# Assessment Plans

for

# Computer Engineering Programs

Spring 2015

# Introduction

The CpE B.S and M.S. degree programs at California State University, Sacramento are joint programs supported by both the Computer Science (CSc) and Electrical and Electronics Engineering (EEE) departments. The Computer Engineering (CpE) faculty members (including the CpE coordinator) are appointed in either the CSc or EEE department.

This report describes the processes used by the CpE faculty to monitor and assess the Program Educational Objectives (PEOs) and Student Outcomes (SOs) for the B.S. degree program – both of which have been established according to due process and the guidelines of ABET, the accrediting agency. This report also describes the processes used by the CpE faculty to assess the PEOs and SOs of the CpE M.S. degree program.

The SOs are defined as the knowledge and those skills that students should be able to demonstrate at the time of their graduation, and the PEOs are those professional characteristics that students should be able to demonstrate approximately five years after graduation. The processes to periodically review the PEOs and assess the SOs are also described.

# B.S. Program Educational Objectives (PEOs)

The list of PEOs for the Computer Engineering B.S. degree is as follows:

1. *Core Knowledge*: Our graduates will have careers in computer engineering, or be engaged in a related career path.

2. *Application of Knowledge*: Our graduates will apply their knowledge and skills to solve practical engineering problems.

3. *Life-long Learning*: Our graduates will continue to develop their skills and seek knowledge after graduation in order to adapt to advancing technology and the needs of society. This may be indicated by the graduate's pursuit of an advanced degree or other formal instruction, and/or that the graduate has developed a professional specialty.

4. *Professionalism*: Our graduates will have the necessary professional skills, such as high ethical standards, effective oral and written communications, and teamwork, to be productive engineers and to advance in their careers.

# B.S. Student Outcomes (SOs)

*Excerpted from ABET General Criteria 3 for Accreditation of Engineering Programs, 2015-2016*

"The program must have documented student outcomes that prepare graduates to attain the program educational objectives. Student outcomes are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program."

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(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

(d) an ability to function on multidisciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

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

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

# Constituencies of CpE Programs

The students, Alumni, employers, and faculty as a whole are the four major constituencies of the CpE programs.

## Students and Alumni
The mission of the CpE Program at CSUS is to provide our students with high quality education with the necessary knowledge, skills, and abilities at the time of graduation to transform our graduates into professionals who are prepared to meet the needs of society and adapt to rapidly changing technology. CSUS has a diverse student body from a wide range of cultures and socioeconomic backgrounds and our current students as well as our graduates are the primary constituents of our program.

## Employers
Computer related industries are the primary employers of graduates from the CpE Program. Our graduates enter a competitive market wherein such employers seek candidates with strong technical and communication skills as well as an ability to thrive within current industry standards and to address the challenges of the future. Our employers are in a unique position to reflect on the talents, abilities and skills that are necessary for our graduates to succeed in the workplace. Experienced employees from the local industries are invited to form the CpE Industry Advisory Council (IAC).
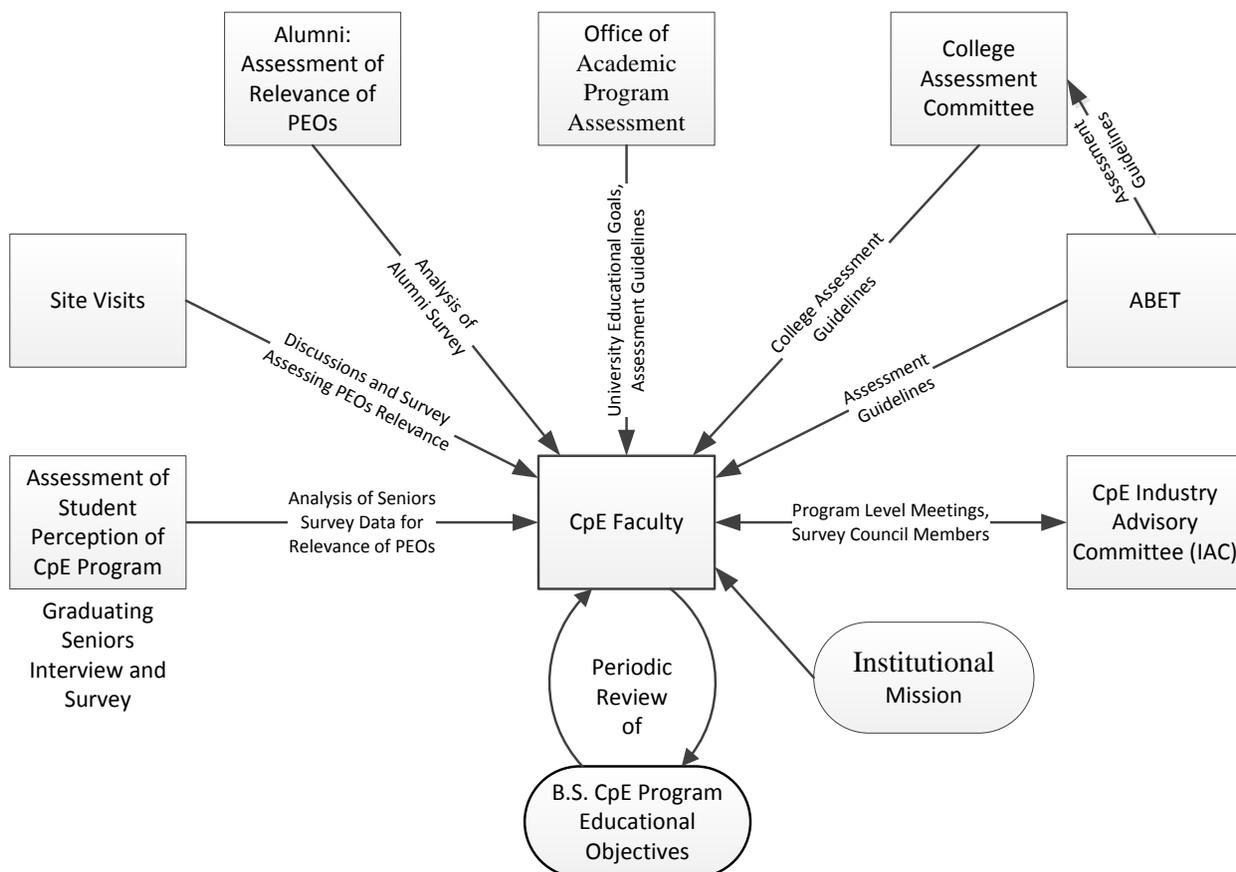
## Faculty
Faculty at-large represent one of the important constituents of the program and they are directly responsible for the education of our students and ensuring that they are prepared to meet the educational objectives of our program. The Office of Academic Program Assessment defines undergraduate leaning goals and provides university-wide assessment guidelines and requirements and the College of Engineering and Computer Science

Assessment Committee provides additional guidelines for the Engineering programs in the College. The CpE faculty is involved directly by providing course outlines, creating course goals and objectives, assessing student outcomes, and closing the loop. Individual faculty members make minor changes within individual courses, while the entire CpE faculty acts upon major curriculum changes resulting from evaluation of the outcomes assessments.

# B.S. PEOs Review Process

Figure 1 illustrates the process to periodically review and update the B.S. degree PEOs. The CpE faculty members receive inputs from various on campus committees, the program constituents, and ABET accrediting body to continuously review and assess the relevance of the PEOs. The Office of Academic Program Assessment defines the University Educational Goals and provides the campus wide assessment guidelines. The goals of the College Assessment Committee is for each Engineering program to exchange and share sound assessment practices and develop college-wide assessment standards and guidelines. The inputs from the CpE Industrial Advisory Council (IAC) meetings, site visits with local industries, student and Alumni, and ABET are used to periodically evaluate the relevance of the PEOs with respect to university and college mission, the needs of the industry, and requirements of the accreditation.



**Figure 1 Flowchart of B.S. Program Educational Objectives Assessment**

Table 1 outlines the methodologies used to periodically review the PEOs using the various inputs CpE faculty receive as shown in Figure 1.

**Table 1 Process to Periodically Review B.S. Degree Program Educational Objectives**

| Constituent | Methodology | Inputs |
|---|---|---|
| Students | Graduating Senior Exit Interview and Survey (Sample list of graduating seniors interviewed every semester) | Verbal student recommendations;<br><br>Seniors shall be asked to rate their perception of the CpE program in terms of the knowledge, skills, and abilities relating to the PEOs. |
| Alumni | Alumni survey, once every 3-5 years. | Survey collected by the Office of Institutional Research (OIS). The Alumni shall be asked to rate the relative importance of the PEOs as Essential, Important, Desirable, or Not Relevant. |
| Employers | The Industry Advisory Council (IAC) meetings, once every year;<br><br>Site visits, one per year. | IAC meeting discussions and survey: The industry members of the Council shall rate the relevant importance of the PEOs as Essential, Important, Desirable, or Not Relevant. Members shall add additional objectives (if any) and also rate their relative importance.<br><br>Company site visits and survey: The managers and Alumni/employees attending shall be asked to rate the relative importance of the PEOs, add and rate new objectives (if any), and provide recommendations to improve the program. |
| University/ College | Office of Academic Program Assessment;<br><br>College Assessment Committee | University educational goals updates,<br><br>University assessment guideline updates,<br><br>College assessment guidelines updates |
| CpE Faculty | Faculty meetings to review PEOs based on the data and inputs received over the past three years | Analysis of Alumni, IAC, and site visits survey results,<br><br>Evaluation of University, College, and/or ABET assessment guidelines updates |

# B.S. Degree SOs Assessment Process

The CpE B.S. degree curriculum includes math and science courses as well as CpE, CSc, EEE, and Engineering (ENGR) prefixed courses that are taught by faculty members from the CSc and EEE departments. The assessment of the CpE program relies on the assessment data received from the two departments where each department uses a different assessment methodology as outline below.

The EEE department uses a set of performance indicators, called Course Outcomes (COs), to assess (when applicable) all or a set of SOs in each course, and the CSc department uses a set of performance indicators from all the courses to assess the SOs for the entire program. The CSc department does not assess SOs in each course. In both cases the assessment instruments are direct and include exam questions, assignments, and/or projects.

For each course where COs are assessed the assessment data is first mapped to SOs using the template shown in Table 2 (Course SOs), where an "X" in any cell would indicate how an SO is assessed in each course. Two or more X's in a single column would indicate the SO is assessed using multiple COs. The data from all such maps is mapped to all the SOs, as illustrated in Table 3, to assess the CpE Program SOs, as required by ABET.

**Table 2 Course SOs: Example Mapping Course Outcomes to Student Outcomes (for Courses Taught By EEE Department)**

| Course Outcome (CO) | Student Outcome (SO) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g | h | i | j | k |
| 1 | | | | | | | | | | | |
| 2 | | | | | | | | | | | |
| 3 | | | | | | | | | | | |
| 4 | | | | | | | | | | | |
| . . . | | | | | | | | | | | |

Place an X in each cell where the Course Outcome assesses the Student Outcome.

For courses that performance indicators are used to assess the SOs for the entire program, the assessment instruments (exam questions, assignments, and/or projects) directly measure the performance of each student on each of the indicators. Multiple indicators from multiple courses are used to assess all the SOs, as also illustrated in Table 3. The quantitative assessment results in Table 3 as well as the inputs from the College Assessment Committee and ABET are used for continuous improvement of the SOs as illustrated by the flowchart shown in Figure 2.

**Table 3 CpE Program SOs: Example Mapping of CSc Performance Indicators (PIs) and EEE Course Outcomes (COs) to CpE Student Outcomes (SOs)**

| Student Outcome (SO) | Courses Taught by CSc Faculty | | | | Courses Taught by EEE Faculty | | | |
|---|---|---|---|---|---|---|---|---|
| | Course 1 PIs | Course 2 PIs | Course 3 PIs | … | Course A COs | Course B COs | Course C COs | … |
| a | | | | | | | | |
| b | | | | | | | | |
| c | | | | | | | | |
| d | | | | | | | | |
| e | | | | | | | | |
| f | | | | | | | | |
| g | | | | | | | | |
| h | | | | | | | | |
| i | | | | | | | | |
| k | | | | | | | | |

Place an X in each cell where a set of performance indicators CSc department or Course Outcomes from EEE department assesses a Student Outcome (SO).
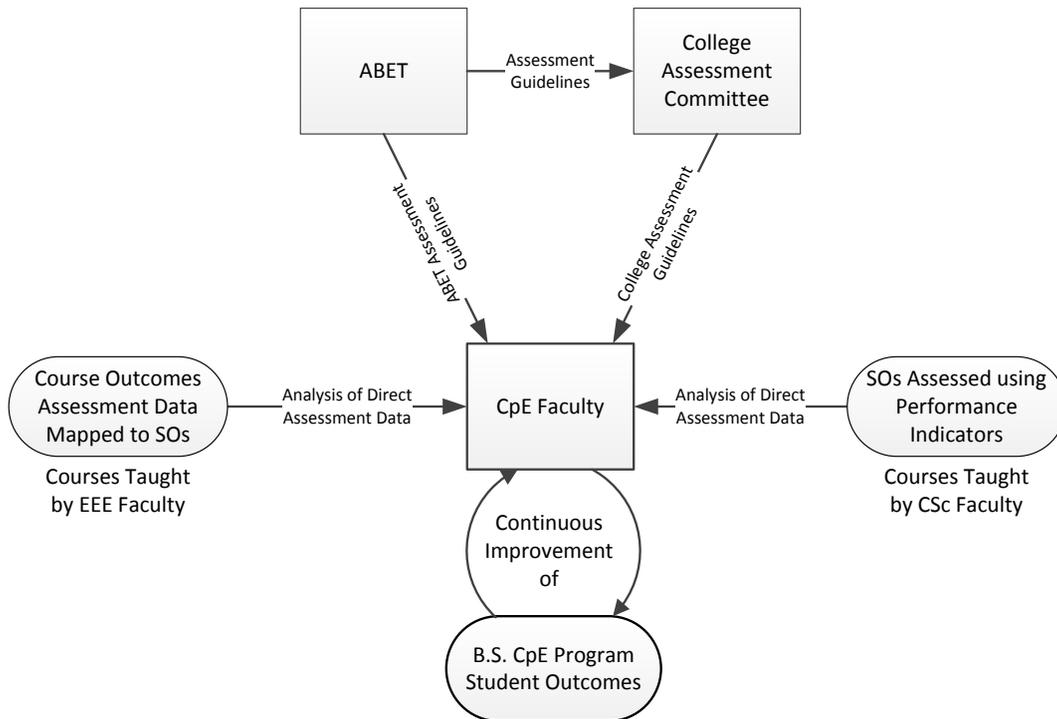


**Figure 2 Flowchart of B.S. Student Outcomes Assessment**

# Assessment of CpE Graduate Programs

The CpE M.S. degree requirements includes Plan A (Masters Project), Plan B (Thesis), or Plan C (Comprehensive Exam).

## M.S. Program Educational Objectives

1. Graduates will be capable of integrating undergraduate fundamentals and advanced knowledge to solve complex Computer Engineering related problems

2. Graduates will be prepared for professional advancement in computer engineering. They will have the ability to pursue continuous learning and identify, understand, and apply new knowledge within the field.

3. Graduates will have the ability to undertake a research and development project and to document the work in clear and effective manner, appropriate to the standards in the field.

4. Graduates will have the ethics and the communication skills to be an effective team member.

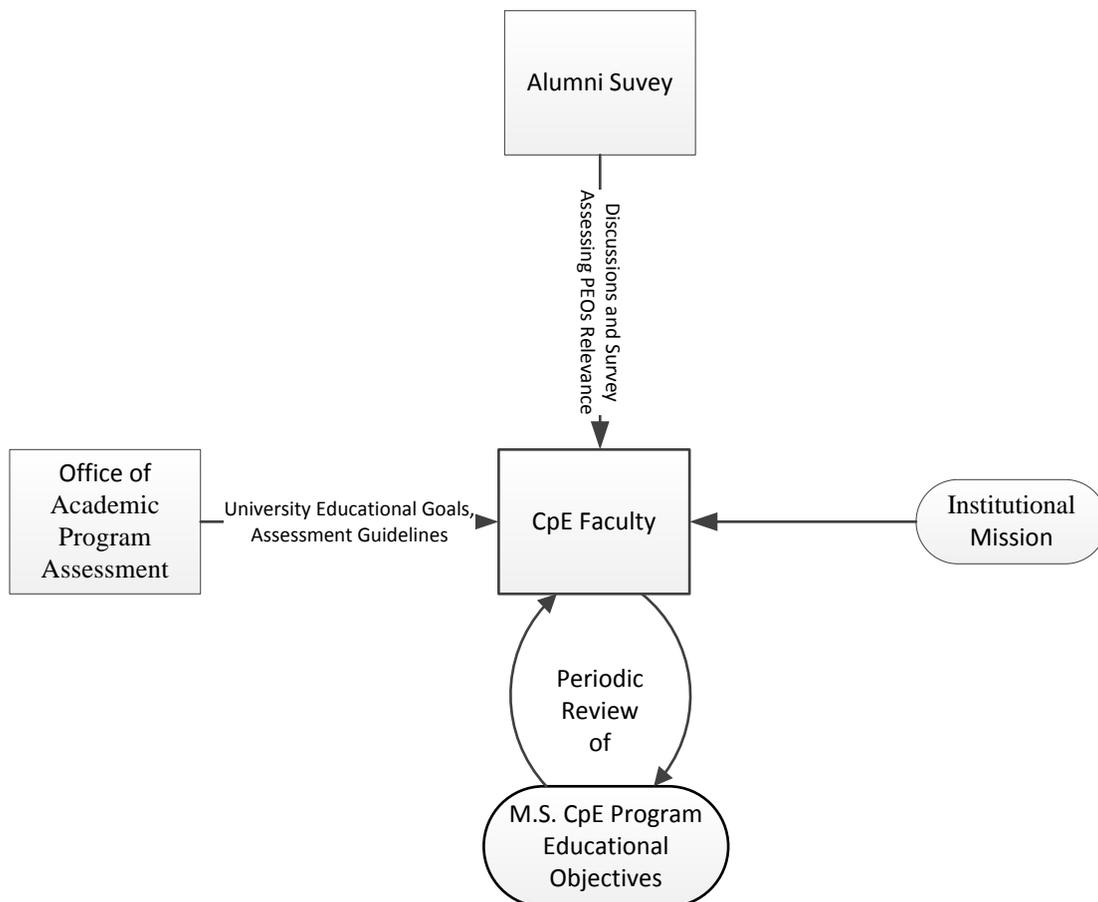The process used to periodically review the M.S. PEOs is shown in Figure 3.



**Figure 3 Flowchart of M.S. Program Educational Objectives Assessment**

# M.S. Student Outcomes

a.  Problem Solving: Graduates apply knowledge from their undergraduate and graduate computer engineering studies and related disciplines to solve complex computer engineering problems that require advanced knowledge within the field.

b.  Critical thinking: Graduates understand and integrate new knowledge within the field.

c.  Creative thinking:  Graduates can plan and conduct projects on advanced topics within the field.

d.  Written communication: Graduates can report on advanced topics within the field.

e.  Integrative and applied learning: Graduates can work as a team in a diverse changing world.

f.  Civic knowledge and engagement: Gradates recognize the ethical standards, and possess skills for effective communication.

Figure 4 illustrates the process used to assess the M.S. degree SOs.
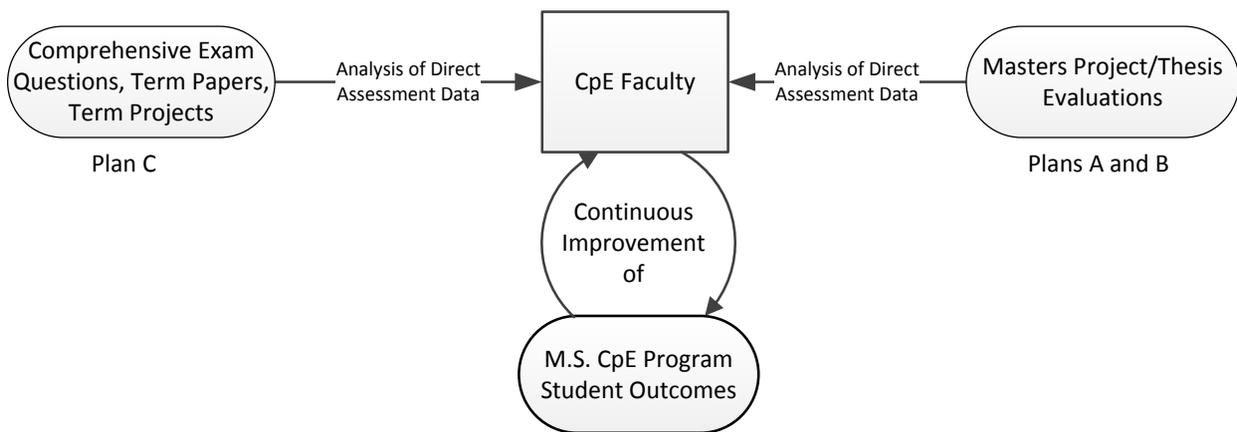


**Figure 4 Flowchart of M.S. Student Outcomes Assessment**