Expected Outcome 1: Breadth
By the time of graduation from the program, graduates of the Computer Engineering (ECPE) Program will have achieved and demonstrated an ability to apply knowledge of mathematics, basic science, and engineering to solve problems encompassing the fundamental areas of computer engineering (circuits and systems, electronics, digital systems, software design, operating systems, and computer system design.)

Assessment Method 1: Course Data Collection

Assessment Method Description
Data is collected typically from final exam questions in junior and senior level courses taught in fall semesters. Particular courses are assessed every other year. A rubric is employed that features three performance indicators to determine how well the student understands the problem (“PI1: Understands Problem”), if the correct solution approach is chosen (“PI2: approach”), and if student is able to implement the solution approach (“PI3: execution”). A 4 point scale is used for each performance indicator on the rubric where scores of 1, 2, 3, 4 correspond to unsatisfactory, developing, meets expectations, and exceeds expectations, respectively. The preliminary assessment is carried out by the course instructor. The data is evaluated by the department’s Curriculum and Assessment Committee.
Success metric: at least 80% of students rate scores of at least a 3 on each PI.
The Fall 2013 assessment for the breadth outcome was carried out for ECPE students in the following courses: ELEC 2120, ELEC 2220, ELEC 3500, ELEC 3800, ELEC 5220 and ELEC 5410.

Findings
Assessment results for the breadth outcome are tabulated:
<table>
<thead>
<tr>
<th></th>
<th>#students</th>
<th>#scoring at least 3(%)</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI-1: Understand the problem</td>
<td>42</td>
<td>36 (86%)</td>
<td>3.57</td>
</tr>
<tr>
<td>PI-2: Approach/Select knowledge relevant to the problem</td>
<td>42</td>
<td>33(79%)</td>
<td>3.36</td>
</tr>
<tr>
<td>PI-3: Execution/Apply the selected knowledge to solve the problem</td>
<td>42</td>
<td>30(71%)</td>
<td>3.13</td>
</tr>
</tbody>
</table>

The success metric was met for PI-1, was borderline for PI-2, and was not met for PI-3. It was observed that many students exhibit weakness in basic circuit analysis and in relating material from one course (most often a pre-requisite course) to another.

**How did you use findings for improvement?**

For most of the perceived shortcomings, improvements have been suggested within the particular course being assessed. Also, faculty are encouraged to remind students that course understanding often depends on mastery of material from previous courses.

The department's curriculum and assessment committee has been following this outcome closely over the last several years and concludes that a laboratory component attached to the signals and systems class would help student understanding of a fundamental area of electrical engineering that feeds many other courses. The committee is working towards a formal request for such a lab.

**Additional Comments**

The department curriculum and assessment committee realizes that the success metric for the three performance indicators is somewhat arbitrary. For instance, it is to be expected that a greater percentage of students would understand the problem (PI-1) but may have trouble figuring out how to solve the problem (PI-2, 3). At this time the committee will retain the 80% success metric for all performance indicators, but may revisit this criterion for success in the future.

**Assessment Method 2: Senior Exit Survey**

**Assessment Method Description**

Survey of graduating seniors; Provides quantifiable data with respect to student satisfaction with their preparation to attain outcomes. Students were asked how well they believed they achieved the Breadth Outcome, stated above. The rating scale was 5 (excellent), 4 (very good), 3 (good), 2 (fair), and 1 (poor).
Findings
Combining the Fall 2013, Spring 2014, and Summer 2014 surveys, there were responses from a total of 51 graduating seniors. The aggregate scores for the Breadth Outcome question from these 47 students are as follows:
5 (excellent): 16 students (31%)
4 (very good): 28 students (55%)
3 (good): 6 students (12%)
2 (fair): 1 student (2%)
1 (poor): 0 students (0%)
The overwhelming majority of our graduates believe they have achieved the breadth outcome.

How did you use findings for improvement?
The department’s Curriculum and Assessment Committee reviewed the survey results for the Breadth outcome and determined that the outcome has been successfully met.

Additional Comments
Presently, the survey instrument combines results for the various undergraduate programs in the Department of Electrical & Computer Engineering. The committee believes that the survey is most effective as a “flag” for poor performance and that the present aggregate data from our closely related programs is both useful and adequate.

Expected Outcome 2: Communication
By the time of graduation from the program, graduates of the Computer Engineering (ECPE) Program will have achieved and demonstrated proficiency in communicating ideas and information orally and in writing.

Assessment Method 1: Course Data Collection

Assessment Method Description
Communication exercises have been integrated into a number of key ELEC courses in the curriculum. All core laboratory courses have technical writing components, especially lab ELEC 3050, and the senior design course ELEC 4000, in which written and oral communications are significant components of the design experience. Students receive feedback and recommendations for improvements from the faculty at all stages of these activities. Many upper level courses also have term projects that require written and/or oral reports.
A writing rubric is employed which features 6 performance indicators (PI): PI1 - Content, PI2 - Organization, PI3 - Style, PI4 - Grammar, PI5 - Figures/Tables, PI6 - Use of sources. An oral presentation rubric is employed which features 5 performance indicators: PI1 - elocution, PI2 - enthusiasm, PI3 - eye contact, PI4 - visual aids, PI5 - content. A 4 point scale is used for each performance indicator on the rubric where scores of 1, 2, 3, 4 correspond to unsatisfactory, developing, meets expectations, and exceeds expectations, respectively. The preliminary assessment is carried out by the course instructor. The data is evaluated by the department’s Curriculum and Assessment Committee. Success metric: at least 80% of students rate scores of at least a 3 on each PI.

The Spring 2014 assessment of communication ability was assessed in four sections of ELEC 4000, with 11 ECPE students.

Findings
Writing Rubric Data Summary: 11 Students

<table>
<thead>
<tr>
<th>PI-1: Content</th>
<th>#scoring at least 3 (%)</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 (100%)</td>
<td>3.43</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PI-2: Organization</th>
<th>#scoring at least 3 (%)</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 (100%)</td>
<td>3.43</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PI-3: Style</th>
<th>#scoring at least 3 (%)</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 (100%)</td>
<td>3.43</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PI-4: Grammar</th>
<th>#scoring at least 3 (%)</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 (100%)</td>
<td>3.43</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PI-5: Figures/Tables</th>
<th>#scoring at least 3 (%)</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 (100%)</td>
<td>3.43</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PI-6: Use of Sources</th>
<th>#scoring at least 3 (%)</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 (82%)</td>
<td>2.88</td>
<td></td>
</tr>
</tbody>
</table>

The success metrics for written communication were met for all performance indicators, with the lowest performance on PI-6: Use of Sources. However, the results show significant improvement over the previous year's assessment for PI-6 (0% for 4 students) indicating that efforts to improve this PI have been somewhat successful.

Oral Rubric Data Summary: 11 Students

<table>
<thead>
<tr>
<th>PI-1: Elocution</th>
<th>#scoring at least 3 (%)</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 (91%)</td>
<td>3.15</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PI-2: Enthusiasm</th>
<th>#scoring at least 3 (%)</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 (82%)</td>
<td>3.06</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PI-3: Eye Contact</th>
<th>#scoring at least 3 (%)</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 (91%)</td>
<td>3.25</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PI-4: Visual Aids</th>
<th>#scoring at least 3 (%)</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 (73%)</td>
<td>3.43</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PI-5: Content</th>
<th>#scoring at least 3 (%)</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 (73%)</td>
<td>3.34</td>
<td></td>
</tr>
</tbody>
</table>

Success metrics were failed for PI-4 Visual Aids and PI-5 Content, and PI-2 Enthusiasm was borderline.
How did you use findings for improvement?

Written Communication:
Although the success metric for PI-6: Use of Sources was much improved over last year, not all instructors emphasized their formal use. Instructors will be reminded to do so in future courses.

Oral Communication:
Some students were challenged by preparation of good visual aids, presentation content, and enthusiasm. This topic will be addressed in future course lectures.

The department's curriculum and assessment committee has been closely following the communication, design, and teamwork outcomes closely with an eye towards improvement in all these areas. The committee's conclusion is that an additional hour is needed to create a two semester senior design project sequence. The first semester would be the one hour introduction to senior design and would allow focus on some of the communication, design and teamwork issues that we wish to improve. The committee is working towards implementing this change in the near future.

Additional Comments
Assessment Method 2: Senior Exit Survey

Assessment Method Description
Survey of graduating seniors; Provides quantifiable data with respect to student satisfaction with their preparation to attain outcomes. Students were asked how well they believed they achieved the Communications Outcome, stated above. The rating scale was 5 (excellent), 4 (very good), 3 (good), 2 (fair), and 1 (poor).

Findings
Communication exercises have been integrated into a number of key ELEC courses in the curriculum. All core laboratory courses have technical writing components, leading up to the final lab course, ELEC 3040/3050/3060, and the senior design course ELEC 4000, in which written and oral communications are significant components of the design experience. Students receive feedback and recommendations for improvements from the faculty at all stages of these activities. Many upper level courses also have term projects that require written and/or oral reports.

Combining the Fall 2013, Spring 2014, and Summer 2014 surveys, there were responses from a total of 51 graduating seniors. The aggregate scores for the Communications Outcome question from these 51 students
are as follows:
5 (excellent): 20 students (39%)
4 (very good): 23 students (45%)
3 (good): 8 students (16%)
2 (fair): 0 students (0%)
1 (poor): 0 students (0%)

The department provides its students with many opportunities to practice their oral and written communications skills. All of the students believe they have been taught good or better skills.

**How did you use findings for improvement?**
At this time the department’s Curriculum and Assessment Committee feels no action need be taken.

**Additional Comments**
Presently, the survey instrument combines results for the various undergraduate programs in the Department of Electrical & Computer Engineering. The committee believes that the survey is most effective as a “flag” for poor performance and that the present aggregate data from our closely related programs is both useful and adequate.

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**Expected Outcome 3: Design**

By the time of graduation from the program, graduates of the Computer Engineering (ECPE) Program will have achieved and demonstrated an ability to design and analyze a component or system to meet desired needs within the field of computer engineering.

**Assessment Method 1: Course Data Collection**

**Assessment Method Description**
We assessed design on the final project report for the Spring 2014 offerings of ELEC 4000, Senior Design Projects. A rubric is employed that features five performance indicators (PI): PI1 - Use knowledge, methods, processes and tools to create a design that meets stated requirements.
PI2 - Evaluate if a design meets desired needs. PI3 - Consider realistic constraints in the design. PI4 - Testing of the final design. PI5 - Constructing a prototype of the design. A 4 point scale is used for each performance indicator on the rubric where scores of 1, 2, 3, 4 correspond to unsatisfactory, developing, meets expectations, and exceeds expectations, respectively. The preliminary assessment is carried out by the course instructor. The data is evaluated by the department’s Curriculum and Assessment Committee.
Success metric: at least 80% of students rate scores of at least a 3.
Findings
The assessment data for this outcome are tabulated as follows for 11 students:

<table>
<thead>
<tr>
<th>Performance Indicator</th>
<th>#Students scoring at least 3 (%)</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI-1: Create Design</td>
<td>10 (91%)</td>
<td>3.27</td>
</tr>
<tr>
<td>PI-2: Evaluate Design</td>
<td>10 (91%)</td>
<td>3.45</td>
</tr>
<tr>
<td>PI-3: Consider Realistic</td>
<td>11 (100%)</td>
<td>3.64</td>
</tr>
<tr>
<td>Constraints</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PI-4: Test Final Design</td>
<td>8 (73%)</td>
<td>3.27</td>
</tr>
</tbody>
</table>

The students met the success metrics on all performance indicators except for PI-4: Test Final Design.

How did you use findings for improvement?
Several suggestions were made by instructors for improving performance on this outcome:

- Students should be dissuaded from pursuing overly-ambitious projects.
- Student participation should be closely monitored throughout the semester
- The outcome C rubric should be shared with students

The department's curriculum and assessment committee has been closely following the communication, design, and teamwork outcomes closely with an eye towards improvement in all these areas. The committee's conclusion is that an additional hour is needed to create a two semester senior design project sequence. The first semester would be the one hour introduction to senior design and would allow focus on some of the communication, design and teamwork issues that we wish to improve. The committee is working towards implementing this change in the near future.

Additional Comments

Assessment Method 2: Senior Exit Survey

Assessment Method Description
Survey of graduating seniors; Provides quantifiable data with respect to student satisfaction with their preparation to attain outcomes. Students were asked how well they believed they achieved the Design Outcome, stated above. The rating scale was 5 (excellent), 4 (very good), 3 (good), 2 (fair), and 1 (poor).
Findings

Combining the Fall 2013, Spring 2014, and Summer 2014 surveys, there were responses from a total of 51 graduating seniors. The aggregate scores for the Design Outcome question from these 51 students are as follows:
5 (excellent): 27 students (53%)
4 (very good): 17 students (33%)
3 (good): 6 students (12%)
2 (fair): 1 students (2%)
1 (poor): 0 students (0%)

How did you use findings for improvement?
The previous year's Senior Exit Survey assessment of this outcome was worse than this year, and the department’s Curriculum and Assessment Committee encouraged faculty to craft better design opportunities for our students wherever possible. This appears to have paid off with better results this year. We will continue to work on this outcome.

Additional Comments
Presently, the survey instrument combines results for the various undergraduate programs in the Department of Electrical & Computer Engineering. The committee believes that the survey is most effective as a “flag” for poor performance and that the present aggregate data from our closely related programs is both useful and adequate.

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Expected Outcome 4: Teamwork

By the time of graduation from the program, graduates of the Computer Engineering (ECPE) Program will have achieved and demonstrated an ability to function as a member of a multidisciplinary team in the solution of engineering problems.

Assessment Method 1: Course Data Collection

Assessment Method Description
Teamwork is introduced in the freshman year, and then emphasized throughout the curriculum by requiring team projects in several courses, building up to a significant multidisciplinary teamwork experience in the senior projects course. Thus, the primary collection of assessment data for teamwork comes from senior design projects. A teamwork rubric is employed which features 5 performance indicators (PI): PI1 - Research and gather information, PI2 - Fulfill team role’s
duties, PI3 - Interacts well with teammates, PI4 - Make fair decisions, PI5 - Receptive to feedback from team members from other disciplines or backgrounds. A 4 point scales is used for each performance indicator on the rubric where scores of 1, 2, 3, 4 correspond to unsatisfactory, developing, meets expectations, and exceeds expectations, respectively. The preliminary assessment is carried out by the course instructor. The data is evaluated by the department’s Curriculum and Assessment Committee.

Success metric: at least 80% of students rate scores of at least a 3 on each PI.

The Spring 2014 assessment for the teamwork outcome was carried out for 11 students in 4 sections of the Senior Design Projects course, ELEC 4000.

**Findings**

The assessment data for this rubric is tabulated as follows for 11 students:

<table>
<thead>
<tr>
<th>Performance Indicator</th>
<th># students scoring at least a 3 (%)</th>
<th>Average score</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI-1: Gather information</td>
<td>11 (100%)</td>
<td>3.6</td>
</tr>
<tr>
<td>PI-2: Fulfill team role's duties</td>
<td>9 (82%)</td>
<td>3.1</td>
</tr>
<tr>
<td>PI-3: Interacts well with teammates</td>
<td>9 (82%)</td>
<td>3.2</td>
</tr>
<tr>
<td>PI-4: Make fair decisions</td>
<td>9 (82%)</td>
<td>3.3</td>
</tr>
<tr>
<td>PI-5: Receptive to feedback</td>
<td>9 (82%)</td>
<td>3.3</td>
</tr>
</tbody>
</table>

All success metrics were met. However, one instructor commented on how PI-4 and PI-5 were difficult to assess by peer evaluation, as students tended to score their teammates highly.

**How did you use findings for improvement?**

Several suggestions were made by instructors for improving performance on this outcome:

- Student participation should be closely monitored throughout the semester
- This outcomes rubric should be shared with students

The department’s curriculum and assessment committee has been closely following the communication, design, and teamwork outcomes closely with an eye towards improvement in all these areas. The committee’s conclusion is that an additional hour is needed to create a two semester senior design project sequence. The first semester would
be the one hour introduction to senior design and would allow focus on some of the communication, design and teamwork issues that we wish to improve. The committee is working towards implementing this change in the near future.

Additional Comments
Assessment Method 2: Senior Exit Survey

Assessment Method Description
Survey of graduating seniors; Provides quantifiable data with respect to student satisfaction with their preparation to attain outcomes. Students were asked how well they believed they achieved the Teamwork Outcome, stated above. The rating scale was 5 (excellent), 4 (very good), 3 (good), 2 (fair), and 1 (poor).

Findings
Teamwork is introduced in the freshman year, and then emphasized throughout the curriculum by requiring team projects in several courses, building up to a significant multidisciplinary teamwork experience in the senior projects course.

Combining the Fall 2013, Spring 2014, and Summer 2014 surveys, there were responses from a total of 50 graduating seniors. The aggregate scores for the Teamwork Outcome question from these 50 students are as follows:

5 (excellent): 14 students (28%)
4 (very good): 19 students (38%)
3 (good): 9 students (18%)
2 (fair): 1 students (2%)
1 (poor): 2 students (4%)

How did you use findings for improvement?
The department’s Curriculum and Assessment Committee believes the department provides many teaming opportunities for its students. The students appear to agree, with 94% ranking their abilities as good or excellent. At this time the committee feels no action need be taken.

Additional Comments
Presently, the survey instrument combines results for the various undergraduate programs in the Department of Electrical & Computer Engineering. The committee believes that the survey is most effective as a “flag” for poor performance and that the present aggregate data from our closely related programs is both useful and adequate.