams and question selection, the relative scores between topical areas on the mini-FE Exam gives some indication of student performance in these areas.

Although some improvement in FE pass rates was noted the semester after the Mini-FE exam was first instituted, this appeared to only be an anomaly, as this increase was not sustained in subsequent semesters. Finding sufficient time to do the review sessions in the ME 4444 Senior Design course and lack of student motivation also became problematic. As a result, the in-house Mini-FE Exam was not adopted as a formal assessment tool and it was discontinued.

**Senior Exit Interview Written Surveys:**

Regarding assessment results for Senior Interview Surveys in the following table, the average ratings for Questions 1-12, 15-20 from Senior Exit Interview Surveys given over the time period are shown in comparison to their Target values.

In the table, items near or above targets show success in a given area; items noticeably below targets indicate areas of possible concern. In addition, the slopes of the linear trend line fitted to the data for each question are given. Slopes with a high positive value indicate improvement in that area; slopes with a negative value indicate a decrease in scores.

**External Advisory Board:**

A list of current ME Advisory Board members is given in Appendix F - External Advisory Board. Use of Advisory Board input and feedback in the continuous improvement process will be addressed later in this report.

**Senior Exit Oral Interviews**

In addition to the Senior Exit Interviews Written Surveys, graduating seniors also meet with the ME Department Chairperson for an informal small-group (5 to 6 students at a time) discussion of ME Program strengths and weaknesses. While the feedback received from these discussions is clearly of an ad hoc nature, this input still can be a useful source of information, primarily in the following two ways:

1. It provides immediate feedback on issues of concern to students, both current and long-term.
2. When used in conjunction with other assessment tools, this feedback can be used as additional supporting information for making continuous improvement decisions.

**Informal Feedback:**
In the same fashion as with the information received from the Senior Exit Oral Interviews in the preceding section, ad hoc feedback from students, employers, and alumni alike can and is used as supporting information in decision-making, and for “taking-the-pulse” of program constituents to be aware of issues of current concern.

VI. Modifications and Continuing Improvement: Program Changes due to Assessments

For Program Goals 1-4; Student Learning Outcomes 4-10 &1

Actions Taken for BSME Program Improvement

Taken as a whole, the data obtained from the various tools used for assessment of the BSME program indicate that at a minimum, a level of “Satisfactory” has been attained for all Program Outcomes and Educational Objectives. However, these same tools also indicated a number of areas of possible program improvement during this time period, which will now be addressed in this section. For clarity of discussion, the actions have been grouped into the following six “Improvement Categories”, which have been numbered I thru VI for identification purposes only:

IMPROVEMENT CATEGORY I: Actions taken for improvement in the ability to communicate effectively

IMPROVEMENT CATEGORY II: Actions taken for improvement in the ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

IMPROVEMENT CATEGORY III: Actions taken for improvement in the ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

IMPROVEMENT CATEGORY IV: Actions taken for improvement in the ability to apply knowledge of mathematics, science, & engineering, and to identify, formulate, and solve engineering problems

IMPROVEMENT CATEGORY V: Actions taken for improvement in the knowledge of contemporary issues

IMPROVEMENT CATEGORY VI: Actions taken for improvement in the ability to transition from engineering concepts and theory to real engineering application

The actions taken for improvement in each of these categories are now discussed in more detail in the remainder of this section.

IMPROVEMENT CATEGORY I: Actions taken for improvement in the ability to communicate effectively

Description: Assessment data from the Alumni Surveys and the Employer Surveys identified both written and oral communications of students as areas for possible improvement. The External Evaluation of Senior Design Projects in the 06F semester also indicated a need for improvement in the final oral presentations of their group projects. Likewise, feedback from the ME External Advisory Board indicated a need for improvement in both written and oral communications. Senior Exit Interview Written Surveys indicate results slightly below the current target value

Action 1: Inclusion of a Video-Taped Oral Proposal Presentation in ME 4444 Senior Design

In response to the need for improvement in the final oral presentations in the ME 4444 Senior Design Project course as described above, a second oral presentation was added to the course. This second presentation was in the form of an oral presentation of each group’s Project Design Proposal near the beginning of each semester. These presentations are videotaped, with the
videotapes then being provided to each student group for self-critique and improvement prior to their final oral presentations.

**Action 2: Inclusion of a Required Oral Communications Course (SPCH 2410 or PC 2500) in the BSME Program**

Beginning with the 04F semester, all undergraduate programs at public institutions in the state of TN were required to add an oral communications course to their curriculums. In response, the ME Department at TTU added the requirement that every student in the BSME program must take either: (1) SPCH 2410 Introduction to Speech Communication, or (2) PC 2500 Communicating in the Professions. These courses are offered by the English department and typically taken in the Sophomore year by ME students.

**Action 3: The Development of a Technical Writing Center Included as an ME Department Objective in the University's Institutional Effectiveness Planning (IEP) Database**

In its 2006 submission of ME Department objectives to the University's Institutional Effectiveness Planning (IEP) database, the ME Department added the goal of the planning, creation, and implementation of a technical writing center to improve the quality of student papers and reports (both written and oral). The writing center would serve both undergraduate and graduate students, along with faculty teaching courses involving report activities. The Writing Center would originally be implemented at the Departmental level, but could be expanded to the College level as desired. Because of the cost involved, this item was also submitted for consideration of University funding under their Quality Enhancement Plan (QEP) program.

**Results:**

- The external evaluation of the senior project final presentations in the 08S indicated an improvement in the oral presentation skills of the students, as noted by the same evaluator on the projects in the preceding semester who had indicated the need for this improvement.
- The creation of a Technical Writing Center has did not occur, due to lack or resources to make it happen.

**IMPROVEMENT CATEGORY II: Actions taken for improvement in the ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability**

Description: The External Evaluation of Senior Design Projects indicated a need for additional instruction in the areas of costing and manufacturability issues. Verbal feedback from the external evaluators also indicated a need for more discussion of six-sigma and lean manufacturing quality improvement methods. In confirmation of this, the ME External Advisory Board indicated the importance of knowledge of six-sigma and lean manufacturing techniques to the employers of the program graduates.

**Action 1: Increased Emphasis on the Importance of Costing and Manufacturability Issues in ME 4444 Senior Design Project**

In response to the need for increased student knowledge of Costing and Manufacturability issues in engineering design, additional time and emphasis on these topics was included in the ME 4444 Senior Design Project course starting in the 06S semester. Knowledge of these topics is tested via exam questions in the course.

**Action 2: Inclusion of a Introduction to Six-Sigma and Lean Manufacturing Techniques in the ME 4444 Senior Design Project Courses**
In response to the external evaluator’s feedback from the 06S semester, lecture material was incorporated in the ME 4444 Senior Design course lectures in three areas of manufacturing quality-improvement techniques: (a) six-sigma, (b) lean manufacturing, and (c) the theory of constraints. Knowledge of these topics is tested via exam questions in the course.

**Action 3: Requirement of both ME 4020 Applied Machine Design and ME 4720 Thermal Design for all Students in the BSME Curriculum**

Prior to the 2004 Fall semester, ME 4020 Applied Machine Design was required only for those students in the Mechanical Systems stem of the curriculum; ME 4720 Thermal Design was required only for those in the Energy Systems stem (ME 4444 Senior Design was required for both stems). In 2004 Fall, this was changed by vote of the ME Faculty to require that all students take both ME 4020 and ME 4720, as well as the ME 4444 Senior design course. This action was taken to ensure that all graduates of the BSME program had design experience in both the Mechanical and Energy systems sides of the curriculum, in support of the ABET Criterion 9 for all ME Programs.

**Results:**

- Since the increased emphasis on costing and manufacturability topics was incorporated into the ME 4444 Senior Design Project course in the 06S semester, no further indications of weakness in these areas has been observed from the External Evaluations of the Senior Design Projects.
- Since the inclusion of material on manufacturing-related quality improvement techniques (six-sigma, lean, theory of constraints) into the ME 4444 Senior Design Project course in the 2006 Fall semester.
- The external evaluation of the ME 4444 Senior Design Projects has been very complimentary of both the quality and complexity of the design projects. Since each project must, by course requirement, include aspects from both the Mechanical Systems and Energy Systems design areas, this is an indication of strength in both the Applied Machine Design (ME 4020) and thermal Design (ME 4720) areas.

**IMPROVEMENT CATEGORY III: Actions taken for improvement in the ability to use the techniques, skills, and modern engineering tools necessary for engineering practice**

Description: Feedback from Senior Exit Oral Interviews during indicated that there was need to incorporate a more formalized and increased amount of instruction in the use MATLAB. In particular, more instructors were beginning to use MATLAB as a required element in their courses, as faculty in other courses were expecting students to have knowledge of this modern engineering tool. More recent feedback from Senior Exit Oral Interviews also indicated the need to provide the increased opportunities for learning other modern computation tools such as FLUENT, ANSYS, and Pro-E, as well as their increased use in courses such as Senior Design Project. Written comments received from the Alumni Surveys also indicated this as an area in need of improvement. The importance of modern computing tools to the employers of our program graduates was also confirmed by the ME External Advisory Board during a discussion of marketplace skills desired in our graduates.

**Action 1: Increase in the Use of MATLAB in the Curriculum**

In response to the indicated need for formalized instruction in MATLAB, five class periods of MATLAB (11% of the total course topics) were added in the 2004 Fall semester to ME 2000 Introduction to Mechanical Engineering & Computing. The content of MATLAB in ME 2000 was then subsequently increased to 15% in later syllabi for the course. Subsequent to this, the recommended programming language for M.E. students in the required course ENGR 1120 Programming, was changed to MATLAB. Although not required, most students opt to take the
MATLAB version of ENGR 1120 instead of FORTRAN. Another action has been the use of MATLAB as the programming language in the lab portion of the required MATH 2010 Matrix Algebra course.

**Action 2: Increased learning opportunities in ANSYS, Pro-E, and FLUENT Software**

To address the need for additional learning opportunities in ANSYS, Pro-E and FLUENT software, two actions have so far been taken:

- Short courses have been offered on a trial basis in ANSYS and Pro-E (sponsored by the Center for Manufacturing Research)
- The ME Tutoring office facilities and paid tutors were used in the 08S semester to provide tutoring free-of-charge in a variety of computer software, including: MATLAB, ANSYS, Pro-E, FLUENT, and C.

**Results:**

Course Outcome Survey data for ME 2000 from the 04F to 08S semesters show a noticeable increase over time in the “Upon Completion” ratings for Q.6 “Use computer language MATLAB to solve a variety of problems”, from a score of 2.6 (moderate-high) in 04F to a score of 3.3 (high-superior) in 08S. In addition, the use of MATLAB in by instructors in various required and AOC courses in the curriculum has been increasing, including ME 3050, 3060, 3710, 3720, 4470, and others.

**IMPROVEMENT CATEGORY IV: Actions taken for improvement in the ability to apply knowledge of mathematics, science, & engineering, and to identify, formulate, and solve engineering problems**

**Description:** Assessment data indicated the possible need for improvement in certain topical areas within the ME curriculum:

1. Course Outcomes Survey and FE Exam results indicated a need for improved coverage in the area of Fans & Pumps in ME 4720 Thermal Design.
2. Results from the FE Exam and the mini-FE Exam indicate a need for improvement in Statics, due to continued underperformance in this subject area.
3. Downward trends were also noted from the FE exam data in the areas of engineering economics, dynamic systems, and electrical engineering. While no specific actions will be taken at this time, close monitoring of these areas for possible future actions will continue.

**Action 1: Improved Coverage of Fans & Pumps in ME 4720**

In response to the indicated need as described above, increased coverage of Fans & Pumps as a topical area was implemented into the ME 4720 Thermal Design starting in the 2003 Spring semester.

**Action 2: Investigation into the Underperformance of ME Students in Statics**

In order to begin the process of determining the cause(s) of the apparent continuing underperformance of ME students in the topical area of Statics on the FE and mini-FE exams, a discussion of this matter was held in a ME Faculty meeting in the 08S semester. As a first step in this plan, ME Faculty were asked to respond as to whether or not they have observed any underperformance in the area of statics as it relates to the courses they teach. Little specific feedback was received from this request. The second step is to approach the CEE department,
which teaches the Statics course, to see if they have any data relating to the performance of CEE students in the area of Statics, and how that compares to ME.

Results:

(a) As a result of the increased coverage of Fans & Pumps, the Course Outcomes Survey data for ME 4720 showed a modest increase in the change from the “Before” to “After” ratings in this subject area from the from 03S to 08S. The FE data for Fans & Pumps/Compressors showed an increase in performance for TTU students from 0.71 to 0.92 of the national average from the 03F semester up to the 05S semester, when that topical area of the FE was discontinued as a separate item.

(b) The plan for identifying the cause of underperformance in the area of Statics is still in progress. A data analysis of the success rate of students earning a “D” in Statics in subsequent courses such as Dynamics and Mechanics of Materials will be conducted in Spring, 2013 to see if the requirement of a “C” or better in Statics should be re-instated.

IMPROVEMENT CATEGORY V: Actions taken for improvement in the knowledge of contemporary issues

Description: Data from both the Alumni Surveys (4-1) and the Employer Surveys (4-2) identify “knowledge of contemporary issues” as an area for possible improvement.

Action 1: Inclusion of News Sources in the Student Lounge and ME Office

Publications (USA Today, Popular Science, and Mechanical Engineering magazine) have been placed in the ME Office and in the Brown Hall Student Lounge with the intent of providing easy access to news items of contemporary interest to students.

Action 2: Inclusion of material on the Importance of Knowledge of Contemporary Issues in ME 3910 Mechanical Engineering Seminar

Material specifically addressing the importance of knowledge of contemporary issues and news was added to the ME 3910 Mechanical Engineering course. (Replaced by ME 3900 Professionalism & Design in 2011-2012).

Results:

Continuation of monitoring of this item.

IMPROVEMENT CATEGORY VI: Actions taken for improvement in the ability to transition from engineering concepts and theory to real engineering application

Description: The ME program at TTU is recognized among its regional peers as a program that produces students with both a strong technical background and the practical skills which enable them to make the transition to the workplace more easily than graduates of many other programs. Nevertheless, data from the Alumni Surveys (4-1) and Senior Exit Interviews (4-6) indicate a desire for continued improvement in this program-distinctive area of TTU’s BSME program.

Action 1: Development of a Demonstration / Hands-On Learning Classroom

A classroom / laboratory space (Brown Hall, Rm 124) was renovated and designated as a demonstration/hands-on-learning facility for use by faculty teaching ME courses. Since it is not possible, for curricular reasons, for every ME course to have a formal laboratory component
associated with it, the BN 124 facility is intended to provide a centralized facility for use by ME instructors who wish to provide specific hands-on experiences and/or demonstrations to students in what are otherwise traditional lecture courses.

**Action 2: Increase the Number of Externally Sponsored Senior Design Projects**

A significant effort has been made to increase the number of externally sponsored Senior Design projects in order to provide more “real-world” experience to the students.

**Results:**

BN 124 demonstration classroom/laboratory facility has already been employed by several ME faculty to provide hands-on demonstrations to their students in the areas of dynamics, machine design, and mechanical testing.

The percentage of externally sponsored Senior Design projects has been significantly increased so that in the most recent offering of the course (2012 Fall), the majority of the projects were externally sponsored. This continues to be an important priority for both the M.E. Department and the College of Engineering.

**Actions Taken for Improvement to the ME Department Continuous Improvement Process**

As part of the end-of-cycle ABET review in 2008 Spring, the ME Goals & Assessments Committee recommended a number of actions for improvement to the assessment tools and evaluation methods used in the ME Department Continuous Improvement Process to the ME Faculty. These recommendations were discussed by the ME faculty in a series of meetings during the 2008 Spring semester, and were subsequently approved for implementation. The recommendations were then presented to the ME External Advisory Board members at the Spring, 2008 meeting of the board, for their input and comments on the proposed changes. Improvements to the assessment and evaluation process were subsequently implemented.
Appendices

Appendix A—Alumni Survey
Appendix B—Employer Survey
Appendix C—FE Exams
Appendix D—Mini FE Exams
Appendix E—Senior Exit Interviews Written Surveys
Appendix F—External Advisory Board Members Spring 2008
Appendix A

Alumni Survey
Surveys are sent out each year to alumni who are approximately 1, 5, and 10-yrs post-graduation. The following supporting data is included in this appendix:

1. Alumni Survey Instrument
2. Composite plot of average ratings from all alumni (1, 5, 10 yrs post-graduation) grouped by survey year.
Tennessee Technological University

MECHANICAL ENGINEERING - ALUMNI SURVEY

SURVEY GOAL: To determine how well we are meeting our undergraduate Program Educational Objectives, from your perspective, as a graduate of the Mechanical Engineering Program at Tennessee Technological University.

INSTRUCTIONS: Rate your level of agreement with each of the statements below, by circling the number of the appropriate response. Answer N/A to statements for which you feel you do not have a sufficient basis upon which to provide a response.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
<th>Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Recent&quot; TTU ME grads who have been out of school approximately 1 year, please answer #1:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>N/A</td>
</tr>
</tbody>
</table>
1a Be a productive employee, within the context of my assigned duties and level of responsibility | 5              | 4     | 3       | 2        | 1                 | N/A            |
1b Participate, at some level, in organizations that serve the profession and/or public | 5              | 4     | 3       | 2        | 1                 | N/A            |
1c Be confident in my work and potential for professional growth and development | 5              | 4     | 3       | 2        | 1                 | N/A            |
1d Be engaged in activities that demonstrate a commitment to personal and professional growth | 5              | 4     | 3       | 2        | 1                 | N/A            |

"Experienced" TTU ME grads, who have been out of school about FIVE years, please answer #2:

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
<th>Not Applicable</th>
</tr>
</thead>
</table>
2a I have achieved an appropriate level of career advancement              | 5              | 4     | 3       | 2        | 1                 | N/A            |
2b I have assumed positions and roles of (greater) responsibility to my employer and subordinates | 5              | 4     | 3       | 2        | 1                 | N/A            |
2c I am recognized by my employer, peers and subordinates as being professionally competent | 5              | 4     | 3       | 2        | 1                 | N/A            |
2d I am engaged in activities that demonstrate a commitment to personal and professional growth | 5              | 4     | 3       | 2        | 1                 | N/A            |

"Long term" TTU ME grads, who have been out of school about TEN years, please answer #3:

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
<th>Not Applicable</th>
</tr>
</thead>
</table>
3a I demonstrate a sustained level of productivity                         | 5              | 4     | 3       | 2        | 1                 | N/A            |
3b I have visibility and recognition as a leader in My profession and community | 5              | 4     | 3       | 2        | 1                 | N/A            |
3c I am engaged in activities that demonstrate a commitment to personal and professional growth | 5              | 4     | 3       | 2        | 1                 | N/A            |

- over -
Your response to a number of additional questions will aid us in assessment of various general skills, aptitudes and attitudes that the TTU Mechanical Engineering curriculum is designed to develop and encourage in our undergraduate students.

**INSTRUCTIONS:** Based on your experiences while in the TTU Mechanical Engineering Program, please rate how effectively you were prepared in the following areas (circle your choice):

<table>
<thead>
<tr>
<th>Area</th>
<th>Outstanding</th>
<th>Above Average</th>
<th>Average</th>
<th>Below Average</th>
<th>Unacceptable</th>
<th>Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identifying, formulating and solving engineering problems</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>2. Engaging in objective “critical thinking”</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>3. Working on multidisciplinary teams</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>4. Preparing effective written communications</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>5. Preparing and delivering oral presentations</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>6. Understanding and appreciating contemporary issues</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>7. Understanding professional and ethical responsibilities</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>8. Understanding the global/societal impact of engineering</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>9. Recognizing the need for and engaging in life-long learning</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Please provide any other comments you may have and care to share about particular strengths and weaknesses you may have observed in the TTU Mechanical Engineering Program:

- **Strengths -**

- **Weaknesses -**

We would like to have contact information for a supervisor in your company who has experience working with TTU Mechanical Engineering graduates, so we could send them an Employer Survey Form. Please provide contact information below:

- **Company Name:** ________________________________
- **Date:** ________________
- **Name:** ________________________________
- **Title:** ________________________________
- **Mailing Address:** ________________________________
- **Email:** ________________________________

Your reply to this survey is greatly appreciated, and will provide valuable input/feedback about our Mechanical Engineering graduates that will be used to guide us in our ongoing efforts to maintain and deliver an undergraduate curriculum that is timely, technically-appropriate and of the highest quality.

Questions or Verbal Comments?

Contact: Dr. Glenn T. Cunningham, P.E.
Email gcunningham@tntech.edu
Phone 1-931-372-3826

Ms. Carolyn Brown, CPS
Box 5014 TTU
Cookeville, TN 38505

Return the completed survey to:
Comfortable making oral presentations

Participate in organizations that serve the profession and/or public

Be confident in my work and potential for professional growth and development

Understanding the global/societal impact of engineering

Understanding professional and ethical responsibilities

Understanding and appreciating contemporary issues

Preparing and delivering oral presentations

Preparing effective written communications

Working on multidisciplinary teams

Engaging in objective critical thinking

Identifying, formulating and solving engineering problems

I am recognized by my employer, peers and subordinates as being professionally...

I have assumed positions and roles of greater responsibility to my employer and...

I have achieved an appropriate level of career advancement

Be engaged in activities that demonstrate a commitment to personal and professional...

Confident in ability to write effectively

Be confident in my work and potential for professional growth and development

Participate in organizations that serve the profession and/or public

Recognizing the need for and engaging in lifelong learning

Understanding professional and ethical responsibilities

Identifying, formulating and solving engineering problems

Engaging in objective critical thinking

Preparing effective written communications

Working on multidisciplinary teams

I am recognized by my employer, peers and subordinates as being professionally...

I have assumed positions and roles of greater responsibility to my employer and...

I have achieved an appropriate level of career advancement

Be engaged in activities that demonstrate a commitment to personal and professional...

Confident in ability to write effectively

Be confident in my work and potential for professional growth and development

Participate in organizations that serve the profession and/or public

Comfortable making oral presentations

Questions

Average

2011-12

2010-11
Appendix B

Employer Surveys
Surveys are sent out each year to alumni who are approximately 1, 5, and 10-yrs post-graduation. The following supporting data is included in this appendix:

1. Survey Instrument
2. Composite plot of average ratings from all alumni (1, 5, 10 yrs post-graduation) grouped by years post-graduation.
MECHANICAL ENGINEERING - EMPLOYER SURVEY

SURVEY GOAL: To determine how well we are meeting our undergraduate Program Educational Objectives, from you the employer’s perspective, based on your experiences with and knowledge of Mechanical Engineering students from Tennessee Technological University.

INSTRUCTIONS: Rate your level of agreement with each of the statements below, by circling the number of the appropriate response, and indicate the approximate number of TTU Mechanical Engineering graduates upon which your general observations are based. Answer N/A to statements for which you feel you do not have a sufficient basis upon which to provide a response.

<table>
<thead>
<tr>
<th>Based on (for) _____ “recent” TTU ME graduates, that have been out of school ONE or TWO years:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a They are productive employees, within the context of their assigned duties and level of responsibility</td>
</tr>
<tr>
<td>1b They participate, at some level, in organizations that serve the profession and/or public</td>
</tr>
<tr>
<td>1c They seem confident in their work and their potential for professional growth and development</td>
</tr>
<tr>
<td>1d They are engaged in activities that demonstrate a commitment to personal and professional growth</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Based on (for) _____ “experienced” TTU ME grads, that have been out of school FIVE to SEVEN years:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a They have achieved an appropriate level of career advancement</td>
</tr>
<tr>
<td>2b They have assumed positions and roles of (greater) responsibility to their employer and subordinates</td>
</tr>
<tr>
<td>2c They are recognized by their employer, peers and subordinates as being professionally competent</td>
</tr>
<tr>
<td>2d They are engaged in activities that demonstrate a commitment to personal and professional growth</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Based on (for) _____ “long term” TTU ME grads, that have been out of school TEN or MORE years:</th>
</tr>
</thead>
<tbody>
<tr>
<td>3a They demonstrate a sustained level of productivity</td>
</tr>
<tr>
<td>3b They have visibility and recognition as leaders in their profession and community</td>
</tr>
<tr>
<td>3c They are engaged in activities that demonstrate a commitment to personal and professional growth</td>
</tr>
</tbody>
</table>

- over -
Your response to a number of additional questions will aid us in assessment of various general skills, aptitudes and attitudes that the TTU Mechanical Engineering curriculum is designed to develop and encourage in our undergraduate students.

**INSTRUCTIONS:** Compared to graduates at the same level of experience from other engineering programs, rate TTU Mechanical Engineering graduates on their abilities in the following areas (circle your choice):

<table>
<thead>
<tr>
<th></th>
<th>Outstanding</th>
<th>Above Average</th>
<th>Average</th>
<th>Below Average</th>
<th>Unacceptable</th>
<th>Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<tr>
<td>2</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<td>3</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<tr>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
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<tr>
<td>7</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>8</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
<tr>
<td>9</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Please provide any other comments you may have and care to share about particular strengths and weaknesses you may have observed in TTU Mechanical Engineering Graduates:

**Strengths -**


**Weaknesses -**


Company Name: _________________________________ Date: ________________

Your Name: ____________________________ Your Title: ____________________________

Your Contact Information: ____________________________ (email address) ________________ (phone)

What is/was your professional relationship to (the majority of) the TTU ME graduates represented in your survey response?  
1[ ] Company Human Resources Officer  2[ ] Company Recruiting Officer  
3[ ] Management-level Superior  4[ ] Immediate Supervisor

Your reply to this survey is greatly appreciated, and will provide valuable input/feedback about our Mechanical Engineering graduates that will be used to guide us in our ongoing efforts to maintain and deliver an undergraduate curriculum that is timely, technically-appropriate and of the highest quality.

Questions or Verbal Comments?  
Return the completed survey to:

**Contact:**  
Dr. Glenn T. Cunningham, P.E.  
Email gcunningham@tntech.edu  
Phone 1-931-372-3826

Ms. Carolyn Brown, CPS  
Box 5014 TTU  
Cookeville, TN 38505
Questions

- Recognize the need for and engaging in life-long learning
- Understanding the global/societal impact of engineering
- Understanding professional and ethical responsibilities
- Understanding and appreciating contemporary issues
- Preparing and delivering oral presentations
- Preparing effective written communications
- Working on multidisciplinary teams
- Engaging in objective critical thinking
- Identifying, formulating and solving engineering problems
- They are engaged in activities that demonstrate a commitment to personal and professional growth
- They have visibility and recognition as a leader in their profession and community
- They demonstrate a sustained level of productivity
- They are engaged in activities that demonstrate a commitment to personal and professional growth
- They are recognized by their employer, peers and subordinates as being professionally competent
- They have assumed positions and roles of greater responsibility to their employer and subordinates
- They have achieved an appropriate level of career advancement
- They are engaged in activities that demonstrate a commitment to personal and professional growth
- They are confident in their work and their potential for professional growth and development
- They participate in organizations that serve the profession and/or public
- They are productive employees, within context of assigned duties and level of responsibility

Average Rating

- 10 Yr Avg
- 5 Yr Avg
- 1 Yr Avg
Appendix C—FE Exam

The following supporting data for the FE Exam as an assessment tool are included in this appendix:

1. Correspondence of New (05F and after) FE Exam topical areas to the Old (pre-05F) topics
2. Plots of FE exam results by topic form 96F to 07F, normalized by national results.

Note: Magenta color in the plots depicts the exam topics for which there was deemed to be a sufficiently close correspondence in new and old topics to append both pre- and post-05F exam data together.
# FE Passing Rate Data

<table>
<thead>
<tr>
<th>Year</th>
<th>TTU</th>
<th>National</th>
<th>Ratio of TTU Passing to National Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>05F</td>
<td>10</td>
<td>679</td>
<td>1.15</td>
</tr>
<tr>
<td>06S</td>
<td>22</td>
<td>1479</td>
<td>0.85</td>
</tr>
<tr>
<td>06F</td>
<td>19</td>
<td>788</td>
<td>1.10</td>
</tr>
<tr>
<td>07S</td>
<td>17</td>
<td>1590</td>
<td>0.94</td>
</tr>
<tr>
<td>07F</td>
<td>13</td>
<td>742</td>
<td>0.78</td>
</tr>
<tr>
<td>08S</td>
<td>32</td>
<td>1846</td>
<td>0.99</td>
</tr>
<tr>
<td>08F</td>
<td>15</td>
<td>828</td>
<td>0.98</td>
</tr>
<tr>
<td>09S</td>
<td>38</td>
<td>1912</td>
<td>0.93</td>
</tr>
<tr>
<td>09F</td>
<td>6</td>
<td>818</td>
<td>1.09</td>
</tr>
<tr>
<td>10S</td>
<td>29</td>
<td>2225</td>
<td>0.87</td>
</tr>
<tr>
<td>10F</td>
<td>32</td>
<td>1903</td>
<td>0.84</td>
</tr>
<tr>
<td>11S</td>
<td>28</td>
<td>3919</td>
<td>0.74</td>
</tr>
<tr>
<td>11F</td>
<td>7</td>
<td>2050</td>
<td>1.09</td>
</tr>
<tr>
<td>12S</td>
<td>32</td>
<td>4796</td>
<td>1.01</td>
</tr>
<tr>
<td>12F</td>
<td>13</td>
<td>2050</td>
<td>###</td>
</tr>
<tr>
<td>13S</td>
<td>13</td>
<td>4796</td>
<td>###</td>
</tr>
<tr>
<td>13F</td>
<td>32</td>
<td>4796</td>
<td>###</td>
</tr>
</tbody>
</table>

## FE Pass Rate: TTU vs National

![Graph showing FE pass rate comparison between TTU and National](image)
The following data shows the percentage of correct answers by topical area for the 07F and 08S administrations of the Mini-FE exam.

<table>
<thead>
<tr>
<th>Question #</th>
<th>AM / PM Exam</th>
<th>Subject Area</th>
<th>Topic</th>
<th>2008 Spring</th>
<th>2007 Fall</th>
<th>08S + 07F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Number</td>
<td>Number Right</td>
<td>% Right</td>
<td>Number</td>
</tr>
<tr>
<td>10</td>
<td>AM</td>
<td>Dynamics</td>
<td>Energy</td>
<td>14</td>
<td>42%</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>AM</td>
<td>Dynamics</td>
<td>F=ma</td>
<td>23</td>
<td>70%</td>
<td>19</td>
</tr>
<tr>
<td>7</td>
<td>AM</td>
<td>Dynamics</td>
<td>ICR</td>
<td>32</td>
<td>97%</td>
<td>20</td>
</tr>
<tr>
<td>9</td>
<td>AM</td>
<td>Dynamics</td>
<td>Polar</td>
<td>14</td>
<td>42%</td>
<td>5</td>
</tr>
<tr>
<td>8</td>
<td>AM</td>
<td>Dynamics</td>
<td>Projectile</td>
<td>14</td>
<td>42%</td>
<td>9</td>
</tr>
<tr>
<td>34</td>
<td>PM</td>
<td>Dynamics</td>
<td>$M=I\frac{d^2\theta}{dt^2}$</td>
<td>20</td>
<td>61%</td>
<td>12</td>
</tr>
<tr>
<td>33</td>
<td>PM</td>
<td>Dynamics</td>
<td>Momentum</td>
<td>15</td>
<td>45%</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Averages:</td>
</tr>
<tr>
<td>26</td>
<td>AM</td>
<td>Fluid Flow</td>
<td>Bernoulli’s Equation</td>
<td>18</td>
<td>55%</td>
<td>20</td>
</tr>
<tr>
<td>27</td>
<td>AM</td>
<td>Fluid Flow</td>
<td>Buoyancy</td>
<td>21</td>
<td>64%</td>
<td>16</td>
</tr>
<tr>
<td>30</td>
<td>AM</td>
<td>Fluid Flow</td>
<td>Orifice Meter</td>
<td>18</td>
<td>55%</td>
<td>16</td>
</tr>
<tr>
<td>29</td>
<td>AM</td>
<td>Fluid Flow</td>
<td>Submerged Object</td>
<td>13</td>
<td>39%</td>
<td>11</td>
</tr>
<tr>
<td>28</td>
<td>AM</td>
<td>Fluid Flow</td>
<td>Water Pressure</td>
<td>14</td>
<td>42%</td>
<td>14</td>
</tr>
<tr>
<td>41</td>
<td>PM</td>
<td>Fluid Flow</td>
<td>Buoyancy</td>
<td>17</td>
<td>52%</td>
<td>9</td>
</tr>
<tr>
<td>42</td>
<td>PM</td>
<td>Fluid Flow</td>
<td>Frictional Flow Loss</td>
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<td>15%</td>
<td>5</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fluid Flow</td>
</tr>
<tr>
<td>16</td>
<td>AM</td>
<td>Materials</td>
<td>Diffusion</td>
<td>22</td>
<td>67%</td>
<td>20</td>
</tr>
<tr>
<td>17</td>
<td>AM</td>
<td>Materials</td>
<td>Microstructures</td>
<td>18</td>
<td>55%</td>
<td>15</td>
</tr>
<tr>
<td>18</td>
<td>AM</td>
<td>Materials</td>
<td>Processes</td>
<td>6</td>
<td>18%</td>
<td>4</td>
</tr>
<tr>
<td>19</td>
<td>AM</td>
<td>Materials</td>
<td>Processes</td>
<td>30</td>
<td>91%</td>
<td>23</td>
</tr>
<tr>
<td>20</td>
<td>AM</td>
<td>Materials</td>
<td>Testing</td>
<td>27</td>
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<td>24</td>
</tr>
<tr>
<td>38</td>
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<td>Materials</td>
<td>Phase Diagrams</td>
<td>11</td>
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<td>0</td>
</tr>
<tr>
<td>37</td>
<td>PM</td>
<td>Materials</td>
<td>Slip Planes</td>
<td>9</td>
<td>27%</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Materials</td>
</tr>
<tr>
<td>15</td>
<td>AM</td>
<td>Mech. of Materials</td>
<td>Buckling</td>
<td>13</td>
<td>39%</td>
<td>9</td>
</tr>
<tr>
<td>13</td>
<td>AM</td>
<td>Mech. of Materials</td>
<td>Moment Diagrams</td>
<td>18</td>
<td>55%</td>
<td>21</td>
</tr>
<tr>
<td>14</td>
<td>AM</td>
<td>Mech. of Materials</td>
<td>Plane Stress</td>
<td>28</td>
<td>85%</td>
<td>21</td>
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<tr>
<td>12</td>
<td>AM</td>
<td>Mech. of Materials</td>
<td>Shear Diagrams</td>
<td>31</td>
<td>94%</td>
<td>21</td>
</tr>
<tr>
<td>11</td>
<td>AM</td>
<td>Mech. of Materials</td>
<td>Torsion in Shafts</td>
<td>7</td>
<td>21%</td>
<td>11</td>
</tr>
<tr>
<td>35</td>
<td>PM</td>
<td>Mech. of Materials</td>
<td>Beams: Dist. Loads</td>
<td>26</td>
<td>79%</td>
<td>20</td>
</tr>
<tr>
<td>36</td>
<td>PM</td>
<td>Mech. of Materials</td>
<td>Beams: Dist. Loads</td>
<td>19</td>
<td>58%</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mech of Materials</td>
<td></td>
<td></td>
<td></td>
<td>Mech of Materials</td>
</tr>
<tr>
<td>4</td>
<td>AM</td>
<td>Statics</td>
<td>3-D Forces &amp; Moments</td>
<td>30</td>
<td>91%</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>AM</td>
<td>Statics</td>
<td>3-D Forces &amp; Moments</td>
<td>10</td>
<td>30%</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>AM</td>
<td>Statics</td>
<td>Moments</td>
<td>8</td>
<td>24%</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>AM</td>
<td>Statics</td>
<td>Sum of forces</td>
<td>21</td>
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<td>16</td>
</tr>
<tr>
<td>2</td>
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<td>Statics</td>
<td>Trusses</td>
<td>5</td>
<td>15%</td>
<td>7</td>
</tr>
<tr>
<td>31</td>
<td>PM</td>
<td>Statics</td>
<td>Cent; Mom. of Inertia</td>
<td>8</td>
<td>24%</td>
<td>7</td>
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<td>PM%</td>
<td>AM</td>
<td>AM%</td>
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<td>PM</td>
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<td>10</td>
<td>30%</td>
<td>9</td>
<td>35%</td>
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<tr>
<td></td>
<td><strong>Statics</strong></td>
<td><strong>Averages:</strong></td>
<td>13.1</td>
<td>40%</td>
<td>10.3</td>
<td>40%</td>
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<tr>
<td>AM</td>
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<td>Conservation of Energy</td>
<td>32</td>
<td>97%</td>
<td>22</td>
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<td>AM</td>
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<td>Cycles</td>
<td>24</td>
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<td>20</td>
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<td>Ideal Gas Law</td>
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<td>18</td>
<td>69%</td>
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<tr>
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<td>Thermodynamics</td>
<td>Properties</td>
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<td>73%</td>
<td>23</td>
<td>88%</td>
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<tr>
<td>AM</td>
<td>Thermodynamics</td>
<td>Work-Energy</td>
<td>20</td>
<td>61%</td>
<td>19</td>
<td>73%</td>
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<tr>
<td>PM</td>
<td>Thermodynamics</td>
<td>Refrigeration</td>
<td>11</td>
<td>33%</td>
<td>6</td>
<td>23%</td>
</tr>
<tr>
<td>PM</td>
<td>Thermodynamics</td>
<td>Refrigeration</td>
<td>6</td>
<td>18%</td>
<td>2</td>
<td>8%</td>
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<tr>
<td></td>
<td><strong>Thermodynamics</strong></td>
<td><strong>Averages:</strong></td>
<td>19.3</td>
<td>58%</td>
<td>15.7</td>
<td>60%</td>
</tr>
</tbody>
</table>

*On the actual FE (but not in the above data), PM questions count twice as much as the AM questions*
Appendix E—Senior Interviews Written Surveys

The following supporting data for the Senior Exit Interviews Written Surveys as an assessment tool are included in this appendix:

1. Survey instrument
2. Summary table of survey data received
3. Plots of the responses to survey questions 1-12 and 15-20
Senior Exit Survey - Q1: Academic Advising that Provides Information for Scheduling...

- Target Value = 5.00
- Data Mean = 4.589
- Fitted Slope = + 0.030

Senior Exit Survey - Q2: Available Courses to Meet Your Degree Requirements

- Target Value = 5.50
- Data Mean = 5.416
- Fitted Slope = - 0.028
Student Satisfaction (1-7) and Rated Importance (0-1)

Senior Exit Survey - Q3: Faculty Who Communicate Course Materials Effectively

Target Value = 5.50
Data Mean = 5.160
Fitted Slope = -0.042

Senior Exit Survey - Q4: Engineering Course Assignments to Improve Communication Skills

Target Value = 5.00
Data Mean = 4.972
Fitted Slope = -0.012
Senior Exit Survey - Q5: Understanding of Course Purpose and Relationship to Other Courses

- Target Value = 5.00
- Data Mean = 5.052
- Fitted Slope = -0.008

Senior Exit Survey - Q6: Available Computer Facilities to Support Studies

- Target Value = 5.50
- Data Mean = 5.694
- Fitted Slope = -0.168
Student Satisfaction (1-7) and Rated Importance (0-1)

Senior Exit Survey - Q7: Knowledge of a Set of Engineering Principles

- Target Value = 5.50
- Data Mean = 5.825
- Fitted Slope = -0.022

Senior Exit Survey - Q8: Hands-On Experience with the Applications of Engineering

- Target Value = 5.00
- Data Mean = 4.364
- Fitted Slope = +0.015
Senior Exit Survey - Q9: Opportunities to Visualize Theory with Hands-On Experiences and Labs

Target Value = 5.00
Data Mean = 4.504
Fitted Slope = + 0.015

Senior Exit Survey - Q10: Ability to Relate Studies to Career Preparation…. Future Employment

Target Value = 5.00
Data Mean = 4.919
Fitted Slope = - 0.001
**Senior Exit Survey - Q11: Opportunities to Become More Aware of Professional Ethics**

- **Target Value**: 5.00
- **Data Mean**: 5.184
- **Fitted Slope**: +0.045

**Senior Exit Survey - Q12: Opportunities to Enhance Abilities to Work in Teams**

- **Target Value**: 5.50
- **Data Mean**: 5.794
- **Fitted Slope**: +0.016
Senior Exit Survey - Q20: Motivation Level When Preparing For & Taking FE Exam, and Pass Rate

Motivation

Pass Rate

Linear (Motivation)  Linear (Pass Rate)
Appendix F—External Advisory Board

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