Electrical Engineering
2011–2012 Assessment Report

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1 Introduction

1.1 Program Goals and Design

Electrical Engineering at OIT aims to impart a thorough grounding in the theory, concepts, and practices of electrical and electronics engineering. Emphasis is on practical applications of engineering knowledge. The hands-on student projects undertaken by all program graduates include real-world applications like electric, hybrid, and fuel-cell cars, a three-term multidisciplinary senior project (design, implementation, and test, not simply simulation) and NASA's High-Altitude Balloon and Rocket Projects. The goal of this practical program design is to graduate engineers who require a minimal amount of on-the-job training while providing sufficient theoretical background to enable graduates to attend and succeed in graduate education in engineering.

1.2 Program History, Enrollment & Graduates

In 2007, the Oregon Institute of Technology (OIT) began offering its new Bachelors of Science in Electrical Engineering program (BSEE) at its main campus in Klamath Falls, Oregon. The BSEE degree is a traditional EE degree that is offered to replace the BSEET program in KF, and it was created to prepare graduates for careers in various fields associated with electrical engineering. These include, but are not limited to, analog ICs and systems, digital and microcontroller systems, signal processing, communication systems and control systems as stated in OIT's 2007–2008 catalog. The first graduating class was in June 2010 and had a class size of 5 students. Total enrollment has increased to 55 students for Fall 2011. Enrollment for 2008–2011 is shown in Table 1. Headcount corresponds to full-time enrollment.

Table 1: Enrollment, Fall 2007 through Fall 2011

2007	2008	2009	2010	2011
36*	38	53	48	55

*2007 includes EET converts and three part-time students

We anticipate that BSEE graduates will enter careers in electrical engineering as design engineers, test engineers, characterization engineers, applications engineers, field engineers, hardware engineers, process engineers, control engineers, power engineers, semiconductor-processing engineers, signal processing and controls engineers, energy system-integration engineers, analog-systems engineers, digital-systems engineers, embedded-hardware engineers. Graduates of the program will be able to pursue a wide range of career opportunities, not only within the more traditional areas of electrical engineering, but within the emerging fields of renewable-energy engineering and smart-grid engineering as well.

The first graduating class of 2007 had five students. Fifteen BSEE students have graduated as of Spring 2011. The BSEE program will have a graduating class at the end of every spring term. The status of Oregon Tech EE graduates in terms of employment and graduate studies is summarized in the Table 2 for June graduates of 2010 and 2011.

Table 2: BSEE Program Graduates

Identifier, Grad Year	**Company (or Graduate School)**	**Job Title**	**Industry (or Major)**
1, 2010	Micron	Industrial Production Eng.	Semiconductor Memory
2, 2010	Weyerhaeuser	Industrial Production Eng.	Paper, and Building Products
3, 2010	JELD~WEN	QC Eng.	Building Products
4, 2010	University of Oregon	Graduate Student	Materials Science
5, 2010	University of Oregon	Graduate Student	Materials Science
6, 2010	Florida Atlantic Univ.	Graduate Student	Ocean Engineering
1, 2011	Advanced Technology & Research Corp.	Junior Eng.	Military & Automation
2, 2011	Leviton Manufacturing	Electrical Eng.	Networking, Energy & Renewable Energy
3, 2011	JELD~WEN	Manufacturing Project Mngr.	Building Products
4, 2011	Alyrica Networks	Technician	Clean-Energy Networking
5, 2011	Novellus	Product Eng.	Manufacturing Equipment for Semiconductor Industry
6, 2011	Novellus	Product Eng.	Manufacturing Equipment for Semiconductor Industry
7, 2011	Novellus	Product Eng.	Manufacturing Equipment for Semiconductor Industry
8, 2011	Biotronix	Test Eng.	Biomedical
9, 2011	Schweitzer Eng.	Design Eng.	Automation, Telecommunications & Power

10, 2011	US Air Guard	Comm. Eng.	Military
11, 2011	PCM Sierra	Design Eng.	Networking & Telecommunications
12, 2011	Black & Veatch	Power Eng.	Construction
13, 2011	SEL	Process Eng.	Power Systems
14, 2011	University of Idaho	Graduate Student	Computer Science
15, 2011	Colorado School of Mines	Graduate Student	Power Engineering

1.3 Industry Relationships

The BSEE program has strong relationships with industry, particularly through its program-level Industry Advisory Council (IAC) and its EE/EET alumni. These relationships with our constituents allow the BSEE program to meet the institutional mission objective of maintaining currency of degree programs.

The IAC has been a mainstay in the development of the EE program since its early EET roots. The IAC provides advice and counsel to the EE program with respect to curriculum content, instructional resources, career guidance and placement activities, accreditation reviews, and professional-development assistance. In addition, each advisory-committee member serves as a vehicle for public-relations information and potentially provides a point of contact for the development of specific opportunities with industry for students and faculty.

1.4 Program Locations

The BSEE program is located only at the flagship campus in Klamath Falls (with a degree-completion program in EET at the Portland campus), serving a large portion of rural Oregon and California as the only university campus offering multiple classical engineering degrees at the Bachelor's (and some at the Master's) level in the region ranging from Corvallis, Oregon, in the north to Chico, California, in the south, and from the Pacific coast in the west to Boise, Idaho, in the east.

Furthermore, the Klamath Falls campus offers unique options for students to gain experience in the subfields of power, energy, and renewable energy since the campus includes a leading geothermal research facility, a large solar facility and a center for applied research in renewable energy, allowing students access to research *and* practical experience in geothermal, solar energy and other sources of green energy. In addition, students can take trailing sequences of EE courses at the Portland campus, giving them improved access to internships in the Silicon Forest, as the semiconductor industry in the Portland metro area is known.

This arrangement satisfies the needs of the state of Oregon by placing a traditional EE program in the southern end of the state to serve that region as well as providing a small-school EE program to students who desire a small student-to-faculty ratio and small class sizes. The EE program also supports the shift at the institution form four-year technology degrees to four-year engineering degrees. The addition of EE completes the ETM College (Engineering, Technology & Management) with CE, EE, ME and REE Programs in Klamath Falls.

2 Program Mission, Educational Objectives and Outcomes

2.1 Program Mission

The mission of the BSEE Program is to provide a comprehensive program of instruction that will enable graduates to obtain the knowledge and skills necessary for immediate employment and continued advancement in the field of Electrical Engineering. The program will provide high-quality career-ready candidates for industry as well as teaching and research careers. Faculty and students will engage in applied research in emerging technologies and provide professional services to their communities.

2.2 Program Educational Objectives

Program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve. The Program Educational Objectives of OIT's Bachelor of Science in Electrical Engineering program are that:

- The graduates of the BSEE program will possess a strong technical background as well as analytical, critical-thinking, and problem-solving skills that enable them to excel as professionals contributing to a variety of engineering roles within the various fields of Electrical Engineering and the high-tech industry;

- The graduates of the BSEE program are expected to be employed in Electrical Engineering positions including (but not limited to) design engineers, test engineers, characterization engineers, applications engineers, field engineers, hardware engineers, process engineers, control engineers, and power engineers;

- The graduates of the BSEE program will be committed to professional development and life-long learning by engaging in professional or graduate education in order to stay current in their field and achieve continued professional growth;

- The graduates of the BSEE program will be working as effective team members possessing excellent oral and written communication skills, and assuming technical and managerial leadership roles throughout their career.

2.3 Relationship between Program Objectives and Institutional Objectives

These program objectives map strongly to objectives in OIT's institutional mission statement, particularly the objective "OIT students possess the skills necessary for program-related employment or graduate school admission."

2.4 Program Outcomes

The BSREE Program Outcomes include ABET's EAC (a)–(k) outcomes as well as the program-specific outcomes (l) and (m). Graduates of our Bachelor of Science in Electrical Engineering program must have:

(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 multi-disciplinary 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 (independent) learning

(j) a knowledge of contemporary issues

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

(l) a knowledge of differential and integral calculus and advanced mathematics including differential equations, linear algebra, vector calculus, complex variables, Laplace transforms, Fourier transforms, and probability and statistics with appropriate applications.

(m) a knowledge of basic sciences, computer science, and engineering sciences necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components, as appropriate to program objectives.

3 Cycle of Assessment for Program Outcomes

3.1 Introduction and Methodology

Table 3 shows the *minimum* set of outcomes assessed during each academic year. (Typically, many more outcomes are assessed per year than shown.)

Assessment of the program outcomes will be conducted over a three-year cycle, starting in 2010–11. (During the 2009–10 academic year, all outcomes were assessed in order to establish a baseline.)

In addition to program assessment, faculty members participate in assessment of Institutional Student Learning Outcomes (ISLOs).

3.2 Assessment Cycle

Table 3: BSEE Outcome-Assessment Cycle

		2007–08	2008–09	2009–10	2010–2011	2011–2012	2012–13
(a)	Fundamentals		**X**		**X**	**X**	
(b)	Experimentation	**X**		**X**	**X**		**X**
(c)	Design within constraints		**X**			**X**	
(d)	Teamwork	**X**	**X**	**X**	**X**		**X**
(e)	Problem-solving	**X**			**X**		**X**
(f)	Ethics			**X**	**X**		**X**
(g)	Communication	**X**			**X**		
(h)	Impacts of engineering			**X**			**X**
(i)	Lifelong (independent) learning				**X**		
(j)	Contemporary issues			**X**	**X**		**X**
(k)	Engineering tools	**X**			**X**		
(l)	Advanced mathematics		**X**			**X**	
(m)	Basic sciences, computer sciences & engineering sciences		**X**			**X**	

3.3 Summary of Assessment Activities & Evidence of Student Learning

3.3.1 Introduction

The BSEE faculty have conducted formal assessment since the 2007–08 academic year using direct measures such as exams, lab projects, presentations, and research papers. Additionally, the program outcomes are assessed using indirect measures, namely results from student evaluations based on methodology developed by the IDEA Center[1], and data from exit surveys of seniors.

3.3.2 Background of Assessment of Program Educational Objectives

Because BSEE graduates have not been in the field for longer than three years, the faculty has not yet conducted assessment of the Program Educational Objectives (PEOs). The BSEE faculty designed the PEOs using broad statements describing career and professional accomplishments that the graduates can expect to achieve.

Assessment of the PEOs will be conducted over a four-year cycle (with overlap), beginning in 2013–14 as shown in Table 4. During the 2012–13 academic year, all four PEOs will be assessed in order to establish a baseline. Future appendices of the annual EE program assessment report will include detailed alumni and employer surveys designed to assess these PEOs.

Table 4: BSEE Program Educational Objectives Assessment Cycle

Educational Obj.	2012–13	2013–14	2014–15	2015–16	2016–17
EO1	**X**	**X**			**X**
EO2	**X**	**X**	**X**		
EO3	**X**		**X**	**X**	
EO4	**X**			**X**	**X**

[1] www.theideacenter.org

3.3.3 Methodology for Assessment of Program Outcomes

The BSEE conducts direct and indirect assessments. The direct assessment process using assignments specifically designed to measure ABET-style outcomes as well as regularly occurring student work (such as exams and homework). As these assessments become regular parts of the courses in which they are used, they become *embedded assessment.*

The indirect assessment process derives assessment data from course evaluations and student surveys.

Direct Measure: ABET Assignments

This direct assessment process links specific tasks within engineering course assignments to EE program outcomes and then to Program Educational Objectives (PEOs) in a systematic way based on rubrics for the EE Program Outcomes and a mapping of PSLOs to the PEOs. The program outcomes are evaluated as part of the course curriculum primarily by means of comprehensive assignments. Some of these are standard assignments (embedded assessment for both program-level and course-level outcomes) while others are specifically designed to measure program-level outcomes. These assignments typically involve a project or lab experiment requiring the student to apply principles of mathematics, science, and engineering, as learned in the course (or throughout their student career), to solve a particular problem requiring the use of modern CAD tools and engineering equipment, working in teams, and writing a project report or giving an oral presentation.

Evaluations of these outcomes are then gathered in outcome-specific tables, analyzed and then summarized. Summaries for all outcomes are then compiled into a comprehensive program-outcome summary. The outcome summary is evaluated for relevance with respect to the Program Educational Objectives. This summary is also formatted and organized for inclusion in an ABET review document.

The mapping process aims to systemize the assessment of engineering outcomes, and to provide a mechanism that facilitates the design of engineering assignments that meet the ABET-general outcomes, (a)–(k), particularly focusing on those that are atypical for traditional engineering coursework. Rather than considering how the outcomes match the assignment, the assignment is designed to map to the program outcomes.

Indirect Measure: KSU IDEA Evaluations

At OIT, course evaluations are conducted using the course evaluation form developed by the IDEA Center[2], an organization originating from Kansas State University. From collected student evaluation forms, an IDEA Center diagnostic report is generated and returned to the instructor.

Methodology for this indirect assessment is detailed in Criterion 3 of the 2011–12 BSEE ABET Self-Study.

[2] www.theideacenter.org

Indirect Measure: Senior Exit Survey

This measure was developed and deployed during the spring term of 2012. Sample questions and an analysis of results are given in the appendices at the end of this document.

3.3.4 2011–12 Targeted Assessment Activities

The sections below describe the 2011–12 targeted assessment activities, and give a summary of student performance for each of the assessed outcomes. Unless otherwise noted, the tables report the percentage of students performing at developing, accomplished, and exemplary levels[3] for each performance criterion, as well as the percentage of students performing at an accomplished level or above.

The minimum acceptable performance level for any outcome is to have 80% or more of the students (taking part in that assessment activity) performing at the accomplished or exemplary level for *all* performance criteria (for that assessment activity). Currently, the faculty use performance-criteria rubrics on class and lab assignments as direct measures. Since this is a new program with the third class of graduates expected in 2011–12, a senior exit survey and alumni survey have been developed as indirect measures.

The following is a set of tables for the outcomes assessed during the 2011–12 academic year. The outcomes are (a), (b), (c), (d), (e) (f), (g), (i), (j), (k), (l), and (m).

Outcomes (a), (c), (l), and (m) are due to the regular cycle; (b), (f), (i), and (k) are part of continuous improvement, as deemed necessary based on previous years' assessments; (d) is part of the institutional assessment for the current year, along with (l); and (d), (e) (g), and (j) were added as additional assessment activity to better understand the performance of the program and its graduates.

Each table is a summary of the various course assignments used to assess the outcomes with the rubric for that outcome. For each rubric, the targeted outcome and the performance criteria are fixed, but faculty have academic freedom to make adjustments to the descriptors of levels of achievement, which they are required to share with the assessment coordinator.

[3] Performance below the developing level is possible, although rare, and would correspond to little or no sign in the work sample for demonstrating understanding or accomplishment in that criterion.

3.3.5 Targeted Assessment of Outcome (a)

An ability to apply knowledge of mathematics, science, and engineering

Assessment (a)1: EE 221, Fall 2011, Dr. Barnes

This outcome was assessed using a final exam. Since this is the first sophomore circuits course, it included the basics of units, KVL, KCL, loop and nodal analysis (using matrix algebra), Thévenin equivalence, basic AC concepts, phasors, reactance, complex impedance, phase shift, Lenz's Law, basic electromagnetism (right-hand rule and induction), and RC time constants using the universal time-constant equation.

Thirty-one students were assessed Fall 2011 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

The table below summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was not met on any of the performance criteria for this program outcome.

Table 5: Targeted Assessment for Outcome (a)

(a) an ability to apply knowledge of math, science and engineering				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Applying knowledge of mathematics	36%	35%	29%	65%
Applying knowledge of scientific principles	43%	42%	16%	58%
Applying knowledge of engineering principles	48%	39%	13%	52%

Assessment (a)2: EE 431, Fall 2011, Prof. Dingman

This outcome was assessed using the last assignment of the term and a related question on the final examination. The assignment was to (electrically) overcome the physical (acoustical) limitations of a concert environment in a very large space. The exam question was to perform calculations from a diver's perspective under water.

Twelve students were assessed Fall 2011 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

The table below summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. Students met or exceeded expectations; they demonstrated their abilities to "apply knowledge of mathematics, science and engineering principles."

Table 6: Targeted Assessment for Outcome (a)

(a) an ability to apply knowledge of math, science and engineering				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Applying knowledge of mathematics	17%	58%	25%	83%
Applying knowledge of scientific principles	8%	42%	50%	92%
Applying knowledge of engineering principles	17%	67%	17%	83%

Assessment (a)3: REE 253, Fall 2011, Dr. Wang

This outcome was assessed using one homework-assignment set and one lab assignment. The objective was to engage the class in a homework assignment on applying the knowledge of mathematics, science and engineering to address problems in the field of electrical machinery. Students are required to work out the homework problems independently and finish the lab assignment in groups. The lab project involves building synchronous generators with Lab-Volt and Feedback electrical machinery equipment. Measurements are also required to be taken to plot the characteristic curves. The students were required to demonstrate reading, writing, listening and speaking skills, identify the technical problem, develop a plan to solve it in a group of five people, execute the experimental method for problem-solving and produce a report on the lab project.

Twenty students were assessed Fall 2011 using the performance criteria listed above. The minimum acceptable performance level was to have above 80% of the student performing at the accomplished or exemplary level in all performance criteria.

The table below summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. Students met or exceeded expectations; they demonstrated their ability to apply mathematics, science, and engineering principles to predict and analyze experimental results and solve technical problems.

Table 7: Targeted Assessment for Outcome (a)

(a) an ability to apply knowledge of math, science and engineering				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Applying knowledge of mathematics	0%	10%	90%	100%
Applying knowledge of scientific principles	0%	15%	85%	100%
Applying knowledge of engineering principles	0%	15%	85%	100%

Assessment (a)4: EE 225, Spring 2012, Dr. Barnes

This outcome was assessed using a problem on a final exam.

Twelve students were assessed in the spring term of 2012 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria. Ten of the twelve students, 83%, met the first criteria. The other two criteria were not applicable to this problem, which only involved a math problem, not one of engineering or scientific principles.

The table below summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was for the performance criterion for this program outcome.

Table 8: Targeted Assessment for Outcome (a)

(a) an ability to apply knowledge of math, science and engineering				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Applying knowledge of mathematics	17%	67%	16%	83%
Applying knowledge of scientific principles	N/A	N/A	N/A	N/A
Applying knowledge of engineering principles	N/A	N/A	N/A	N/A

Recommendations based on the End-of-Year Faculty Review of Outcome (a)

In the faculty discussion regarding mathematics as reflected in outcomes (a) and (l), it was decided that the mathematical portion of outcomes assessment is best carried out in the senior courses, such as EE 401-Communication Systems (so students have completed more of the math and science courses) to collect more meaningful data.

This outcome was the topic of two closing-the-loop sessions, one focusing on the mathematics criterion early in the spring term, and one focusing on the other two criteria near the end of the term. It was decided at the later meeting that faculty need to engage in more specific assessment practices, such as rating math proficiency based on a particular targeted question, as opposed to the overall mathematical performance of students on the entire exam.

3.3.6 Targeted Assessment of Outcome (b)

An ability to design and conduct experiments, as well as to analyze and interpret data

Assessment (b)1 (continuous improvement): EE 323, Winter 2012, Dr. Barnes

This outcome was assessed via a lab assignment. The class was given a basic 2-stage CS NMOS-CMOS amplifier circuit with a series-shunt feedback. No values of resistors, biasing voltages or feedback details were given. The exercise was to design the system to achieve specific closed-loop gain, input and output impedances, as well as feedback gain. Two three-hour lab periods were allotted for the project, the first to simulate the designs with Linear Technologies SPICE (LTSpice), and the second to implement on a breadboard using a CA4007 CMOS-array IC chip. No help was given by the instructor, as students were expected to figure out all parameters amongst themselves.

Nine students were assessed Winter 2012 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

The table below summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was not met on any of the performance criteria for this program outcome.

Table 9: Targeted Assessment for Outcome (b)

(b) an ability to design and conduct experiments as well as analyze and interpret data				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Designing an experiment	78%	22%	0%	22%
Conducting an experiment	89%	11%	0%	11%
Analyzing and interpreting experimental data	78%	22%	0%	22%

Assessment (b)2 (continuous improvement): EE 305, Winter 2012, Dr. Shi

The outcome was assessed using the course project of EE305 Optoelectronics III taught Winter 2011. The project was set up as a replacement of lab experiments to test student's capability in designing and conducting experiments, and analyzing the data. This project was designed as a team based project. Two topics were assigned to two teams of senior and junior students. One team of students engaged in designing, conducting an experiment to measure attenuation of optical fiber to different wavelengths of light propagating in the optical fibers. The second team engaged in designing, conducting an experiment to split the white light and channel the spliced light down to the photo-detectors and solar cells for testing the response of optical receiver device to different wavelengths of light. The class of six is divided into two groups by letting students sign in to their area of interest. It turned out that three students signed in working on optical fiber attenuation measurement, and the other students signed in working on splitting white light and testing the spectral response of photo-detector and solar cells. During the implementation process, 4 presentations were scheduled for students to present the progresses on their projects. Final reports with collected data and data analysis were collected to evaluate their performance and assess the outcome. The first team designed the experiment and measured the attenuation of two types of optical fibers by employing lasers with four different wavelengths. The second team designed the experiment and spliced white light emitted from tungsten bulb by employing grating and lenses and channeled spliced light into optical fiber. Then photo-detector and concentrator multi-junction solar cells were tested for their spectral responses. The group projects are evaluated for the following: Identify the measurement methods and design the experiments; conduct the experiments and collect data; analyze the data and conclude the results.

Six students were assessed using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in all performance criteria.

Table 10 below summarizes the results of this targeted assessment. The results indicate that the performance level higher that 80% was met on the performance criteria for this program outcome, demonstrating that the students in the evaluated class have the ability to design, conduct experiment and analyze data.

Table 10: Targeted Assessment for Outcome (b)

(b) an ability to design and conduct experiments as well as analyze and interpret data				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Designing an experiment	0%	0%	100%	100%
Conducting an experiment	0%	0%	100%	100%
Analyzing and interpreting experimental data	0%	0%	100%	100%

Assessment (b)3 (continuous improvement): EE 456, Winter 2012, Dr. Wang

This outcome was assessed in EE 456 Modern Control Systems, Winter 2012, using one midterm exam and one signal-design project set. The objectives were to engage the class in a midterm exam and a signal-design project on applying the knowledge of classical control theories in addressing practical control problems. The lab project involved using the hardware and software co-design with the modern PLC/PAC controllers, which are very practical in industrial control applications. The Automation Direct PAC 3000 system and Human Machine Interface (HMI) hardware and software co-design have been used in the signal design project, which provided students a very practical way of learning the Ladder diagram, PID controller design, root-locus method, etc. The students are required to demonstrate reading, writing, listening and speaking skills; identify the technical problem; developing a plan to solve it in a group of two people, executing the experimental method for problem solving and producing a report on the lab project.

Seventeen students were assessed Winter 2012 using the performance criteria listed above. The minimum acceptable performance level was to have above 80% of the student performing at the accomplished or exemplary level in all performance criteria.

Table 11 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. Students met or exceeded expectations; they have demonstrated the ability to design and conduct experiment as well as analyze and interpret data.

Table 11: Targeted Assessment for Outcome (b)

(b) an ability to design and conduct experiments as well as analyze and interpret data				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Designing an experiment	0%	29%	71%	100%
Conducting an experiment	0%	29%	71%	100%
Analyzing and interpreting experimental data	0%	29%	71%	100%

Recommendations based on the End-of-Year Faculty Review of Outcome (b)

It was suggested that the cases of weak performance seem to be resulting from the amount and timing of project experience. Feedback about this outcome needs to be delivered to the students earlier in the program. This needs to be done either by giving the students the relevant rubric for outcome (b) with the lab assignment.

An additional decision was to use the "Performance-Evaluation Guide (PEG)," a rubric designed by the assessment coordinator for assessing undergraduate electrical-engineering lab work, during the next assessment cycle.

3.3.7 Targeted Assessment of 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

Assessment (c)1: REE 346, Fall 2011, Dr. Feng Shi, assessed by Prof. Zipay

The outcome was assessed using the course project of REE346 Biofuel and Biomass taught Fall 2011. The project is a team-based project. The project involves an algae-related biodiesel-generation system. The objective of this project is to get students understanding the process of biodiesel generation from algae-growing through oil extraction to biodiesel production by involving an algae-growing reactor design, algae-growing process design, and algae-oil extractor design. The students of this class implemented their designs, tested the performance of their subsystems and evaluated the feasibilities of their systems. The class was divided into three groups to work on three subsystems of the project. The first team was working on the algae-growing reactor design, implementation, and test. The second team was working on the algae-growing process design, implementation, and test. And the third team was working on the algae-oil extractor design, implementation, and test. The project was adapted to assess the students' capability to design a system or a process to meet desired needs within realistic constraints. The algae-reactor design is used to test student ability to design a system that meets the requirements of supplying CO_2 and light efficiently, and harvesting algae easily; students were required to implement the solution within the time and financial constraints. The algae-growing group was required to design a process to grow algae with local strains of algae efficiently. The algae-harvesting and algae-oil extracting group was required to design a machine that could extract algae oil and that can be implemented within the constraints of current conditions.

Fourteen students were assessed Fall 2011 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

Table 12 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on two of the performance criteria for this program outcome, and barely missed in the performance criterion related to developing a design strategy.

Table 12: Targeted Assessment for Outcome (c)

(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.				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Recognition of need	14%	43%	43%	86%
Develop design strategy	29%	21%	50%	71%
Evaluates relative value of a feasible solution	14%	43%	43%	86%

Assessment (c)2: REE 346, Fall 2011, Dr. Feng Shi, assessed by Prof. Vurkaç

This outcome was assessed using a project as described above in assessment (c)2.

Fourteen students (in groups of five, five, and four) were assessed Fall 2011 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

Table 13 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on only one performance criterion for this program outcome.

Table 13: Targeted Assessment for Outcome (c)

(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.				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Recognition of need	36%	36%	29%	64%
Develop design strategy	0%	64%	36%	100%
Evaluates relative value of a feasible solution	36%	64%	0%	64%

Assessment (c)3: EE 321, Winter 2012, Dr. Vurkaç

This outcome was assessed using a design project that took place during the lab component of the course. The project was to design a power supply to meet very tight specs.

Eight students were assessed Winter 2012 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

Table 14 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. Students met or exceeded expectations; they demonstrated their abilities to recognize, define, carry out, and evaluate the needs for a practical project, as well as succeed in achieving the technical goals of the project.

Table 14: Targeted Assessment for Outcome (c)

(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.				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Recognition of need	0%	25%	75%	100%
Develop design strategy	0%	25%	75%	100%
Evaluates relative value of a feasible solution	0%	0%	100%	100%

Assessment (c)4: REE 449, Winter 2012, Prof. Zipay

This outcome was assessed using a preliminary design review (PDR) for the second course (three courses) of the capstone senior project. The three teams presented a 20 – 30 minute design review to the class and other faculty and staff members. In the PDR the teams discussed the project design, design decisions and the overall test plan. The teams received questions and feedback regarding the current project status to guide possible changes as the project approaches completion in spring term. The students discussed preliminary design solutions, how they chose one and how they plan to test and characterize the design choice.

Ten students (on three teams) from EE and REE programs were assessed Winter 2012 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in all performance criteria. One team project was designing an electric bike using a combination of fuel cells and batteries for energy storage. Another team is developing a new type of down-hole heat exchanger for a geothermal well (direct use). The final team is designing a solar powered emergency water generation system. The teams discussed designs in a PDR and submitted a written test plan to discuss solution verification and characterization.

Table 15 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. Students met or exceeded expectations; they demonstrated their abilities to design systems or components to solve engineering problems using sound engineering design principles such as identifying solutions, basic design constraints and parameters and determining a final solution. Most of the PDR design questions involved very minor changes that suggest good design choices and progress toward project completion.

Table 15: Targeted Assessment for Outcome (c)

(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.				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Recognition of need	0%	50%	50%	100%
Develop design strategy	0%	40%	60%	100%
Evaluates relative value of a feasible solution	0%	50%	50%	100%

Recommendations based on the End-of-Year Faculty Review of Outcome (c)

During the regularly scheduled meetings for closing the loop (Spring 2012), it was understood that the weaknesses suggested by the scores for REE 346 were technicalities in the assessment process as undertaken by faculty other than the course instructor. The course instructor, who performed separate grading-related assessment, assured the rest of the faculty that the students' performance would be deemed satisfactory had the other faculty had assessed the written reports of the project groups as well. Faculty were convinced after a thorough discussion that students in REE 346 may have indeed performed comparable to students in EE 321 and REE 449, and that it was the assessment that failed to show this.

Furthermore, at least one rater was uncertain as to how the performance criteria could have been assessed for each individual given the nature of the group presentations. At the closing-the-loop discussion, it was decided that future assessment of this outcome should not be done solely with oral presentations. Nonetheless, no immediate need is perceived for assessing outcome (c) outside of the regular assessment cycle.

3.3.8 Targeted Assessment of Outcome (d)

An ability to function on multi-disciplinary teams

Assessment (d)1 (ISLO cycle): REE 449, Winter 2012, Prof. Zipay

This outcome was assessed using a preliminary design review (PDR) for the second course (three courses) of the capstone senior project. The three teams presented a 20 – 30 minute design review to the class and other faculty and staff members. In the PDR the teams discussed the project design, design decisions and the overall test plan. The teams received questions and feedback regarding the current project status to guide possible changes as the project approaches completion in spring term. The students discussed preliminary design solutions, how they chose one and how they plan to test and characterize the design choice. Teams were evaluated on how well they conducted the PDR, group participation and overall teamwork on project.

Ten students (on three teams) from EE and REE programs were assessed Winter 2012 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in all performance criteria. One team project was designing an electric bike using a combination of fuel cells and batteries for energy storage. Another term is developing a new type of down-hole heat exchanger for a geothermal well (direct use). The final team is design a solar powered emergency water generation system. The teams discussed designs in a PDR and submitted a written test plan to discuss solution verification and characterization.

Table 16 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. Students met or exceeded expectations; they demonstrated their abilities to work on teams to solve engineering problems or design a project. The students showed ability to manage the team, assign project duties, and hold meetings to discuss progress and issues. All presentations were done in a very professional manner with smooth transitions between group members with all actively participating. All three teams showed a delegation of responsibility to all team members with design partitioning between team members.

Table 16: Targeted Assessment for Outcome (d)

(d) an ability to function on multi-disciplinary teams (Major Project)				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Team Participation and Communication	0%	40%	60%	100%
Develop a group consensus	0%	0%	100%	100%
Manages team effectively, delegates responsibilities	0%	100%	0%	100%

<u>Recommendations based on the End-of-Year Faculty Review of Outcome (d)</u>

As part of the OIT ISLOs (Institutional Student-Learning Objectives), this outcome will continue to be assessed in the spring and fall of 2012.

3.3.9 Targeted Assessment of Outcome (e)

An ability to identify, formulate, and solve engineering problems

Assessment (e)1: EE 456, Winter 2012, Dr. Wang

This outcome was assessed in EE 456 Modern Control Systems using one midterm exam set and one signal-design project set. The objectives were to engage the class in a midterm exam and a signal-design project on applying the knowledge of classical control theories in addressing practical control problems. The lab project involved using the hardware and software co-design with the modern PLC/PAC controllers, which are very practical in industrial control applications. The Automation Direct PAC 3000 system and Human Machine Interface (HMI) hardware and software co-design have been used in the signal design project, which provided students a very practical way of learning the Ladder diagram, PID controller design, root-locus method, etc. The students are required to demonstrate reading, writing, listening and speaking skills; identify the technical problem; developing a plan to solve it in a group of two people, executing the experimental method for problem solving and producing a report on the lab project.

Seventeen students were assessed Winter 2012 using the performance criteria listed above. The minimum acceptable performance level was to have above 80% of the student performing at the accomplished or exemplary level in all performance criteria.

Table 17 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. Students met or exceeded expectations; they have demonstrated the ability to identify, formulate and solve technical problems.

Table 17: Targeted Assessment for Outcome (e)

(e) an ability to identify, formulate, and solve engineering problems				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Identifying engineering, managing teams, developing solutions, and adapting methods	0%	6%	94%	100%
Solving conceptual and numerical engineering problems	0%	12%	88%	100%

Recommendations based on the End-of-Year Faculty Review of Outcome (e)

Students performed higher than the desired level. No weaknesses have been observed. This was an additional assessment performed to learn more about the EE program and its performance. No further recommendations are made at this time.

3.3.10 Targeted Assessment of Outcome (f)

An understanding of professional and ethical responsibility

Assessment (f)1 (continuous improvement): EE 419, Fall 2011, Prof. Zipay

This outcome was assessed using an in-class required quiz for all students in a senior-level class on power electronics. The quiz presented a case study that had multiple ethical dilemmas in it. The case study was related to some design choices involving power electronic devices and QC testing. The students were asked to identify the ethical dilemmas and how they were in opposition to the IEEE Code of Ethics (provided on quiz). Then the students had to discuss what they would do and why. The focus of the grade was based on whether students identified the ethical dilemmas and how they justified their solutions to the problems (no right or wrong answer). The students were not given any in-course lectures in this course on ethics or ethical behavior.

Nineteen students were assessed Fall 2011 using the performance criteria listed below. These senior-level students were a mixture of EE (elective course) and REE (required course) majors. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in all performance criteria.

Table 18 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. Students met or exceeded expectations; they demonstrated their abilities to analyze an engineering project design solution that had some ethical issues representative of what they might encounter in industry and discuss how they would deal with such issues.

Table 18: Targeted Assessment for Outcome (f)

(f) an understanding of professional and ethical responsibility				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Demonstrating knowledge of professional codes of ethics	0%	47%	53%	100%
Evaluating the ethical and professional dimensions of engineering practice	5%	16%	79%	95%

Recommendations based on the End-of-Year Faculty Review of Outcome (f)

Students performed higher than the desired level. No weaknesses have been observed so far.

Improved performance has been recorded in this outcome. Further discussion during the regularly scheduled faculty meetings during the spring term of 2012 resulted in clarification among the faculty as to the meaning of the outcome and its assessment:

3.3.11 Targeted Assessment of Outcome (g)

An ability to communicate effectively

Assessment (g)1 (additional assessment): EE 321, Fall 2011, Dr. Barnes

This outcome was assessed using a paper reporting on a sequence of four BJT labs. Lab 1 introduced the regions of operation of the BJT. Lab 2 continued the application common-emitter circuit, biasing and analyzing the AC model to put it into the standard voltage-amplifier model. Lab 3 built on the first lab by adding a common-collector current booster/follower. Lab 4 was a discrete BJT differential amplifier.

Thirty-two students were assessed in twelve teams during Fall 2011 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

Table 19 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was not met for this program outcome.

Table 19: Targeted Assessment for Outcome (g)

(g) an ability to communicate effectively				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Oral communication	NA	NA	NA	NA
Acquiring information from various sources	58%	42%	0%	42%
Written communication	25%	42%	33%	75%

Assessment (g)2 (additional assessment): EE 225, Fall 2011, Prof. Vurkaç

This outcome was assessed using a multi-faceted laboratory project and associated independent-learning assignment. The laboratory work consisted of a term-long characterization of a passive and an active bandpass filter using *s*-domain techniques (Laplace analysis). The students were asked to provide detailed theoretical analysis as well as LTSpice and MATLAB simulation, and oscilloscope captures and photographs of the actual circuits they built. In addition, to evaluate their propensity for independent learning (which may be seen as an indicator of the ability for lifelong learning), they were told (in lecture and lab) that the series resistance of an inductor was an important aspect of accurately characterizing their circuits, and that this is something they are expected to research, learn about, and include in their design work.

Seven students in three teams were assessed Fall 2011 (small class due to trailing sequence) using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

Table 20 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was not met on either of the targeted performance criteria for this program outcome.

Table 20: Targeted Assessment for Outcome (g)

(g) an ability to communicate effectively				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Oral communication	NA	NA	NA	NA
Acquiring information from various sources	43%	57%	0%	57%
Written communication	71%	29%	0%	29%

Recommendations based on the End-of-Year Faculty Review of Outcome (g)

This was an additional assessment performed to learn more about the EE program and its performance.

During closing-the-loop discussions, it was decided that oral communication needs to be specifically addressed during the 2012–13 academic year, perhaps in the senior project, and also that the rubric needs to be updated. The following recommendations from the OIT-Portland EET 2010–11 assessment report were adopted:

Students will be required to do at least one oral presentation for at least half of the upper-division core courses in the EE(T) curriculum. Students will be provided with guidelines for oral presentations as well as a copy of the rubric so that they can develop an adequate idea of the level expected and the criteria used for evaluation. After their presentation, students will be provided timely feedback on their oral presentations so that they are aware of the areas where they need improvement. Having multiple presentations throughout the curriculum will give the students the ability to progressively build their confidence and skill as oral communicators, as well as perfect their oral presentation skills by receiving feedback for their own presentations and attending the presentations of their classmates. Additionally, students will be required to do an oral presentation as part of their senior project demonstration. This will be assessed and will count towards the final grade in their senior project.

In addition, expectations need to be clearly communicated to students. Criteria and expectations (in the form of the rubric itself, or a distilled version) should be given to the students up front, and the relevant form of communication (oral or written, depending on the assignment) should be given clear and sufficient weight in the grading so that students take notice and display their abilities. It is also important that communication outcomes should be assessed on an individual basis, even if the project is done by a group. The OIT ISLO written- and oral-communication rubrics (or the Speech Department scoring sheet) are to be adopted for the 2012–13 academic year.

3.3.12 Targeted Assessment of Outcome (i)

A recognition of the need for, and an ability to engage in life-long learning

Assessment (i)1 (continuous improvement): EE 225, Fall 2011, Prof. Vurkaç

This outcome was assessed using a multi-faceted laboratory project (with an independent-learning component with outcome (i)) involving extensive use of Laplace transform methods in a term-long design, testing and characterization of a bandpass filter using *s*-domain techniques (Laplace analysis). The students were asked to provide detailed theoretical analysis as well as LTSpice and MATLAB simulations, oscilloscope captures, and photographic evidence of the actual circuit (even though the circuits were observed by the instructor while being built in the lab). Statistics and Probability were not pertinent to the course material. Students had the option of connecting the transform methods to their time-domain equivalents and exploring applied differential equations, although this did not reflect in their reports (discussed below).

Seven students in three teams were assessed Fall 2011 (in a small class due to it being a trailing course) using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

Table 21 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on one of the performance criteria for this program outcome. The strength of the student work was that every group identified, gathered, and analyzed information, which they applied to this project. The primary weakness may have been in terms of following directions: Only one group of two (out of three groups in a class of seven) actually carried out the independent-learning assignment, or at least, wrote about it in their report. (The values in their equations also fail to report having taken the inductor series resistance into account.) The opportunity here is to improve both the assignment and the way it was presented by the instructor so that students better understand not just the project but to report on it as well.

Table 21: Targeted Assessment for Outcome (i)

(i) a recognition of the need for, and an ability to, engage in lifelong learning				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Demonstrating an awareness that knowledge must be gained	71%	0%	29%	29%
Identifying, gathering and analyzing information	0%	100%	0%	100%
Recognizing that the acquisition of knowledge is a continuous process	100%	0%	0%	0%

Assessment (i)2 (continuous improvement): EE 423, Winter 2012, Dr. Vurkaç

This outcome was assessed using a research paper. The assignment (hence, the paper) had three components: to discuss the scientific and historical context of the digital-IC industry, to find and explain the physical, mathematical, chemical, mechanical, and electrical aspects (as applicable) of an emerging technology in IC manufacturing, and to examine the socio-economic, environmental, political and similar ramifications of such technology.

Twelve EE students were assessed Winter 2012 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

The tables below summarize the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was not met for this program outcome.

Table 22: Targeted Assessment for Outcome (i)

Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Demonstrating an awareness that knowledge must be gained	58%	0%	42%	42%
Identifying, gathering and analyzing information	25%	0%	75%	75%
Recognizing that the acquisition of knowledge is a continuous process	NA	NA	NA	NA

Recommendations based on the End-of-Year Faculty Review of Outcome (i)

Students performed satisfactorily for the most part in identifying, gathering and analyzing information in both courses. During the faculty discussion for closing the loop, the following recommendations were agreed upon.

- In order to gauge independent learning, students need to understand what is expected of them. To this end, assignments must be written so that students understand what is involved in demonstrating independent learning.
- Until about halfway through the junior year, students are occupied thoroughly with the accumulation of tools and techniques. Hence, the assessment of outcome (i) should take place mid-junior year or later. Some courses identified as candidates for further assessment of outcome (i) are EE 301, EE 325, EE 419, EE 423, EE 456, REE 407, REE 412, and REE 451. Emphasis will be placed on the EE courses for this assessment (for the EE program). During Fall 2012 convocation, the faculty will choose no fewer than three courses in which to assess this outcome again, this time with thorough written clarification to the students as to what is expected.

3.3.13 Targeted Assessment of Outcome (j)

Knowledge of contemporary issues

Assessment (j)1 (additional assessment): EE 423, Winter 2012, Dr. Vurkaç

This outcome was assessed using a research paper. The assignment (hence, the paper) had three components: to discuss the scientific and historical context of the digital-IC industry, to find and explain the physical, mathematical, chemical, mechanical, and electrical aspects (as applicable) of an emerging technology in IC manufacturing, and to examine the socio-economic, environmental, political and similar ramifications of such technology.

Twelve EE students were assessed Winter 2012 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

The table below summarize the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on only one performance criterion for this program outcome, but met consistently (by the whole class and the EE majors) for that criterion. Students met or exceeded expectations when it came to presenting the historical context of the development of the IC industry, which revolved around Moore's law. However, in terms of demonstrating knowledge of contemporary issues, and especially in recognizing the temporal nature of contemporary issues associated with the IC industry, students performed mostly at the developing (level 1) and accomplished (level 2) levels, with few exhibiting mastery at the exemplary level. Overall, the percentage of students displaying knowledge of contemporary issues and their temporal nature was below the desired standard.

Table 23: Targeted Assessment for Outcome (j)

Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Knowledge of contemporary issues	58%	42%	0%	42%
Temporal nature of contemporary issues	67%	25%	8%	33%
Historical context of contemporary issues	17%	75%	8%	83%

Assessment (j)2 (additional assessment): EE 401, Spring 2012, Dr. Vurkaç

This outcome was assessed using a research paper on contemporary issues in communication technology. The assignment had three components corresponding to the three criteria for the OIT EERE rubric for contemporary issues:

- to discuss aspects of communications technology in terms of relevant concerns such as social, economic, political, health, environmental, or other issues;
- to summarize how the issues have been experienced over a significant period of time (no less than a decade), and how societies have changed as a result of these technologies; and
- to give the historical context of the technology *and its impacts*, interpreting specific scenarios caused by the interaction of such technology with populations, economies, or environments.

Ten EE students were assessed Spring 2012 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

Table 24 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on two of the four criteria (with the original criterion 1 seen above under assessment 1 for this outcome split into two criteria). Once again, we see that the nature of the assignment and the course in which assessment is done have an effect on the students' motivation to include certain types of information or discussion in their reports. In this case, environmental (ecological) effects were addressed by very few students. Even in the case of political and socio-economic issues, students' coverage was lacking. This presents an opportunity to define the newly instituted "contemporary issues" sessions for the senior-project courses, starting Fall 2012. Addressing this issue is important because in a department that also houses an engineering degree in renewable energy, students' understanding of the context and impacts of technologies in the environmental arena is paramount.

Table 24: Targeted Assessment for Outcome (j)

Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	% students at 2 or 3
Knowledge of contemporary issues (a)	20%	20%	60%	80%
Knowledge of contemporary issues (b)	80%	20%	0%	20%
Temporal nature of contemporary issues	20%	60%	20%	80%
Historical context of contemporary issues	10%	80%	10%	90%

Recommendations based on the End-of-Year Faculty Review of Outcome (j)

The primary question at the closing-the-loop meeting was whether the departmental faculty are responsible for cultivating awareness of contemporary issues in our students. The consensus was YES.

As a result of the discussion on how to do this, the faculty decided on a dedicated seminar. There was also a popular suggestion that all course syllabi indicate that knowledge of contemporary issues is a serious concern and a relevant aspect of becoming an engineer.

It was determined that multi-faceted assignments (as were used in the EE 423 assessment) are not a good way to judge student-learning outcomes. Book reports were suggested. The final decision was to hold *mandatory sessions in Senior Project (Dingman)* on contemporary issues.

Faculty discussions during the spring term of 2012 (2011–12) addressed the plans to emphasize contemporary issues in the curriculum. This assessment activity serves to support this decision. Further assessment is to take place in the upcoming years according to the assessment plan.

3.3.14 Targeted Assessment of Outcome (k)

An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Assessment (k)1 (continuous improvement): EE 412, Winter 2012, Prof. Dingman

This outcome was assessed using a group oral presentation on video of the second-term summation of a three-term group senior project. It was used to assess outcomes (k) and (m) by looking and listening for the listed criteria.

Twelve students were assessed Winter 2012 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

Table 25 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. Students met or exceeded expectations; they demonstrated ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Table 25: Targeted Assessment for Outcome (k)

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Proficiency with engineering software: CAE, FEA, programming, data analysis, etc.	0%	75%	25%	100%
Proficiency with engineering hardware, test/measuring equipment, prototyping, etc.	0%	50%	50%	100%
Proficiency with communication tools and skills	0%	25%	75%	100%

Assessment (k)2 (continuous improvement): EE 412, Winter 2012, Prof. Dingman, assessed by Dr. Vurkaç

This outcome was assessed using group oral presentations on video. Video was chosen to clearly and verifiably show students' proficiency on engineering software, programming, measuring and test equipment, prototyping, and also on communication (presentation) tools. This assessment was conducted near the end of the second term a three-term group project. The videos, which have been archived and are available for viewing, demonstrate that the students have capably and efficiently utilized all or most of the above-listed tools with success.

Twelve students were assessed Winter 2012 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

Table 26 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. Students met or exceeded expectations; they demonstrated ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

Table 26: Targeted Assessment for Outcome (k)

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Proficiency with engineering software: CAE, FEA, programming, data analysis, etc.	0%	58%	42%	100%
Proficiency with engineering hardware, test/measuring equipment, prototyping, etc.	0%	0%	100%	100%
Proficiency with communication tools and skills	0%	100%	0%	100%

Assessment (k)3 (continuous improvement): REE 449, Winter 2012, Prof. Zipay

This outcome was assessed using a preliminary design review (PDR) for the second course (three courses) of the capstone senior project. The three teams presented a 20 – 30 minute design review to the class and other faculty and staff members. In the PDR the teams discussed the project design, design decisions and the overall test plan. The teams received questions and feedback regarding the current project status to guide possible changes as the project approaches completion in spring term. The students discussed preliminary design solutions, how they chose one and how they plan to test and characterize the design choice. Teams were evaluated on how well they used design presentation tools in the PDR, how they used design CAE tools such as PSpice, LabVIEW, eQuest and custom CAE tools, and how they tested and characterized the prototype subsystems .

Ten students (on three teams) from EE and REE programs were assessed Winter 2012 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in all performance criteria. One team project was designing an electric bike using a combination of fuel cells and batteries for energy storage. Another term is developing a new type of down-hole heat exchanger for a geothermal well (direct use). The final team is design a solar powered emergency water generation system. The teams discussed designs in a PDR and submitted a written test plan to discuss solution verification and characterization.

Table 27 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. Students met or exceeded expectations; they demonstrated their abilities to utilize basic engineering tools (both hardware and software) to solve technical problems and deliver project design reviews. All teams utilized design presentation tools very well in the PDR using a mix of text and professional graphics. The teams also have used various engineering design tools in developing the project designs and testing subsystems. One team even uses some customized vendor tools for a battery charge controller and microcontroller IDE. The teams all provided some hardware demonstrations of some of the system components.

Table 27: Targeted Assessment for Outcome (k)

(k) An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Proficiency with Engineering SW (CAE/CAD, FEA, Data Analysis)	10%	50%	40%	90%
Engineering HW (test Equipment and prototyping)	0%	40%	60%	100%
Communication and Presentation Tools	0%	20%	80%	100%

Recommendations based on the End-of-Year Faculty Review of Outcome (k)

Students' performance was better than desired in all criteria in both assessments. This outcome reflects a core focus and expectation of the program. We focus on laboratory work and modern engineering tools, so this is one of the strengths of the program.

No weaknesses were noted. Further discussion took place during the regularly scheduled faculty meetings for closing the loop and learning from our assessments throughout the spring term of 2012, and no recommendations were made for changes. No action was found necessary.

3.3.15 Targeted Assessment of Outcome (l)

Knowledge of differential and integral calculus and advanced mathematics, including differential equations, linear algebra, vector calculus, complex variables, sequences and series, Laplace transforms, Fourier transforms, and probability and statistics with appropriate applications

Assessment (l)2: EE 225, Fall 2011, Prof. Vurkaç

This outcome was assessed using a multi-faceted laboratory project (with an independent-learning component with outcome (i)) involving extensive use of Laplace transform methods in a term-long design, testing and characterization of a bandpass filter using *s*-domain techniques (Laplace analysis). The students were asked to provide detailed theoretical analysis as well as LTSpice and MATLAB simulations, oscilloscope captures, and photographic evidence of the actual circuit (even though the circuits were observed by the instructor while being built in the lab). Statistics and Probability were not pertinent to the course material. Students had the option of connecting the transform methods to their time-domain equivalents and exploring applied differential equations, although this did not reflect in their reports (discussed below).

Seven students in three teams were assessed Fall 2011 (in a small class due to it being a trailing course) using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

Table 28 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on one of the performance criteria for this program outcome. Another criterion was inapplicable to the course and the project. The remaining criterion was applicable, but the reports do not reflect the students' knowledge or understanding of this application. Students did, however, meet or exceed expectations in terms of transform methods, demonstrating their abilities to apply mathematics and engineering principles to analyze and solve technical problems, but less so to predict experimental results. The main strength observed in this group and their work was that the writing quality was much higher than previously noted on similar assignments. Weaknesses, however, were many. Students might not have taken the report part of the project very seriously. They worked hard to make their circuits work, but they are not used to documenting such effort or its results. They also do not seem to be good at following instructions. This certainly is an opportunity for growth for the instructor. A big part of the problem may be that the project was due at the end the term, which gave no time for teacher feedback or reworking reports. This was based on giving the same assignment in the summer term in the past—the summer term may be too short to have the project due any sooner than the end of the term, but fall term is not. In the future, project reports need to be due sooner, perhaps incorporating a multi-stage revision process. It also seems it is not sufficient to show students examples of good reports. One tactic that has since been suggested is to show students weak or even average-quality reports as poor ones, accompanied by the rubric, and explain that they are expected to do better, as described in the rubric.

Table 28: Targeted Assessment for Outcome (l)

(l) a knowledge of differential and integral calculus and advanced mathematics including differential equations, linear algebra, vector calculus, complex variables, sequences and series, Laplace transforms, Fourier transforms, and Probability and Statistics, with appropriate applications				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Statistics and Probability	NA	NA	NA	NA
Transform methods	0%	57%	43%	100%
Applied differential equations	100%	0%	0%	0%

Assessment (l)2: EE 341, Fall 2011, Dr. Klopf

This outcome was assessed using questions #1 and #2 of homework #8.

Seven students were assessed Fall 2011 using the performance criteria listed; one of the eight students in the class did not turn in any part of the assignment and was consequently not included in the assessment. Students did not meet expectations for any of the three criteria. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

Table 29 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was not met on any of the performance criteria for this program outcome. The evaluation of criterion 1 involved the use of statistical concepts (mean and standard deviation), which were outside of the standard material for this class, but were included for the sake of the assessment process. Out of the seven students evaluated, six attempted the statistical part of problem #2. Out of these, only two correctly performed the entire calculation. The students who attempted the calculations all demonstrated a basic understanding of the steps to take towards solving the problem. However, the students who did not reach the correct answers may have had difficulty in remembering how to perform the specified calculations. It might help students to better retain basic statistical concepts if they are regularly introduced into the curriculum. With regards to criterion 2, most of the students demonstrated a basic understanding of the steps needed to solve the evaluation question. Students who had difficulty solving the problem appeared to stumble while performing either the part of the calculation involving imaginary numbers or in the transformation to a phasor value. This difficulty was possibly due to a lack of practice in performing these types of calculations. Students could be helped to improve their skills with a drill exercise, as well as by increasing the amount of class time spent discussing this topic. With regards to criterion 3, all of the students attempted the problem and demonstrated a general understanding of using Kirchhoff's laws to write current and voltage expressions describing the lumped-element model. However, although a number of them referred to it, most students did not appear to fully understand how □ z approaching zero between voltage/currents at points separated by □ z was used to create a differential expression and consequently the first-order differential equations that were the point of the question. This is a fundamental mathematical concept that would have been addressed in previous courses. It might be worthwhile to discuss students' difficulty with this concept with the professor who teaches differential equations, or to include it as a review topic in this class.

Table 29: Targeted Assessment for Outcome (l)

(l) a knowledge of differential and integral calculus and advanced mathematics including differential equations, linear algebra, vector calculus, complex variables, sequences and series, Laplace transforms, Fourier transforms, and Probability and Statistics, with appropriate applications				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Statistics and Probability	43%	28%	29%	57%
Transform methods	43%	28%	29%	57%
Applied differential equations	29%	42%	29%	71%

<u>Recommendations based on the End-of-Year Faculty Review of Outcome (l)</u>

This outcome is to be assessed primarily in EE 401 because this is the only course that follows all of the math prerequisites addressed by the outcome.

3.3.16 Targeted Assessment of Outcome (m)

In addition to mathematics, knowledge of basic sciences, computer science, and engineering sciences necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components, as appropriate to program objectives

Assessment (m)1: EE 456, Winter 2012, Dr. Wang

This outcome was assessed in EE 456 Modern Control Systems using one midterm exam set and one signal-design project set. The objectives were to engage the class in a midterm exam and a signal-design project on applying the knowledge of classical control theories in addressing practical control problems. The lab project involved using the hardware and software co-design with the modern PLC/PAC controllers, which are very practical in industrial control applications. The Automation Direct PAC 3000 system and Human Machine Interface (HMI) hardware and software co-design have been used in the signal design project, which provided students a very practical way of learning the Ladder diagram, PID controller design, root-locus method, etc. The students are required to demonstrate reading, writing, listening and speaking skills; identify the technical problem; develop a plan to solve it in a group of two people, execute the experimental method for problem solving and produce a report on the lab project.

Seventeen students were assessed Winter 2012 using the performance criteria listed above. The minimum acceptable performance level was to have above 80% of the student performing at the accomplished or exemplary level in all performance criteria.

Table 30 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. Students met or exceeded expectations; they have demonstrated: (outcome E) the ability to identify, formulate and solve technical problems, (outcome B) the ability to design and conduct experiments as well as analyze and interpret data; and (outcome M) the knowledge of basic sciences, computer science and engineering sciences necessary to design and analyze complex electrical and electronic devices, software, and systems containing hardware/software components as appropriate to program objectives.

Table 30: Targeted Assessment for Outcome (m)

(m) knowledge of basic sciences, computer science, and engineering sciences necessary to design and analyze complex electrical and electronic devices, software, and systems containing hardware/software components as appropriate to program objectives				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Knowledge of basic sciences necessary to design and analyze electrical/electronic hardware and required software	0%	41%	59%	100%
Knowledge of computer sciences necessary to design and analyze electrical/electronic hardware and required software	0%	41%	59%	100%
Knowledge of engineering sciences necessary to design and analyze electrical/electronic hardware and required software	0%	41%	59%	100%

Assessment (m)2: EE 412, Winter 2012, Prof. Dingman

This outcome was assessed using a group oral presentation on video of the second term summation of a three term group senior project. It was used to assess outcomes (k) and (m) by looking and listening for the listed criteria.

Twelve students were assessed Winter 2012 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

Table 31 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. Students met or exceeded expectations; they demonstrated their knowledge of basic sciences, computer sciences and engineering science necessary to design and analyze complex electrical and electronic devices, SW, and systems containing HW/SW components as appropriate to program objectives.

Table 31: Targeted Assessment for Outcome (m)

(m) knowledge of basic sciences, computer science, and engineering sciences necessary to design and analyze complex electrical and electronic devices, software, and systems containing hardware/software components as appropriate to program objectives				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Knowledge of basic sciences necessary to design and analyze electrical/electronic hardware and required software	0%	100%	0%	100%
Knowledge of computer sciences necessary to design and analyze electrical/electronic hardware and required software	0%	17%	83%	100%
Knowledge of engineering sciences necessary to design and analyze electrical/electronic hardware and required software	0%	33%	67%	100%

<u>Assessment (m)2: EE 412, Winter 2012, Prof. Dingman, assessed by Dr. Vurkaç</u>

This outcome was assessed using group oral presentations on video. This assessment was conducted near the end of the second term a three-term group project. The videos, which have been archived and are available for viewing, provide verifiable examples of students demonstrating knowledge of basic sciences, computer science, and engineering science. Overall, the evidence for computer-science knowledge is strongest. Knowledge of basic physical sciences is also clearly displayed. Knowledge of engineering sciences is difficult to discern as separate from that of basic sciences, but it *can* be discerned with care.

Twelve students were assessed Winter 2012 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in each of the performance criteria.

Table 32 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all but one performance criterion for this program outcome. Students met or exceeded expectations in all areas except explicit demonstration of engineering sciences as separate from basic sciences. This may be the result of the rater's pickiness, since the course instructor's assessment does not show this deficit. Overall, students demonstrated their knowledge of basic sciences, computer sciences and engineering science necessary to design and analyze complex electrical and electronic devices, SW, and systems containing HW/SW components as appropriate to program objectives.

Table 32: Targeted Assessment for Outcome (m)

(m) knowledge of basic sciences, computer science, and engineering sciences necessary to design and analyze complex electrical and electronic devices, software, and systems containing hardware/software components as appropriate to program objectives				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Knowledge of basic sciences necessary to design and analyze electrical/electronic hardware and required software	0%	100%	0%	100%
Knowledge of computer sciences necessary to design and analyze electrical/electronic hardware and required software	0%	75%	25%	100%
Knowledge of engineering sciences necessary to design and analyze electrical/electronic hardware and required software	25%	25%	50%	75%

<u>Assessment (m)3: REE 449, Winter 2012, Prof. Zipay</u>

This outcome was assessed using a preliminary design review (PDR) for the second course (three courses) of the capstone senior project. The three teams presented a 20 – 30 minute design review to the class and other faculty and staff members. In the PDR the teams discussed the project design, design decisions and the overall test plan. The teams received questions and feedback regarding the current project status to guide possible changes as the project approaches completion in spring term. The students discussed preliminary design solutions, how they chose one and how they plan to test and characterize the design choice. Teams were evaluated on how well they used design presentation tools in the PDR, how they used design CAE tools such as PSpice, LabVIEW, eQuest and custom CAE tools, and how they tested and characterized the prototype subsystems .

Ten students (on three teams) from EE and REE programs were assessed Winter 2012 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in all performance criteria. One team project was designing an electric bike using a combination of fuel cells and batteries for energy storage. Another term is developing a new type of down-hole heat exchanger for a geothermal well (direct use). The final team is design a solar powered emergency water generation system. The teams discussed designs in a PDR and submitted a written test plan to discuss solution verification and characterization.

Table 33 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. Students met or exceeded expectations; they demonstrated a thorough knowledge of basic sciences and engineering sciences to design the various projects. Team one used an understanding of heat transfer, thermodynamics and fluid flows to design and analyze a new type of down hole heat exchangers. Team two used an understanding of solar energy, dehumidification, microcontroller systems and energy storage to design and analyze their project. Team three used an understanding of principles of energy storage and energy conversion to mechanical motion.

Table 33: Targeted Assessment for Outcome (m)

(m) knowledge of basic sciences, computer science, and engineering sciences necessary to design and analyze complex electrical and electronic devices, SW and systems containing HW/SW components as appropriate to program objectives.				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
Knowledge of basic sciences	10%	40%	50%	90%
Knowledge of computer sciences	20%	40%	40%	80%
Knowledge of engineering sciences	0%	20%	80%	100%

Recommendations based on the End-of-Year Faculty Review of Outcome (m)

Except for a small amount of uncertainty in defining "engineering sciences" as separate from "basic sciences," this assessment has continuously found no weakness in the students' performance.

Assessment results are highly satisfactory. Nonetheless, further discussion by the faculty in the regularly scheduled meetings for closing the loop and learning from our assessment during the spring term of 2012 led to several recommendations.

In terms of the details of assessment practice, it was decided that the expression "in addition to mathematics" should be removed from the statement of the outcome, as it was seen to have led to confusion about the target criteria. (Some faculty thought mathematics performance was part of the outcome.)

The discussion as to whether the results point to a programmatic weakness or not resulted in the conclusion that this was not the case, and that there were further confusing aspects to the outcome and its criteria. For example, the faculty did not agree on the definition of "engineering science." Suggested definitions were:

- The scientific basis of engineering devices
- The collection of scientific knowledge for engineering uses
- The use of engineering principles to advance knowledge, and
- To develop new engineering principles or hypotheses.

In the end, the decision was to alter the criterion to read "knowledge of engineering" or "knowledge of engineering applied to project design." It was agreed that the outcome is to be rewritten for next year.

3.4 Summary of Direct-Measure Assessment for 2011–12

Strengths have been noted in the areas of conducting and analyzing experiments, designing systems and system components according to realistic specs and constraints, teamwork, problem-solving, ethics, and in the use of engineering tools and techniques. Students consistently demonstrated strong skills in problem-solving, design, and the use of engineering tools.

Recommendations

The recommendations are divided into two groups: those regarding the process of assessment, and those regarding program improvement.

In terms of assessment practices, it was determined that several of the guidelines of OIT EERE assessment passed down from prior academic years may be relaxed to allow better assessment of student-learning outcomes.

- Our rubrics are no longer required to have three and only three criteria. For example, in the rubric on contemporary issues, the inclusion of multiple concepts in criterion 1 was a holdover from the standard OIT EERE assessment practice of only three criteria per rubric. (Originally, this development was a natural and positive response to an even older set of departmental rubrics which had featured an excessive number of criteria, rendering the department's earliest assessment efforts prohibitively complex.) As a result of recent faculty discussions, it has become clear that we can move in the direction of a sensible middle ground: one of having more than three criteria if required to make the assessment activity meaningful. As long as this new guideline is not taken to extremes (with a prohibitively high number of criteria), the faculty feel that this is an improvement of our assessment process.
- Faculty are allowed (though not required) to state a desired performance level other than 80% (either higher or lower) for any criterion. This is aimed at reflecting the different levels of importance different criteria (or even outcomes) may have at various points in the curriculum, or even throughout the program.
- A performance level of "0" (no or insufficient evidence) may be added to rubrics. This is helpful in terms of removing the psychological tendency to score 2 out of 3 (midpoint) whenever the factors leading to a score are particularly ambivalent. Similarly, some of the evaluation-level performance descriptors have been removed from some rubrics (not all) because those levels of Bloom's Taxonomy are typically reached during graduate work, and not expected at the undergraduate level.
- Assessment later in the program, and even later in each academic year (such as the spring term of a junior cohort's progress) is expected to give better indications of summative results. Formative and summative assessments need to be separated in reports and in faculty discussions to draw more useful information from assessment. Feedback from formative assessments needs to be delivered to students earlier (and more frequently) in the curriculum.

- Alternative rubrics from OIT-Portland, the OIT ISLOs, and individual program faculty may be used whenever they better target the outcome, or a specific criterion under inquiry.
- The mapping of outcomes and their assessment to oral versus written student presentations needs to be more carefully planned. This requires tighter two-way communication between the assessment coordinator and the faculty member carrying out the assessment.
- The number of outcomes assessed per assignment needs to be kept low (less than three).
- The assessment of outcome (i) should take place mid-junior year or later. Some courses identified as candidates for further assessment of outcome (i) are EE 301, EE 325, EE 419, EE 423, EE 456, REE 407, REE 412, and REE 451. Emphasis will be placed on the EE courses for this assessment (for the EE program).
- Outcome (m) is to be rewritten in 2012–13 to clarify what is intended by "engineering sciences" as different from the basic sciences.

In terms of program improvement regarding curriculum and pedagogy, the following recommendations are made.

- A program-wide emphasis on mathematical rigor is needed, along with better-targeted assessment of advanced mathematics.
- The relevant rubric or a summary of it needs to be presented to students, even for the more traditional engineering assignments like laboratory experiments, but especially for papers addressing soft skills and understanding. This is a teaching issue, not just an assessment issue, because it concerns transparency in terms of what faculty expect students to learn and achieve.
- Oral-communication skills need to be specifically addressed by the faculty in the design of assignments and given significant weight in grading.
- Students will be required to do at least one oral presentation for at least half of the upper-division core courses in the EE(T) curriculum. Students will be provided with guidelines for oral presentations as well as a copy of the rubric so that they can develop an adequate idea of the level expected and the criteria used for evaluation. After their presentation, students will be provided timely feedback on their oral presentations so that they are aware of the areas where they need improvement.
- Additionally, students will be required to do an oral presentation as part of their senior project demonstration. This will be assessed and will count towards the final grade in their senior project.
- Criteria and expectations (in the form of the rubric itself, or a distilled version) should be given to the students up front, and the relevant form of communication (oral or written, depending on the assignment) should be given sufficient and clear weight in the grading for students to take notice and display their abilities.
- It is also important that communication outcomes should be assessed on an individual basis, even if the project is done by a group.

- Contemporary issues will have an explicit place in the curriculum: mandatory sessions in senior project. Furthermore, all faculty are encouraged to state in their syllabi (and include in their lectures or assignments) the relevance and importance of an awareness of contemporary issues to modern engineers.

Appendix A: Academic-Year Direct-Assessment Activities

Program Outcomes Assessed During the 2011–12 Academic Year

We have collected assessment data for the following outcomes:

(a): 3 sets, satisfied.
(b): 3 sets, more than satisfied.
(c): 4 sets, more than satisfied.
(d): collected 1 set; the remainder postponed by request of the OIT Assessment Council to match ISLO cycle.
(e): satisfied.
(f): satisfied.
(g): 2 sets, satisfied.
(i): 2 sets, satisfied.
(j): satisfied.
(k): 2 done, satisfied
(l): 2 sets, satisfied.
(m): 3 sets, satisfied.

Of these,

- (b), (f), (i), and (k) were closing-the-loop activities;
- (a), (c), (l), and (m) were essential to the assessment cycle;
- (e), (g), (j), and the additional runs of (f), (i), and (l) were extra assessment activities.

Appendix B: Indirect Assessment: Results of the Senior Exit Survey

Ten students took the senior exit survey during the spring term of 2012. All ten entered their student ID numbers. Five reported having accepted employment; one reported plans to continue education (who is known to have been accepted into several graduate programs); and four reported looking for employment. Of the five reporting employment already secured, all entered employer name, location, job title and salary. The student reporting graduate-school plans entered that they will be majoring in Computer Engineering at the University of California, Santa Barbara.

For the institutional student-learning outcomes, the following chart (Figure 1) illustrates the student responses.

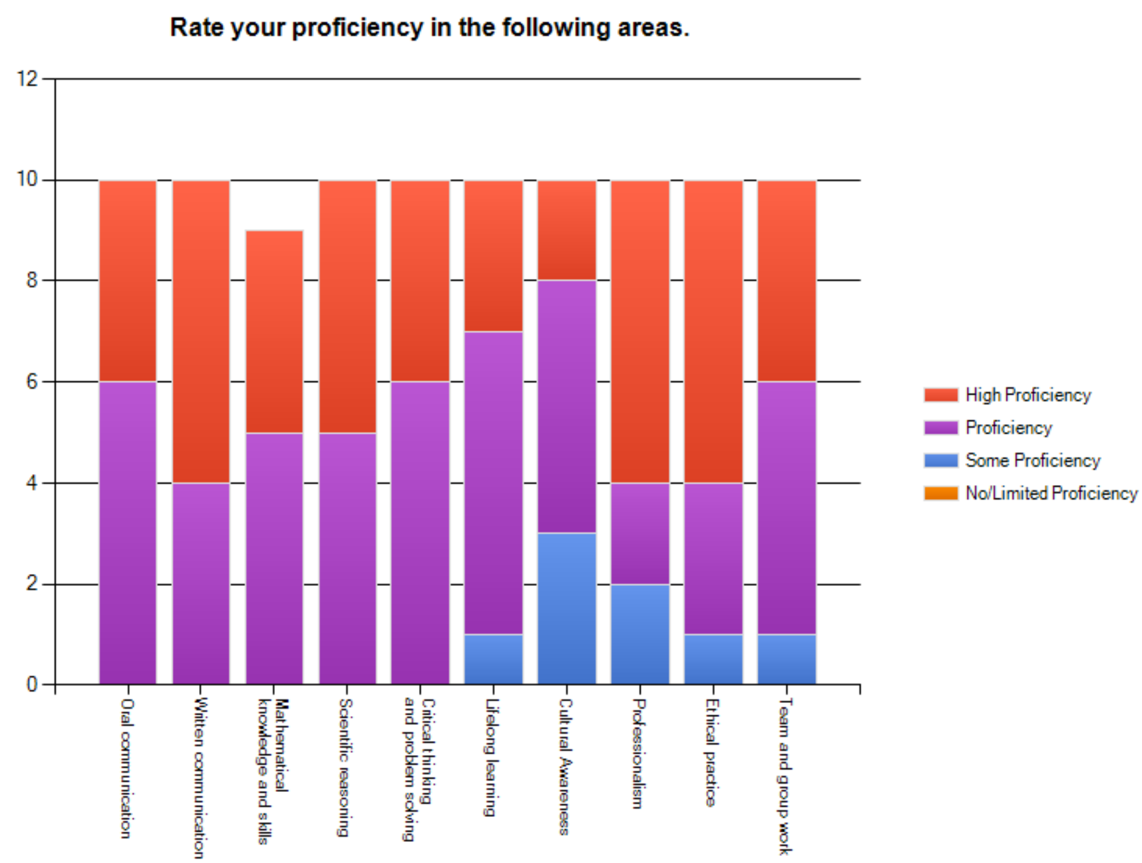

Figure 1: Graduating EE seniors' self-report responses regarding their proficiency in the areas of the OIT institutional student-learning outcomes (ISLOs)

In response to how well the EERE department prepared them for proficiency in the ABET outcomes, students' self-report is given in (Figure 2). Nine out of ten students report being *to some extent* adequately prepared in all areas, with the only areas of inadequate preparation being outcomes (h) and (i). However, the same group of seniors responded with all favorable answers to the same (or related) criteria when listed under the Institutional Student-Learning Outcomes (ISLOs) one page prior in the same survey, as shown in Figure 1.

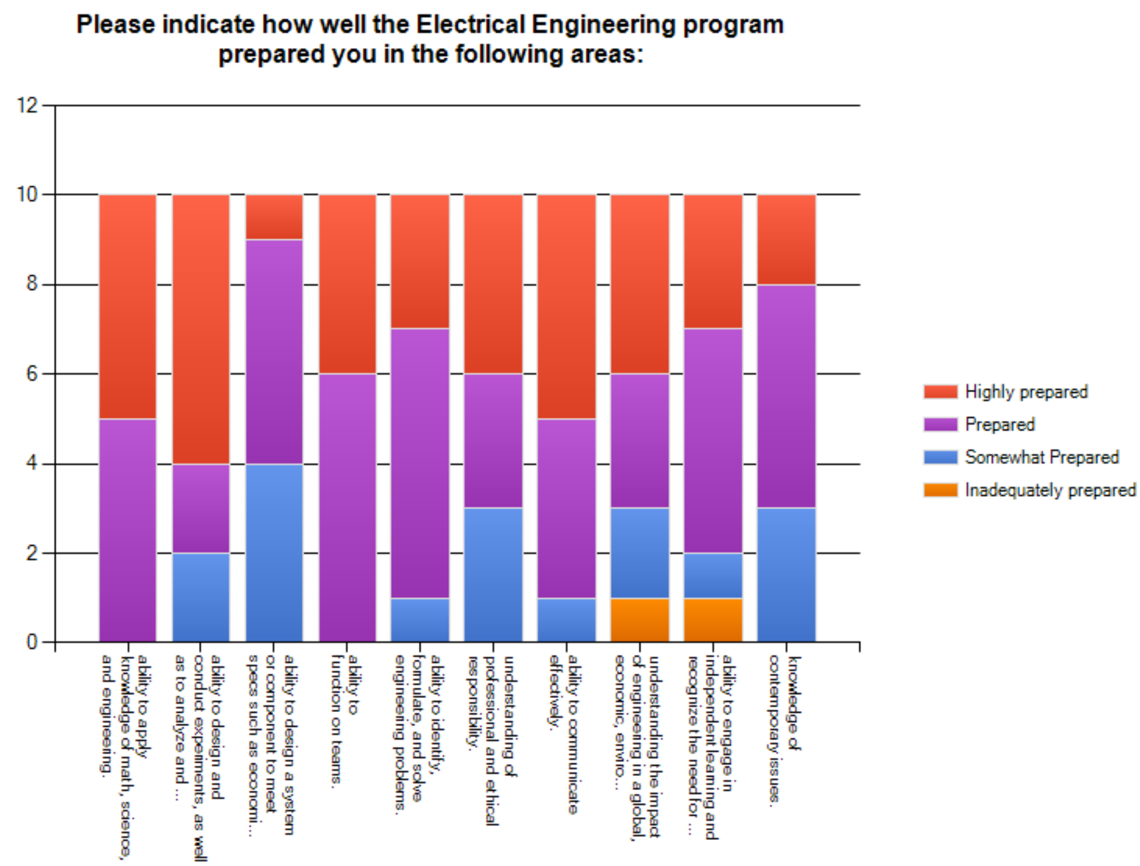

Figure 2: Graduating seniors' self-report responses regarding their proficiency in the areas of the ABET outcomes

Graduating seniors' responses to questions about the quality, relevance, and availability of the curriculum are summarized in Figure 3. There is some disagreement (less than half) from the students that the curriculum provides everything needed. For instance, one student disagreed with the statement that the "curriculum provides opportunities for hands-on experiences." Since the curriculum explicitly provides several such opportunities, this response may be understood in terms of specific written responses to this survey: One student wrote that they considered MATLAB experiments not to be sufficiently practical, and that the more "digital" courses suffered in this regard. It is the opinion of the faculty in general that MATLAB is the disciplinary standard for much industry work, and that favoring individual devices instead would rob the students of a critical skill required by most industry employers.

Similarly, there is one disagreement with the statement that the "curriculum provides courses that meet [students'] career needs." This is likely a result of the fact that the OIT EE curriculum provides a *traditional* EE degree, not an "Electrical and Computer Engineering" degree. There was one student in this group of seniors who was particularly interested in Computer Engineering, as opposed to traditional Electrical Engineering.

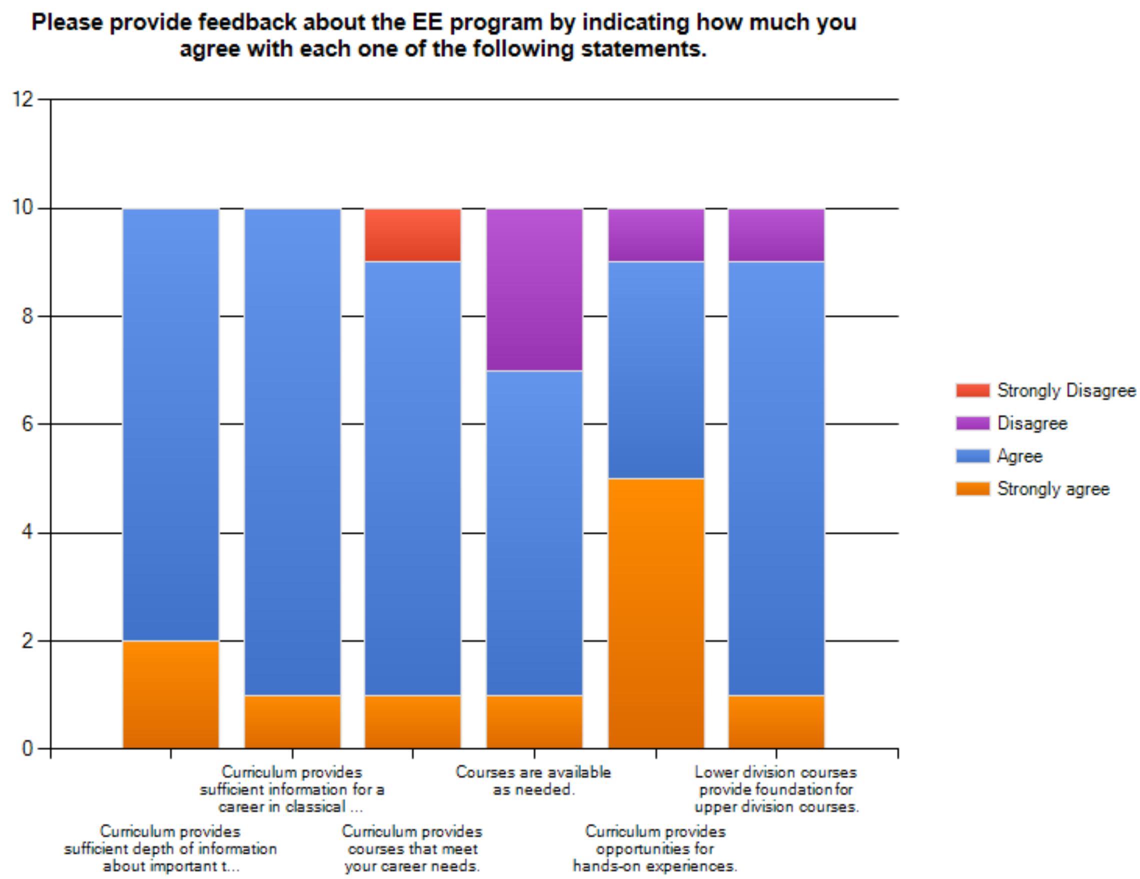

Figure 3: Graduating EE seniors' self-report responses regarding the EE program and its curriculum

The most common of the complaints is in terms of the availability of courses. While some courses are offered multiple times per year and have trailing sequences, it is true that some do not. The EE curriculum as listed in the OIT Catalog specifies "required courses and recommended terms during which they should be taken." The curriculum is rigorous and demanding. Those students who somehow do not to put in the necessary effort, or who were not adequately prepared prior to the program or face extracurricular difficulties may need to take courses out of the ideal sequence and timing. This is a natural aspect of college education, and every effort is made within departmental resources to make as many alternate-term courses available as possible. As indicated by the next figure, the students are indeed satisfied with the quality of education they have received (Figure 4).

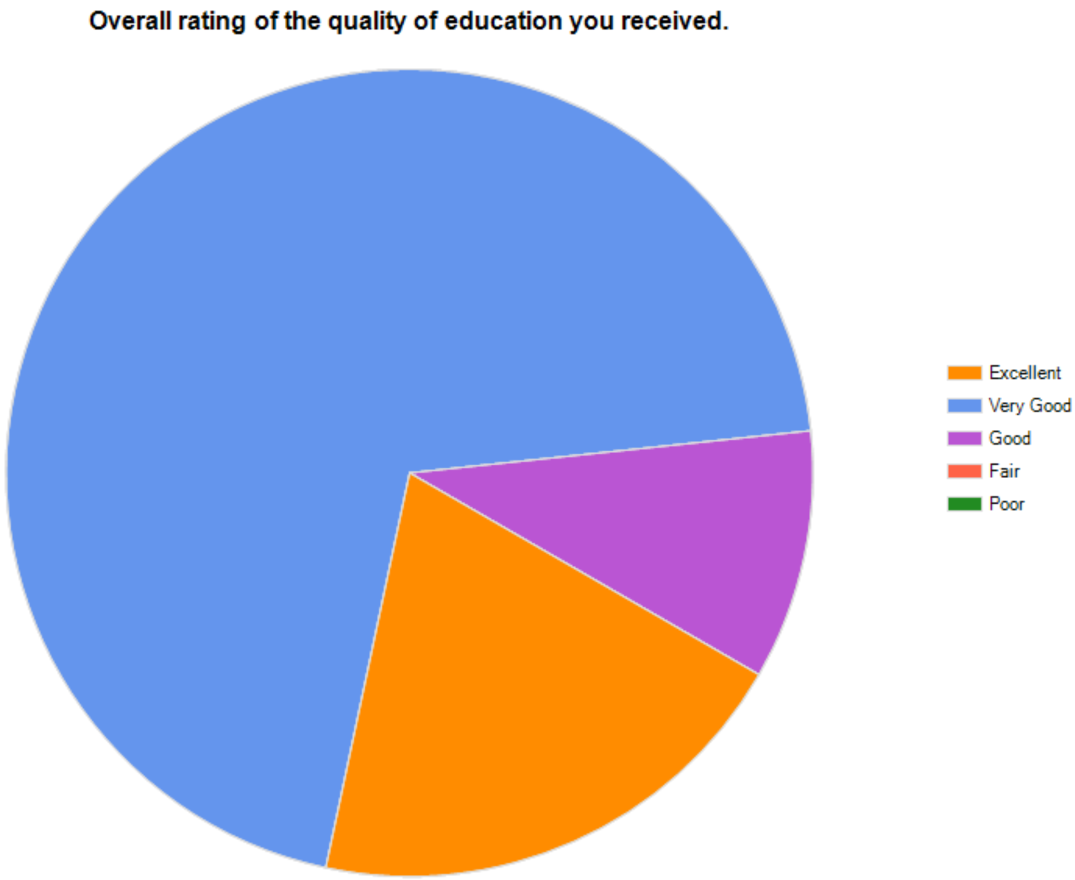

Figure 4: Graduating EE seniors' self-report responses regarding the overall quality of education at OIT

Appendix C: Indirect Assessment: Samples of the Senior Exit Survey

Selections of questions and answers from the senior exit survey follow.

Comments about advising (students' typos corrected in brackets):
"I feel my advisor has gone out of his way to make sure I am doing all I need to in order to graduate. He [has] bent over backwards in many ways to ensure my success here at [OIT]."

"My advisor when first enrolling was [name removed; former OIT professor] who deceased two months into my first term. I had minor issues with [name removed] and his willingness to assist me with small but important problems with the transi[tion] to this college and community. My concerns and questions extinguished quickly as soon as I was appointed a new advisor in [name removed; current OIT professor]. [name] had an open door policy which gave me confidence and direction with the questions and answers I would ask him over the last 3 years. More then an advisor, I viewed [name] as my [friend] and a mentor. Even though I was never a top student in any of his classes, never once did I feel nervous or ashamed to talk to [name] about future classes or projects. This type of student[–]advisor relationship is why I [chose] this school over a bigger university such as Oregon State, which offers the same program."

"My advisor ([name removed]) showed a sincere interest in my success, and met with me every term to make sure I was on track. He was quick to help me resolve any problems that I encountered. During my career search, [name] was very helpful in offering interview advice as well as referrals to engineering companies."

Comments about the EE curriculum (students' typos corrected in brackets):

"It has been a road of ups and downs here at OIT. I feel the facaulty has done their best to accomodate us students, even when unseen unfortunate events have come up. I truly feel they all care deeply about my success and all always [there] to help. In fact, even when us students are slacking a bit when we get burned out in life and school, they care enough to sit us down on individual [basis] and tell us how [we're] not pulling our weigh. Professors [names removed] are all adequate teachers who honestly care about our success. They have made the experience here [worthwhile] and I would not give any of them up for anyone else. They as a team are rockstars[.]"

"The challenges of the [curriculum] are very intense. Preparation is key. This is why I [chose] EE. Life [isn't] easy outside the wing of the educational system. But [preparation] is essential to [succeeding] in a career and other ventures. What I like most about the EE [curriculum] is the small classes, broad spectrum of topics covered, and hands[-]on lab experience. One of the biggest drawbacks of the program was the [u]navailability of the courses I needed to stay on track to graduate after I failed or got behind in course sequences."

What have been the three BEST things about the major? (students' typos corrected in brackets): "Student[–]professor relationship is by far the greatest advantage to OIT. I know all of my professors by name, and at one time or another they have been very gracious in helping me overcome an obstacle or pursue my endeavors. Some professors, particularly newer professors in the REE [program], have been exceptionally helpful. I believe that if all professors would adopt their teaching style, caring nature and genuine interest in the success of their students, then OIT's EE program would be competitive with top schools in the country. Because his performance was so exceptional, I feel it necessary to name-drop: [name removed] is an amazing professor, and the knowledge I gained through his Control Systems course was clear, concise, and extremely helpful [on] the FE exam."

"Small class sizes. Hands[-]on learning. Professors that care [about] your success."

"The best things about this degree have been able to use the information I have learned on the job (sic). Helping me gain the drive to complete and find information for any task that is given to me. The labs throughout the digital, signals and systems, [microcontroller] courses [were] awesome."

"1. Finally figuring out how transistors make logic gates (this had bugged me for years). 2. The hands-on labs and experience with both physical and computerized tools of the trade. 3. Realizing that with enough time, space and tools, I could build a fully functioning computer out of raw silicon and copper (programming it might be a different story, but that's CSET's job)."

Any other comments about your time at OIT? (students' typos corrected in brackets):

"From my observations, OIT's EE/REE [department] is continuing to grow and develop. I feel that many of the experiences my class had were part of an awkward adjustment phase, and have since been rectified. Overall I rate my education at OIT as satisfactory, and look forward to comparing my education and experience against others as I pursue my graduate degree."

"Aside from being rather isolated, I believe that my time here was well-spent. EE professors are very helpful, and I feel that I have received a pretty thorough education overall. Ultimately, OIT prepared me for my job search, and as a result, I have been successful in meeting my ultimate goal of having a good engineering job after I graduate."

Summary:

In summary, we see that there is a favorable degree of match between graduating seniors' self-report of their knowledge and skills as engineers and the findings of faculty assessment of student learning, with the exception being that faculty assessment is more rigorous of students' theoretical skills (mathematics, in particular). Shortcomings revealed by faculty findings and student comments are being addressed by the program faculty's processes of continuous improvement through work groups formed to address various issues and improve the curriculum and instruction.