CRITERION 4. CONTINUOUS IMPROVEMENT

The complete set of continuous improvement processes is captured in Figure 4-1. In addition there is an iterative process of evaluating the specific assessment methods themselves (for courses, alumni feedback, etc).

A. Program Educational Objectives

The components of the assessment cycles that influence the program educational objectives are depicted in Figure 4-2.

The key elements are the alumni and employer feedback, both with respect to the identification of the PEOs as such as well as for a basis for the assessment of the student’s achievements.

The data collection elements are:

1. **Alumni focus groups and surveys.** Organized once a year, these are qualitative conversations with alumni re. their post-graduation experience and career path, and how their learning environment shaped their career. The surveys gather quantitative and qualitative data on the post-graduation performance of the graduates, and eliciting feedback on the program educational objectives themselves.

2. **Employer surveys.** These are performed every three years, gathering quantitative and qualitative data on the professional performance of the graduates, and eliciting feedback on the program educational objectives themselves.

3. **Advisory Council feedback.** The advisory council meets once a year, and one topic at every other meeting is a review of the program educational objectives and their currency with respect to industry expectations and needs.
4. Student exit focus groups and evaluations. These focus groups address primarily the student outcomes achievements, but can serve as early indicators with respect to whether we can expect the students to achieve the program educational objectives a few years after graduation.

In order to determine whether the Computer Engineering program is achieving its program educational objectives, and to be able to improve the effectiveness of the program, several different types of data are being collected and used to evaluate the program.

The PEOs assessed in the 2006–2009 cycle were with respect to the PEOs in place at the time, to wit:

*That the graduates a few years after graduation had*

1. Demonstrated an understanding of the fundamental knowledge that is a prerequisite for the practice of computer engineering, including its scientific principles and the importance of rigorous analysis and creative design.

2. Demonstrated a practice-oriented, hands-on understanding of how to apply theoretical concepts to real world problems.

3. Demonstrated clear communication skills, responsible teamwork, leadership, and professional attitudes and ethics.

4. Successfully entered the engineering profession, and embarked on the process of lifelong learning in engineering or other professional areas.

**B. Student Outcomes**

The assessment processes for student outcomes are summarized in Figure 4-3.

**Assessment in the major courses**

The basis for the student outcomes assessment and the collection frequency is

- Course syllabi (every term).

- Sample questions and assignments from each required course (every year).

- Sample student work for each of these questions/assignments (one good, one mediocre, one barely acceptable) (every year).

Criterion 4 – 2
- Evaluations of oral presentations (every year).
- Scored student outcome-specific rubrics for sample evaluation instruments (every year).
- Publically evaluated deliverables for the capstone project experience. Evaluations performed by industry partners, faculty members and fellow students (every term).
- Focus groups/exit evaluations with graduating students (every year).

The assessment process is based on course assessment reports for the courses in the major (CARs), each authored by the course coordinator for the course in question. The evaluation is based on rubrics for the student learning objectives for each course. The CARs together with non-course-specific evaluation instruments serve as the basis for Outcome Assessment Reports (OARs) which are collected annually and reviewed by the undergraduate Studies Curriculum Committee (UCC), which may recommend changes in the course or the degree curricula depending on what they find. The OARs report on the students’ performance with respect to the rubrics relevant to the outcome, where 70% of the students performing at a “satisfactory” or “exceptional” level is considered to be overall satisfactory. If the number falls below 70% then corrective action is deemed to be necessary. (A sample OAR is provided in Appendix H – Department Sample Reports)

The UCC may also take into account information not specifically directed to a student outcome, such as retention and graduation rates, the students’ progress towards degree, etc.

**Lower Division General Education and Upper Division SJSU Studies**

Besides the major courses taught by the department faculty, the 59 units of the university’s lower division general education (GE) and the upper division SJSU studies programs contribute significantly towards some of the student outcomes. The assessment of these programs is governed by university policy S09-2 (see Appendix E - University Policies and Practices) and require an annual assessment of each course, covering all the student outcomes.
learning objectives for the course across a six-year program review cycle. The students may satisfy the SJSU Studies requirement in various ways, but the program has identified two particular SJSU Studies courses (CMPE 198 and ENGR 100W) as being required for the BS Computer Engineering degree and the assessment of these courses is performed in consultation with the BS Computer Engineering faculty, applying rubrics directed towards the student outcomes for the BS Computer Engineering degree specifically besides those used to evaluate the student learning objectives with respect to the SJSU Studies requirements.

Assessment Points
For each of the student outcomes the department has identified which course (or, in the case of the General Education and SJSU Studies program, the appropriate General Education or SJSU Studies area) provides support for the student’s progression towards achieving the outcome. Within this matrix of mapping support from course to outcome (see below), the department identifies a subset of courses for which outcome-specific assessment is performed (highlighted in the table).
### Student Outcomes vs. Courses (assessment schedule AY 2010/11)

(courses assessed with respect to outcomes by university policy lightly shaded, by department practice, darker shaded)

<table>
<thead>
<tr>
<th>Outcome /Course</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>g</th>
<th>h</th>
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<td>GE Area B: Science and Mathematics*</td>
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<td>GE Area D: Social Science</td>
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<td>GE Area E: Human Understanding &amp; Development</td>
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* GE Area B covered within Math, Physics & Chemistry required courses
GE Area R & Z covered within required course ENGR 100W
C. Continuous Improvement

Program Educational Objectives

Alumni Surveys
The program has surveyed alumni the fall of 2008, 2009 (leading up to the PEO revision in 2009/10), and in a revised form again in 2010 and spring 2011 (the 2010 response rate was too low). The surveys were designed to test reasonable indicators for each of the four PEOs, and the appropriateness of the PEOs themselves. The 2008-09 set consisted of the following questions:

1. Please list the five most relevant fundamental topics (e.g., in mathematics, sciences, social sciences; engineering analysis and design) that you have found useful the last few years. (PEO 1)
2. Please name some tools, methodologies, or equipment that you have used professionally the last few years. (PEO 2)
3. How many professional presentations have you given in the last 12 months? (PEO 3)
4. How many reports or articles have you written in the last 12 months? (PEO 3)
5. Did you present to or write for people outside the engineering profession? (PEO 3)
6. How many training or university courses have you attended since graduation? (PEO 4)
7. Please list the job titles you have held since graduation. (PEO 3, 4)

PEO #3 was probed particularly closely, since the previous assessment cycle had identified this as an area where improvement would be particularly welcome.

The surveys were given to a focus group of 43 graduates in December 2008 and 38 graduates December 2009. The overall conclusion is that the responding alumni in general meet the program educational objectives.
Table 4-1 Summary of Alumni Surveys 2008-09

<table>
<thead>
<tr>
<th>Objective</th>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Please list the five most relevant fundamental topics (…) that you have found useful the last few years.</td>
<td>All respondents listed more than one area. The breakout is below.</td>
</tr>
<tr>
<td>KE Areas¹</td>
<td>Distribution</td>
<td></td>
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<tr>
<td></td>
<td>Programming Fundamentals</td>
<td>13.25%</td>
</tr>
<tr>
<td></td>
<td>Mathematics Knowledge</td>
<td>12.97%</td>
</tr>
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<td></td>
<td>Social and Professional Issues</td>
<td>11.95%</td>
</tr>
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<td></td>
<td>Computer System Engineering</td>
<td>9.45%</td>
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<tr>
<td></td>
<td>Software Engineering</td>
<td>12.07%</td>
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<tr>
<td></td>
<td>Computer Architecture and Organization</td>
<td>7.64%</td>
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<td></td>
<td>Digital Logic</td>
<td>7.38%</td>
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<tr>
<td></td>
<td>Sciences</td>
<td>4.84%</td>
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<tr>
<td></td>
<td>Other</td>
<td>2.65%</td>
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<tr>
<td></td>
<td>Computer Networks</td>
<td>4.96%</td>
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<tr>
<td></td>
<td>Circuit and Signals</td>
<td>3.14%</td>
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<td></td>
<td>Probability and Statistics</td>
<td>2.02%</td>
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<td></td>
<td>Embedded Systems</td>
<td>2.47%</td>
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<td></td>
<td>Operating Systems</td>
<td>3.59%</td>
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<tr>
<td></td>
<td>Algorithms</td>
<td>4.38%</td>
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<td></td>
<td>Database Systems</td>
<td>2.59%</td>
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<tr>
<td>II</td>
<td>Please name some tools, methodologies, or equipment that you have used professionally the last few years.</td>
<td>All respondents listed one or more professional tools. The tools list was also used to guide the choice of tools in the curriculum.</td>
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<tr>
<td>III</td>
<td>Professional presentations the preceding 12 months?</td>
<td>80% had made one or more presentations, the median being 2.</td>
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<tr>
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<td>Professional articles/reports the preceding 12 months?</td>
<td>68% had authored one or more, the median being 4.</td>
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<td>III</td>
<td>Present to or write for people outside the engineering profession?</td>
<td>47% yes</td>
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<td>How many training or university courses have you attended since graduation</td>
<td>83% of those 3 years or more out had attended one or more courses, with a median of 3 courses</td>
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<tr>
<td>IV</td>
<td>Job titles</td>
<td>95% discipline related.</td>
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</table>

¹ From The IEEE/ACM Computer Engineering Body of Knowledge
Criterion 4 – 7
In 2010 a few more questions were added, probing the alumni’s experience with design work, and their assessment of their preparation with respect to ethics and professional responsibility. In particular:

1. “Has your work required systematic analysis and design? If it is possible, please give some examples.”
2. “Did SJSU prepare you to be aware of ethical, environmental and economical issues?”

The 2010 survey had a low response rate, so another solicitation was made spring 2011, with 49 respondents. Of the graduates that were more than two years out 74% answered in the positive on (1), and 83% answered in the positive on (2).

In all the surveys the alumni were in favor of the four program educational objectives.

**Employer Surveys**

In 2009 the department engaged the Office of Institutional Research (OIR), whose professionals routinely gather feedback data from community and industry personnel. This survey process is on a three-year cycle, with the next one being in 2012.

OIR submitted a survey instrument to 202 managers in Silicon Valley companies. The response rate was 21%. The survey consisted of 18 questions, and a copy of the survey report is in Appendix I – Survey Instruments.

**Highlights/Selected findings:**

**Desired skills for new graduates/Interns:**

- Employers felt that problem solving and analytical skills were the most important attribute of a new graduate ($\bar{x} = 1.86$)
- Other skills that employers thought were important were: technical skills ($\bar{x} = 2.31$), communications and presentation skills ($\bar{x} = 2.71$), leadership and teamwork ($\bar{x} = 2.83$), and related job experience ($\bar{x} = 3.29$).

**Current status of performance:**

- 85% of the responders had a graduate or intern from the Department of Computer Engineering employed in their firm. (Q11)
- 83% employed three or less graduates or interns. (Q12)
- 77% would rank these employees or interns in the 1st or 2nd quartile. (Q13)
- 66% say there are knowledge areas that they would like to see strengthened during the first year of employment. (Q14)

**Desirable performance:**

- 79% agree or strongly agree that Department of Computer Engineering students/graduates should be able to demonstrate an understanding of advanced knowledge of the practice of computer or software engineering, from vision to analysis, design, validation and deployment. (Q18.a)
• 79% agree or strongly agree that Department of Computer Engineering students/graduates should be able to tackle complex engineering problems and tasks, using contemporary engineering principles, methodologies and tools. (Q18.b)

• 91% agree or strongly agree that Department of Computer Engineering students/graduates should be able to demonstrate leadership and the ability to participate in teamwork in an environment with different disciplines of engineering, science and business. (Q18.c)

• 87% agree or strongly agree that Department of Computer Engineering students/graduates should be aware of ethical, economic and environmental implications of their work, as appropriate. (Q18.d)

• 94% agree or strongly agree that Department of Computer Engineering students/graduates should be able to show potential to advance successfully in the engineering profession, and sustain a process of life-long learning in engineer or other professional areas. (Q18.e)

• 94% agree or strongly agree that Department of Computer Engineering students/graduates should be able to communicate effectively, in both oral and written forms. (Q18.f)

**Overall Evaluation of Program’s Ability to Achieve Program Educational Objectives**

Based on the alumni survey, employer survey, and student outcome assessment (see below), the students’ ability to achieve the PEOs is summarized as follows:

*Program Educational Objective I – Demonstrated an understanding of the fundamental knowledge that is a prerequisite for the practice of computer engineering, including its scientific principles and the importance of rigorous analysis and creative design.*

Analysis

The alumni survey indicated that students graduating from the program have achieved this objective.

The employer surveys indicated that the employers in general are satisfied with our students regarding this objective.

The program outcome assessment indicated that the students currently in the program are likely to be able to achieve this objective in the future.

Conclusion

The program has achieved its goals with respect to this objective. Focus for further improvement is to strengthen the student’s ability to work on open-ended design problems.

*Program Educational Objective II – Demonstrated a practice-oriented, hands-on understanding of how to apply theoretical concepts to real world problems.*

Analysis

The alumni survey indicated that students graduating from the program have achieved this objective.
The employer surveys indicated that the employers in general are satisfied with our students regarding this objective.

The program outcome assessment indicated that the students currently in the program are likely to be able to achieve this objective in the future.

Conclusion
The program has achieved its goals with respect to this objective.

Program Educational Objective III – Demonstrated clear communication skills, responsible teamwork, leadership, and professional attitudes and ethics.

Analysis
The alumni survey indicated that students graduating from the program have achieved this objective to some extent. The fact about half the respondents had not addressed a non-engineering audience is likely a reflection of the fact that these are recent graduates who are working primarily with technical management and fellow engineers.

The employer surveys indicated that the employers in general are somewhat satisfied with our students regarding this objective. The employer focus group indicated that there was room for improvement in the area of communication skills.

The program outcome assessment indicated that the students currently in the program are likely to be able to achieve this objective in the future.

Conclusion
The program has achieved its goals with respect to this objective.

Continue to monitor the communication skills of the students and continue to explore ways to enhance these skills within the context of their coursework.

Program Educational Objective IV – Successfully entered the engineering profession, and embarked on the process of life-long learning in engineering or other professional areas.

Analysis
The alumni survey indicated that almost all of the students graduated from the program have successfully entered the engineering profession. It also indicated that 53% of the respondents attend further studies – be it degree-oriented or skills- and profession-oriented. The 45% responding that they have not attended further studies during their first two years after graduation is worthy of note. The number may reflect the downturn in the job market during the period these graduates have been out of school, and the limited opportunities new, young employees have in the current job situation.

The employer survey indicated that the employers in general are satisfied with our students regarding this objective.

The program outcome assessment indicated that the students currently in the program are likely to be able to achieve this objective in the future.

Conclusion
The students graduated from the program have achieved this objective. The percentage of respondents that demonstrate a commitment to continued pro-
fessional development is satisfactory, but could be improved. This PEO warrants continued attention.

**Improving the Program Educational Objectives**

The program has also engaged its industry partners, alumni and the members of the advisory council in a conversation re. the PEOs themselves (cfr. the section on Criterion 2, above):

The current PEOs are the result of the assessment/improvement cycle that culminated in 2009, three years after the previous cycle ended. The cycle was initiated with a series of focus groups inviting alumni and employers of our graduates to evaluate the importance of the then-current PEOs, and to suggest improvements.

These focus groups were convened every December, coinciding with the department’s *Capstone Project Exposition*, where alumni and industry partners (and participants in the Department Advisory Council) are invited to review the quality of work delivered by the graduating students. Based on the external feedback provided on December 8, 2007 and December 6, 2008, a slightly reworded set of PEOs were proposed by the department faculty. These were submitted to the department’s undergraduate studies committee and a sample of alumni, with the final version being discussed by the Department Advisory Committee in December 2009, and then adopted by the department.

The resulting PEOs are the basis for the current cycle of program evaluation and improvements.

**Student Outcomes**

Within the assessment processes described above, the following are evidence-based changes that the program has been subjected to. For ease of reading, we will provide an overview by outcome. For a description of how the various courses in the curriculum support the outcomes, please refer to Criterion 5.

**By Outcome**

**Outcome a - an ability to apply knowledge of mathematics, science, and engineering**

The major courses assessed specifically with respect to outcome (a) are CMPE 110, 127, 148, 152, 195B, ISE 130 and ENGR 10. The analysis of the student work indicates that the students achieve the outcome by the time they get their degrees. However, the data also indicated a need for changes in the program:

1. Based on the assessment in AY 2007/08, two changes were implemented:
   1.1. In CMPE 152, to give more weight to the topics of symbol tables and to optimization.
   1.2. Replace Math 133A (Differential Equations) with the broader course Math 123 (Differential Equations and Linear Algebra) as a prerequisite (and program component – this was part of a broader curricular change, described separately in section “Improved retention and progress towards degree” below).

2. Based on the assessment in AY 2008/09, an additional change was recommended
2.1. To add ungraded drill exercises

3. Based on the assessment in AY 2009/10, an additional change was recommended
   3.1. Give greater weight to exercises that drill the students’ proficiency in applying
classic equations to digital design problems.

Changes 1.1, 2.1 and 3.1 where validated as beneficial in subsequent years. It is too early
to tell with respect to change 1.2, since it takes 2-3 years before a change in the course
mix for the degree starts applying to the students. (Math 123 is taken in the second or
third year of a student’s career, and students to whom the new requirement applies are
likely to take the course in 2010, moving on to CMPE 110 in 2011).

**Outcome b – an ability to design and conduct experiments, as well as to analyze and interpret data**

The major courses assessed specifically with respect to outcome (b) are CMPE 30, 110,
124, 130, 152, 195B and ENGR 10. The analysis of the student work indicates that the
students achieve the outcome by the time they get their degrees. However, the data also
indicated a need for changes in the program:

1. Based on the assessment in AY 2007/08 it was conjectured that the students in CMPE
   130 were doing poorly in their laboratory assignments due to bad time management
   and procrastination with respect to laboratory work:
      1.1. Enforcing timeliness of laboratory work through late penalties was recommend-
           ed.
2. Based on assessments in AY 2008/09 it was determined that 1.1 had no discernible
   effect, and one looked deeper into the issues. The recommendation was to change di-
   didactics and
      2.1. Make greater use of programming exemplars, where students learn through the
           manipulation of existing code.
3. Based on a broader assessment of curricular structure (see below), in 2009/10 it was
determined that the course content in CMPE 130 be significantly revamped. The new
course sequence content was implemented fall 2010, and the result will be assessed
spring 2012 (when the cohort going through the new sequence reaches CMPE 130).
4. Based on the same assessment, spring 2011 the rubrics relevant to outcome (b) were
   refined for the capstone project course. The initial findings suggest a need to improve
   the students’ understanding of systematic validation of implementations. The finding
   will be investigated further in fall 2011, with the likely result being a curricular re-
   finement to be implemented spring 2012.

**Outcome c – 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, manufacturability, and sustainability**

The major courses assessed specifically with respect to outcome (c) are CMPE 50²,
CMPE 125, 126, 127, 130, 152 and CMPE 195B (the capstone experience). For the as-
essment of outcome (c) in the capstone experience course, we augmented our internal

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² Until Spring 2010

Criterion 4 – 12
assessment with a review by industry partners of the project deliverables (incl. interviews with the students). The analysis of the student work indicates that the students achieve the outcome by the time they get their degrees.

However, the data also indicated a need for changes in the program, specifically that the earlier course CMPE 126 did not bring the students to the level expected:

1. Based on the assessment in CMPE 126 (and to some degree in CMPE 152) in AY 2007/08 and 2008/09, changes were instituted:
   1.1. The overall introductory software track (culminating in CMPE 130) was changed (see below). CMPE 126 strengthens the problem-solving and design-oriented topics and CMPE 130 extends the students’ ability to design algorithms and system components further.
   1.2. The course was changed to become agnostic with respect to which IDE to use – students enter the course from a variety of lower division institutions, and requiring proficiency in a particular IDE was deemed to be counterproductive.
   1.3. The course structure was changed to add a scheduled laboratory experience in order to increase the students’ proficiency with using tools to design and implement systems.

AY 2010/11 is the first year where students are entering CMPE 126 with the new background in CMPE 30 and 50 (cfr. earlier comments with respect to the pace of programmatic change). The initial assessment is that the change in the lower division curriculum has improved the students’ preparation coming into CMPE 126, and thus 1.1 is tentatively deemed a success. Change 1.2 was implemented (and effective) immediately. 1.3 will be implemented fall 2012 and thus is still pending.

The initial findings from the spring 2011 CMPE 195B experience is that the students demonstrate at the expected or higher level with respect to quality design for components and systems using appropriate design methods. They provided well documented design constraints. They also demonstrated the required quality of functional components and systems.

**Outcome d – an ability to function on multidisciplinary teams**

The major courses assessed specifically with respect to outcome (d) are CMPE 131 (starting AY 2010/11), ENGR 10, 100W and CMPE 195A+B. The analysis of the student work indicates that the students achieve the outcome by the time they get their degrees. In particular, the most broadly multidisciplinary courses (CMPE 198, ENGR 100W) both assess this outcome as being successfully achieved, as does the third-year course in software engineering (CMPE 131) where students from computer engineering, software engineering and industrial and systems engineering work together.

The finer-grained rubrics used in CMPE 195A+B in AY 2009/10 identified possible issues with respect to professional team behavior. The recommendation was an increased emphasis on team structuring and interpersonal responsibilities. That recommendation was implemented 2010/11, and assessed spring 2011.

The conclusion was that the changes had improved the students’ achievement of this outcome, and that they performed well (i.e., satisfactory or better).

Criterion 4 – 13
**Outcome e – an ability to identify, formulate, and solve engineering problems**

For outcome (e) the courses CMPE 102, CMPE 127, CMPE 140, CMPE 142 and CMPE 195B were assessed. In addition the program invited industry partners to evaluate the capstone project deliverables and the students’ presentation of their project achievements. Employers of the program graduates were also asked to evaluate their experience with the graduates, and alumni were surveyed for their post-hoc evaluation of the program with respect to this outcome. The assessment of the capstone project indicates that the outcome is achieved. However, in CMPE 142 there is a continuing challenge with particular topics that warrant watchful attention (specifically, process synchronization).

**Outcome f - an understanding of professional and ethical responsibility**

The major courses assessed with respect to outcome (f) are ENGR 10, 100W, CMPE 131, 195A+B and 198.

The ethics and professional conduct component of the frosh course ENGR 10 will be strengthened, to focus the students’ attention early on the engineering aspects of professional conduct and ethical behavior.

Assessment data from the junior level courses ENGR 100W and CMPE 131 indicates satisfactory understanding of this outcome in the middle of the students’ degree career. ENGR 100W is a precursor to CMPE 198 (see below), and there has been an increased use of topics in professional ethics to strengthen the students’ understanding of how to achieve a reasoned response to ethical dilemmas.

CMPE 198 was introduced as a follow-up to the 2006 ABET report – the report indicated a need to strengthen outcome (f). The requirement became effective as of the fall 2007 catalog, which applies to the classes of 2011 and 2012. The students started attending the class fall 2010, and the initial assessment indicates that the students perform well, and that the outcome is satisfactorily achieved. However, there is room for improvement (particularly in the area of identifying the correct action to take in response to an identified ethical dilemma). ENGR 100W focused attention on this area spring 2011, and the initial assessment is promising. We will assess how this carries forward to CMPE 198 in 2012, as well as evaluate possible improvements in CMPE 198 itself.

The outcome has also been assessed in CMPE 195A+B (the capstone project course) by internal measures as well as by our industry partners. The finding is that the students performed well (satisfactory or better) as they are about to graduate from the program.

After a review of the academic integrity records of the program, in 2007 the department determined to reinforce professional behavior (particularly with respect to intellectual property) and to that end instituted a very strict policy regarding academic and professional integrity. The policy was supported by diligent enforcement, the use of modern plagiarism detection tools and (most importantly) every class in the major opens the term with a review of professional conduct requirements and the consequences of breaches.

As a result the number of ethical misconduct incidences has fallen to (close to) zero, and the students’ behavior as observed in the capstone project (and other) classes provide evidence that the students have a solid operational understanding of professional conduct and ethical behavior.

Criterion 4 – 14
**Outcome g – an ability to communicate effectively**

The major courses assessed specifically with respect to outcome (g) are ENGR 10, 100W (engineering reports), CMPE 148 (computer networks) and CMPE 195A+B (the capstone project). Assessment of student work in the courses as well as by industry partners during the capstone project confirms that the students achieve the outcome by the time they get their degrees.

**Outcome h – the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context**

Outcome (h) has been specifically assessed in ENGR 10, 100W, CMPE 195B, 198 and (from AY 2010/11) CMPE 131. It has also been assessed through the university Board of General Studies assessment processes for GE areas C, D (lower division) and R, S, and V (upper division). Based on the recommendation fall 2010, assessment processes for this outcome have been implemented for ENGR 100W starting spring 2011.

The outcome is being achieved, and aside from a continued refinement of course delivery no substantive changes have been required.

**Outcome i – a recognition of the need for, and an ability to engage in life-long learning**

The outcome is being assessed by the University’s Board of General Studies for GE areas C, E (lower division) and S, V (upper division), and in CMPE 195A+B.

Having applied a finer-grained rubric in AY 2009/10 in the capstone course it was determined that though the students were able to engage in independent learning, their articulated recognition of the need for continuous learning and the tools supporting professional development (e.g., professional societies, social networks and the like) could be improved upon. This was addressed in AY 2010/11, and the assessment of the improvement indicated a satisfactory achievement of the outcome by the students.

**Outcome j – a knowledge of contemporary issues**

Outcome (j) is assessed specifically by the University’s Board of General Studies in GE area D, and in the courses ENGR 10, CMPE 140, 148 and 195A+B. Students attended the Silicon Valley Leadership seminars and completed a survey report to demonstrate their understanding of contemporary issues. The outcome has been satisfactorily achieved and no outcome-specific changes have been recommended.

**Outcome k – an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.**

Outcome (k) was assessed specifically in ENGR 10, CMPE 50, 125, 131, 140 and 195B. The outcome was evaluated based on student hands-on engagement of multiple labs in all the courses where this outcome is being assessed as well as on industry partners’ review of the capstone projects.

The outcome was found to be satisfactorily achieved. With the change in the organization of the sophomore programming class CMPE 126 (the addition of a laboratory component) in fall 2012 we will assess the tools mastery in that early class as well as in the preparatory CMPE 50.

Criterion 4 – 15
**Improvements across multiple outcomes**

During the period under review, the department has made a number of programmatic changes to the curriculum, based on evidence gathered and with specific programmatic goals.

**Improved retention and progress towards degree**

The program faced the challenges of losing many students before they graduated, and of having students repeat courses before successfully moving on towards the degree (or changing majors). Examining the underlying material from the Office of Institutional research, contributing factors were determined to be related to the structure of the student advising system, the degree of lower division engagement in the major and a frequently misaligned level of preparation from secondary schools with respect to the requirements for the degree.

Specifically, students entering with a significant need for remedial instruction in mathematics were found to be very unlikely to ever graduate with an engineering degree.

Furthermore, students were determined to be somewhat overwhelmed by the amount of learning necessary within the single lower division course in computer engineering required to prepare for the sophomore software design course.

The actions taken were:

- More intrusive and professional advising structures.
  
  The college established its Engineering Student Success Center with professional advisors focusing on general education, preparation for the major and development of general professional and study skills.

  The program changed its advising structure, designating two tenure-line faculty members as the principal advisors in the major, ensuring consistency and well-founded advising for the students.

- Closer tracking of student progress, with clear cut-off points and procedures
  
  The program instituted a policy for probation and disqualification in the major. These procedures aim to assist student to avoid lingering on in the major with little or no realistic hope for success. Students who do not do well in the major courses are put on probation, are provided with strong and directed advising and in the end assisted in finding alternative majors if they do not succeed in engineering. Students are place on probation if their major GPA falls too low, and while on probation a student is required to improve the GPA towards an acceptable threshold every semester. Students who are unable to progress towards an acceptable grade in the major are disqualified from the major and have to transfer to another major.

- Improved lower division computer engineering engagement
  
  The single (and overwhelming) course in software design (CMPE 46) was replaced by two courses (CMPE 30 and CMPE 50). The objective in CMPE 30 is to combine a first-year experience with a first exposure to compute engineering work. The course is quite innovative, making use of embedded systems, sensors and robots to introduce the students to programming and software design. The course is then followed up
with a more traditional object-oriented programming course, setting the stage for the upper division courses in software and hardware design.

Observed consequences are a better flow of students through the curriculum (resulting from the improved advising structure) and a better preparation of the students for the upper division classes. The latter is not firmly supported by evidence yet, as we only had one semester of students who have been through the new curriculum.

**Reshaping the curriculum**

During the 2000-2006 accreditation cycle the program offered a course in networking as a technical elective, but a student could graduate without any exposure to networks as an academic and professional subject.

The 2006 accreditation report noted this, and observed that students graduating from a BS Computer Engineering program would be expected to have some degree of mastery of computer networks and networked systems. In consultation with our industry partners and after a conversation within the faculty of the department, it was determined that the practice of strongly recommending CMPE148 as one of the technical electives (practically all the graduating students included it among their courses) should be reflected in the program requirements. Consequently, CMPE 148 is now a required course, with all graduates understanding the basics of computer networks.

The retention data identified a challenge in the students’ progression through CMPE 130 – file processing. An analysis of the students’ preparation and where they were failing was the basis for a repurposing of the course, changing it from a course in file structures and B-trees into a more general-purpose algorithm design course. The feedback from that improvement is quite encouraging – the passing rate in the course has improved from mid-50% to over 80%.

**Pending significant actions**

The program is identifying areas of possible refinement and improvements on an annual basis (as can be seen from the above). Arising from the previous outcome-level assessment cycles, the significant improvements with currently pending implementation and assessment of effectiveness are:

- Adding a scheduled laboratory for CMPE 126. To be implemented fall 2011.

**Improved university assessment processes**

The university has an extensive set of processes for the assessment of the general education courses. The assessment process represented a significant burden, and the results were of questionable utility.

As a consequence the university’s Board of General Studies (BOGS) assessed its processes, and proposed a new set of general education assessment guidelines. These were presented to the Academic Senate in 2009, and adopted.

The principal changes were (1) to treat the general education program as a program, assessing the overall efficacy rather than to fragment the assessment into independent course-assessments only, and (2) to refine the course level assessment into a more lightweight process.

Criterion 4 – 17
The resulting processes are being implemented, and as a sample please see Appendix E - University Policies and Practices for a sample assessment report (for general education area S “Self, Society & Equality in the U.S.”)

Additional Information

The College of Engineering Strategic Planning Process

The College of Engineering underwent a strategic planning exercise in 2005, entitled Engineering the Vision. This process resulted in a drive towards improving excellence in the College and set the context for significant capital fundraising. That effort resulted in considerable effort towards improving student success by using external resources to create our Engineering Student Success Center (ESSC). Today, we have top-ranked programs, expert faculty, successful graduates with broad and impressive accomplishments, close ties with Silicon Valley industry, and unique global opportunities for our students. Our College of Engineering is a vibrant educational environment. Now we’d like to move from good to great.

We are now finishing the next phase of Strategic Planning, which we refer to as Engineering 2015. The new plan is the result of a continuous improvement process to ensure that our college strengthens its commitment to core values, prepares for the challenges of the coming years, and engages in a process of moving from good to great. During AY 2009-10, Dean Belle Wei launched the Engineering 2015 Task Force, in order to engage all stakeholders in open dialogue and envision a future based on no-limitation thinking. This task Force completed its work in Spring 2011.

The Engineering 2015 Task Force was a broadly representative committee comprised of COE faculty and staff, an industry representative, a graduate student, and an undergraduate student. It was charged it with the responsibility to "...lay a solid foundation for the future and continue maintaining an environment devoted to excellence and research, despite what may appear to be the current adverse financial climate...” While the Task Force has been convened in an adverse financial climate, the scope of its work is rooted in COE’s Vision and Mission, not its budget.

The Task Force reviewed the College's Vision and Mission statements developed in 2004 and affirmed that they are current, valuable, and need no revision:

**Vision:** To be a learning community that empowers its students to better the world through innovative applications of engineering knowledge and skills

**Mission:** To educate new engineers for the new century, who are technically excellent, broadly educated, and socially responsible

The early meetings of the Task Force involved brainstorming and research as the members asked: In the College of Engineering: What do we do? What are we good at? What are we passionate about? Ideas were elicited from faculty, administration, staff, alumni, students and employers, using focus groups and surveys.

Spring 2010 involved:
- Reviewing core values that are essential to the College
- Identifying gaps and opportunities to better prepare our students for a changing future landscape

Criterion 4 – 18
Establishing priorities and direction
Researching benchmark schools
Considering alternative and innovative models
Determining strategic strengths to maintain and develop

Inclusive open communication and collaborative processes were significant. There was a sincere desire and drive to have wide-ranging discussion formats in an inclusive environment. The task force members met together regularly as a team and also formed numerous subcommittees to research and report back on, for example, other campus policies, literature on change management, best practices, lifelong learning, Silicon Valley issues, university issues and data, and COE statistics. There was motivation to realistically appraise alternatives and courses of action. Decision-making required information, data, statistics, and abundant participation. They met in forums with faculty, chairs, staff, and students, as well as open forums. This comprehensive approach created synergy.

In a nutshell, we determined what are stakeholders most proud of:

- Distinctiveness
- Hands-on education
- Diversity and global outlook
- Silicon Valley connections and spirit

We are the only public engineering university in this entrepreneurial, high tech, world-renowned Silicon Valley. Students and alumni value the education received here as #1. Alumni, students, staff, and faculty value the hands-on education in the College, the cultural and ethnic diversity, and the Silicon Valley location.

Students appreciate good professors and networking with fellow students, but they would like us to further expand our bridges with Silicon Valley. There were also comments about curriculum not being cutting edge. These issues were explored and plans for addressing them are in the Engineering 2015 Plan.

Three broad categories are the heart of the Engineering 2015 Plan:
- Educational Excellence
- Faculty Excellence
- Silicon Valley Connections

Educational Excellence

For continuous improvement, the following are guiding directives as we continue our forward momentum from good to great in Engineering Excellence:

- Empower students for success through excellence in the major.
- Create a supportive atmosphere of engagement, critical thinking, innovation, and success.
- Develop students into responsible graduates who have a thorough understanding of fundamental engineering theory.
- Provide exemplary student support.
- Maintain—and continue to improve—advising. Focus on early intervention to help students improve early and have a greater chance of success and to make sure that the right students are in our program.
- Achieve 15% improvement in the 6-year graduation rate by 2015.
• Assist incoming students through a Frosh Summer Bridge Program.
• Continue to provide opportunities for improved communication between whom?.
• Partner with industry and other college to benefit student learning and transfer technology.
• Work to incorporate open-ended projects in our required classes to improve life-long learning skills and ease the transition to the “real world.”
• Develop Silicon Valley Capstone Projects

Faculty Excellence
The College of Engineering encourages its faculty members to excel in teaching, research, and service and plans to sponsor new Faculty Excellence Programs (FEPs), to which College faculty members apply on a competitive basis. The funding levels and sources, and specific requirements and metrics are under development for Fall 2011 deployment. To help launch the use of performance metrics in encouraging faculty excellence, the Task Force members suggested a small set of measures and grouped them into four categories: teaching, research, service, and “holistic and other.” Each of the first three categories is further partitioned into Above and Beyond vs. Normal sub-categories. For example:

Teaching
• winning student projects and external student competitions
• cutting-edge courses
• above-and-beyond advising and supervision of masters projects
• strong record in teaching through pedagogical innovation and leadership

Research
• above-and-beyond research for the purpose of creating new knowledge
• external recognition (e.g., grants/awards)
• quality and quantity of publications

Service
• above-and-beyond service to external communities, leadership to professional community, invited lecturer of external organization; organize conference, service committee members or officers of professional societies
• long hours with high impact

Holistic qualities based on advancing the College vision through:
• Leadership
• Collaboration
• Collegiality

Silicon Valley Connections
Industry Connections are vital. These are key to the distinctiveness of our College. The Dean's Silicon Valley Leadership Symposia have been significant (really? Ed. Comment – may want to say how they have been significant). Expanding these relationships is crucial for who we are as a College. Faculty, staff, students, and alumni appreciate our proximity to Silicon Valley. Alumni, graduate and undergraduate students value industry relevance and are counting on more industry connections. An immediate step
is the creation of a multidisciplinary project development team that will work with industry to provide an interdisciplinary senior capstone project that will last for two semesters. **In conclusion,** the Task Force looked inward and outward to establish priorities and guidelines to advance the College through Educational Excellence, Faculty Excellence, and strengthening Silicon Valley Connections.