Addressing ABET 2000 Requirements for Continual Evaluation and Program Improvement

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Abstract

The University of South Alabama (USA) College of Engineering was among the first colleges of engineering in the southeastern United States to apply for accreditation under the Accreditation Board for Engineering and Technology (ABET) Educational Criteria 2000 (EC 2000). In addition, the Electrical and Computer Engineering (ECE) Department was seeking first time accreditation of a four-year degree program in Computer Engineering. To introduce the required process of continual improvement that characterizes the EC 2000 criteria, the ECE Department developed procedures for obtaining input from constituencies.

One of the key differences in EC 2000 and earlier ABET requirements is that program objectives must be regularly reviewed, discussed, and if necessary, modified. At USA, program constituencies take an active role in defining the program objectives. In addition, program assessment procedures are continuously reviewed and revised in response to constituent input. The participation of representatives from the following constituencies is central to continual program objective review and improvement:

- Industrial Advisory Board (IAB)
- Alumni
- Employers of alumni and of co-op students
- Student professional and honor societies
- ECE and CIS faculty
- Students enrolled in the USA ECE programs
- Administration of the College of Engineering
- ABET
- Prospective high school students and parents
- Alabama Commission of Higher Education
- Alabama State Board of Professional Engineers and Land Surveyors
- Electrical and Computer Engineering Department Heads Association (ECEDHA)
- Southern Accreditation Association for Colleges and Schools (SACS)

The USA ECE Department was successful in obtaining a full six-year accreditation of the Electrical Engineering (EE) and the Computer Engineering (CpE) programs. The contribution of this paper to engineering education is an enhanced understanding of the ABET 2000 process, which, by ABET's own admission, is a work in progress.

Introduction

The University of South Alabama (USA) was founded in 1964 in Mobile, Alabama, as a regional educational institution. The Electrical Engineering program in the USA College of Engineering received its first six-year accreditation by the Accreditation Board for Engineering and Technology (ABET) in 1978. In the latest cycle, USA opted to seek accreditation under ABET's Educational Criteria 2000 (EC 2000) program, a set of guidelines that is mandatory for all engineering programs. A self-study period followed by a site visit by an ABET team evaluated the Batchelor of Science in Electrical Engineering and Batchelor of Science in Computer Engineering programs based on criteria in each of the following areas:[1]

- Students
- Program Educational Objectives
- Program Outcomes and Assessment
- Professional Component
- Faculty
- Facilities
- Institutional Support & Financial Resources
- Program Criteria

The required one-year self-study was performed in 1998 and an ABET site visit was conducted in October 1999. In August 2000, ABET sent a report identifying weaknesses in both programs, which were given a two-year accreditation with a written report required at the end of the two-year period. The weaknesses were successfully addressed and both programs were fully accredited for 6 years in August of 2002. Significant lessons were learned in the process of correcting the weaknesses, resulting in constructive program changes.

EC 2000 Criterion 1 and Criteria 4 through 8 are similar to the older ABET program criteria. The main differences in EC 2000 and earlier evaluation criteria are Criterion 2, Program Educational Objectives, and Criterion 3, Program Outcomes and Assessment.
According to ABET, institutions, in this case USA, and programs, in this case, EE and CpE, define objectives to meet the needs of their constituents. Program educational objectives are broad statements describing what graduates should be doing three to five years after graduation. Whether the objectives are successfully achieved or not can only be directly measured by feedback from graduates and their employers in three to five years. Program outcomes are what USA graduates will be capable of doing upon graduation. If outcomes are properly linked to program objectives and an appropriate set of assessment procedures are utilized, a short-term idea of how well educational objectives are being met can be obtained. ABET suggests eleven

program outcomes, which must be measured by assessment tools developed by the institution.[2] The outcomes are associated with objectives, defined by the institution, which are consistent with its mission and the interests of the constituents.

ABET emphasizes that EC 2000 is a process of continuous improvement. Program objectives must be formulated with the input and approval of the program constituents, which include industries that employ graduates, the graduates themselves, students, faculty, and other interested parties. A process must be in place to fine-tune programs to better meet objectives with the full knowledge and approval of the program constituents.

The ABET site visit in October 1999 identified two weaknesses: one under Criterion 2 (Program Educational Objectives) and one under Criterion 3 (Program Outcomes and Assessment). ABET granted accreditation of the Electrical Engineering and the Computer Engineering programs through September 30, 2002. The USA ECE Department provided documentation that the weaknesses were remedied in a report in January 2002. ABET accepted the report and extended accreditation of the Electrical and Computer Engineering programs to September 30, 2006.

ABET's primary concerns involved procedures for the selection of program constituent representatives, evidence that the constituents were helping to establish program objectives, and how the programs are revised as a result of assessment, again with evidence of constituent participation. It was found that an Annual Retreat, held in January of each year, provides a multipurpose forum for obtaining input from constituents and for reaching a consensus on program evolution.

Weakness 1

As stated in ABET's August 2000 report, a weakness was identified under Criterion 2 (Program Education Objectives):

"The weakness remains pending documentation of progress and actions taken on the following items: the procedures for selection of constituent representatives and obtaining input from constituencies, and results of constituent participation in establishment and review of program objectives."

To ensure that all constituents have an opportunity to contribute to program objective establishment, an Annual Retreat is held every year. At the retreat the program objectives are reviewed, discussed, and if necessary, modified.

The participation of representatives from the following constituencies is central to continual program objective review and improvement.

Industrial Advisory Board (IAB)
The members are nominated and elected each year at the department Annual Retreat. Nominations for the IAB are solicited from all constituents of the program. The constituents include, but are not necessarily limited to: students, alumni, faculty, and industrial employers.

Input is solicited from the Industrial Advisory Board concerning program objectives, course offerings, and assessment tools.

Alumni
The names of 100 alumni are selected every year on a rotation basis from the alumni database. Feedback on the BSEE and BSCpE programs is obtained through the use of a questionnaire.

Employers of alumni and of co-op students
The names of 100 employers are selected every year on a rotation basis from the employer database. Feedback on the BSEE and BSCpE programs is obtained through the use of a questionnaire.

Student professional and honor societies
Elected officers of the student professional and honor societies, such as the Institute of Electrical and Electronics Engineers (IEEE), Tau Beta Pi, Eta Kappa Nu (HKN), the Society of Women Engineers (SWE), the National Society of Black Engineers (NSBE), and the Association of Computing Machinery (ACM) are all representatives.

ECE and CIS faculty
In addition to the general faculty membership and the department chairman, two committees play an important role:

> CpE Coordination Committee – Consists of a chairman and one faculty member from the Electrical and Computer Engineering Department, and two faculty members from the School of Computer and Information Sciences.
>
> ECE Undergraduate Affairs Committee – Consists of all members of the ECE faculty with the exception of the department chairman.

Students enrolled in the EE and CpE programs
All students are invited to participate and to provide input through a Student/Faculty Forum, held at least once per semester, summers included, or they can express their concerns directly to the department chair.

Input is also received from the following constituencies; however, they do not necessarily participate in the Annual Retreat:

Administration of the College of Engineering

ABET

Prospective high school students and parents

Alabama Commission of Higher Education

Alabama State Board of Professional Engineers and Land Surveyors

Electrical and Computer Engineering Department Heads Association (ECEDHA)

Southern Accreditation Association for Colleges and Schools (SACS)

Procedures for obtaining input from constituencies

Constituency input is obtained through a variety of questionnaires and/or documented meetings. The procedure for obtaining input from each constituency is described below.

Alumni
Questionnaires are sent to ECE program graduates in the Spring or Fall semester each year to solicit feedback in areas such as life-long learning; computer/mathematics skills; ethical issues; team work; written communications; practical skills; ability to use techniques, skills and modern engineering tools in the workplace; oral communications; and design skills. Each area is rated on a 1-10 scale, 10 being the highest rating. The questionnaires are reviewed by all constituencies at the Annual Retreat and are updated on a yearly basis.

Employers of alumni
Employers of EE and CpE program graduates are surveyed in the Spring semester each year to solicit feedback on the performance of USA graduates in areas such as design skills, practical skills, ethical issues, life-long learning, overall job performance, team work, computer/ mathematics skills, oral communications, and written communications. The questionnaires are reviewed by all constituencies at the Annual Retreat and are updated on a yearly basis.

Elected officers of student professional and honor societies
Input from students is solicited at least once per semester, summers included, in the form of a Student Faculty Forum. Representatives of student organizations including, but not limited to: IEEE, SWE, NSBE, Tau Beta Pi, and HKN, are invited to participate. In addition, the forum is open to any student in the Department who wishes to attend. The forum is conducted in such a way as to allow voicing of any concerns students may have, good or bad, about the program. Forum minutes are kept anonymous to alleviate students' concerns. Minutes for Student/Faculty Forum meetings are presented at the Annual Retreat for feedback from constituencies.

ECE and CIS faculty
The CpE and CIS faculty members submit course reports for each course taught in the curriculum at the conclusion of each semester. The course reports include information such as class policy, homework assignments, lab reports, quizzes, tests, in-class individual and team projects, final exams, mid-semester surveys, end-of-semester learning objectives surveys, faculty assessment of classes, and supplementary information on EC 2000. Student comments obtained on mid-semester (optional) and end-of-semester (mandatory) surveys provide the instructors with valuable feedback on each course. Depending on the comments, the department chair meets with individual faculty members to discuss issues raised in the surveys.

Students enrolled in the EE and CpE programs

The main feedback is based on the end-of-semester assessment form used for each course. Also, exit questionnaires are requested from each student during their final semester. The questionnaire includes such topics as: career preparedness; course syllabi, general facilities, faculty instruction, advising, laboratory facilities, relevance of instruction, quality of instruction, and course textbooks. This questionnaire is used for both EE and CpE students and includes questions applicable to the individual programs. Each area is rated on a 1-10 scale, 10 being the highest rating. The questionnaires are reviewed by all constituencies at the Annual Retreat and are updated on a yearly basis.

Establishment and review of program objectives

One of the primary purposes of the Annual Retreat is to present the input of all constituents for the establishment and review of program objectives. An agenda of items to be discussed at the Annual Retreat is circulated by the ECE Undergraduate Affairs Committee at least 30 days prior to the Annual Retreat meeting. The agenda may be added to or commented upon by any constituency. The retreat is conducted in accordance with Robert's rules of order and results in a documented consensus among all constituents on program objectives.

Weakness 2

As stated in ABET's August 2000 report, a weakness was identified under Criterion 3 (Program Outcomes and Assessment):

"The weakness remains pending documentation of progress and actions taken on the following items: revised procedures for program assessment, constituent acceptance of the revised procedures, method of evaluating the assessment tools, program revisions resulting from assessment procedures, and effectiveness of program revisions or modifications resulting from the assessment evaluation."

Procedures for program assessment

In response to constituent input, particularly the students and ECE faculty, the program assessment procedures are continuously reviewed and revised as shown in Figure 1.
The procedure for program assessment implies the use of assessment tools for the collection of data. The assessment tools selected represent a revised set from the tools originally proposed in USA's ABET 2000 report. The revision was done to eliminate subjectivity and redundancy, as well as to reduce inconvenience to constituencies as suggested by ABET. It is critical that all constituencies take ownership of the continuous improvement of the program and not view the collection of data as merely an exercise. For this reason, assessment tools and procedures are discussed and voted on at the Annual Retreat to establish a clear consensus.

Revised program assessment tools, approved by all constituencies, include the following:

End of semester surveys – Conducted each semester for each course taught in the ECE Department. The surveys document the student's opinion of how well the course objectives have been met. The surveys become a permanent part of each course report.

Alumni questionnaires – Conducted once per year.

Employer questionnaires – Conducted once per year.

Course Reports – Include all instructional materials and surveys for each course taught in the department. Course reports are kept on file for six years and are periodically reviewed by the ECE Undergraduate Affairs Committee.

Subject-Specific FE Exam results – Evaluated twice per year.

IEEE Southeastcon Hardware Competition Results – Once per year.

The CpE Coordination Committee and the ECE Undergraduate Affairs Committee are responsible for evaluating assessment tools and making recommendations for changes. The ECE Faculty is responsible for formally reviewing the recommendations of the committees concerning assessment tools and procedures. The evaluation method is shown in Figure 1.

Program revisions resulting from assessment procedures

Program revision recommendations are made by the appropriate department committee(s), with the input and approval of the department chairman. Since many proposed revisions result directly from feedback from constituencies, the improvements are presented to all constituents during the Annual Retreat for discussion and approval. Program revisions implemented based on recommendations from the 2000 and 2001 Annual Retreats include the following:

Revisions made in response to alumni input

- Laboratory courses on Programmable Logic Controllers (EE 425) and Programmable Logic Devices (EE 447) were added to the curriculum.

Revisions made in response to employers input

- Introduced contract law as a topic in EE 301 (Professionalism and Ethics in ECE).
- Modified courses to include Internet use.
- Introduced several new courses to cover state-of-the-art topics, including VHDL, VLSI, Verilog, Neural Networks, and Optical Networks.

In addition, more emphasis is placed on oral and written communications.

- Formal presentations are now required in EE 401/404 (Senior Design) and EE 301.
- Formal written reports are now required in EE 227 (Circuits and Devices Laboratory) and EE 337 (Electronics Laboratory).
- The use of word processing, graphics, and spreadsheet software are now required for all laboratory reports.

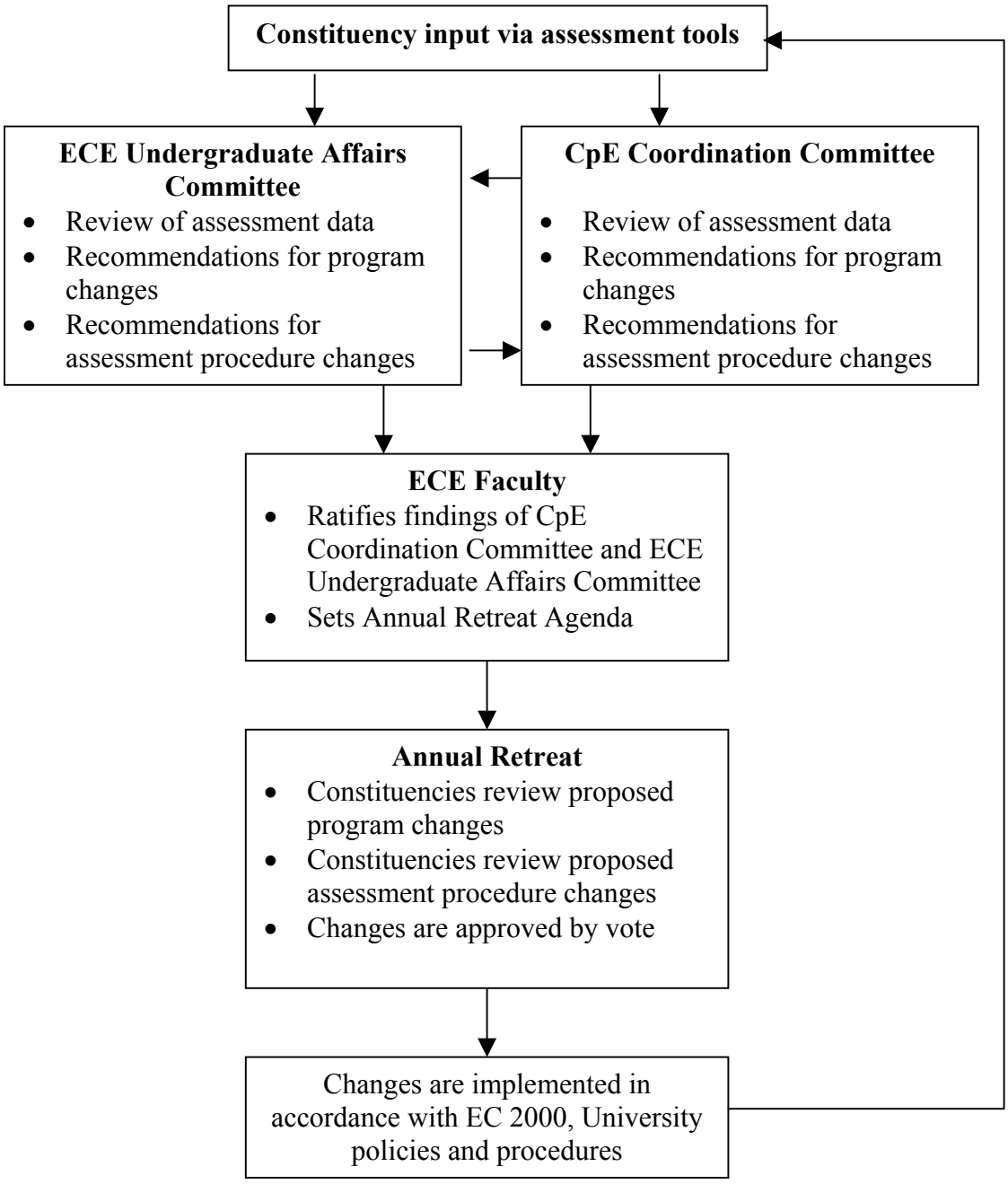

Figure 1. Procedure for program revisions in response to constituent input.

Revisions made in response to student's input

- Academic minors were introduced.
- All laboratory experiments have been reviewed and updated.
- More options have been added for senior design projects.
- Course offerings have been modified to avoid time conflicts.
- Supplemental instructors and tutors have been introduced for core courses.

Revisions made in response to faculty input

- Changes were made to the 2001 – 2002 Bulletin, which include new course offerings, changes to course numberings, and changes of prerequisites for courses.
- A yearly advising workshop for faculty was implemented.
- FE review courses were introduced.
- Textbooks for several courses were reviewed and updated.
- Laboratory safety certification for all laboratories was introduced.
- Greater emphasis was placed on life-long learning in senior design classes.

Facilities improvements in response to all constituents' input

- The ECE building is open after hours and on weekends.
- Extensive renovations for instructional labs have been done: over $300,000 has been spent to purchase and install equipment in the instructional laboratories.
- A new computer laboratory with 26 new computers has been added.
- A new senior design laboratory facility has been added.
- A wireless network has been installed in the ECE building.
- All facilities were inspected by the University safety office and upgraded to meet OSHA standards.

Effectiveness of program revisions

Effectiveness of program revision is indicated in two ways: positive feedback from constituents, and improvement in the program as indicated by the outcome assessment tools. It is emphasized that program improvement is a process, which is continually revised, reviewed, and refined by all constituents. Satisfaction of employers with new skills acquired by graduates, responses of alumni, and student responses to improvements made in the department are key metrics for improvement. Data that is utilized to measure program effectiveness includes the following:

Graduation rate - Significant increase in graduation rate for 2002.

Increased enrollment – A 4.3% increase in the Fall 2001 semester.

Teacher effectiveness - Measured by a University-wide survey each semester.

FE exam results - Obtained twice per year, in April and October.

Student awards and scholarships - The number of scholarships increased by 100% in 2002.

Student enrollment in IEEE and Honor Societies - IEEE memberships increased significantly in 2002.

Acceptance of EE and CpE graduates in graduate programs - Added a question to graduate questionnaire to determine if graduates are continuing their education.

Numbers of graduate teaching assistants - Graduate teaching assistantships doubled in 2002.

Increase in Faculty - Hired a new ECE Department chairman in June 2001, hired a new visiting faculty member for Fall 2001, hired a new tenure-track faculty member beginning January 1, 2002.

Improvements Resulting From Program Observations

- The entire ECE building has been renovated.
- Obsolete office equipment has been replaced.
- New computers were purchased for all faculty.
- Better coordination with the School of Computer and Information Sciences has been established.
- Advising for computer engineering students has been streamlined. Computer engineering students are now advised in the ECE department.

New relationships have been built with local industry. For example, Alabama Power provided $500,000 in endowment funds to provide scholarships for ECE students; negotiations are underway with Ferson Optics and Radiance Technologies for hiring ECE Co-op students; and Ferson Optics is planning to commercialize a provisional patent on a beam splitter developed by the ECE faculty.

Conclusion

The ABET 2000 accreditation process was a constructive learning experience. It is the intent of ABET that engineering education be shaped by the consumers of electrical and computer engineering graduates in addition to being shaped by the producers of electrical and computer engineering graduates. It is primarily for this reason that the constituents of the University of South Alabama ECE Department are a vital part of a continuing process of improvement. It is equally important that USA not be just a training facility for local industry. It is for this reason that the ECE Department Chairman and faculty are essential partners with the other constituents.

The assessment procedures instituted in the ECE Department are subject to approval and modification by constituents. In order to measure something, the right tools must be used. There is a tendency to simply collect data and not spend the necessary time and resources to evaluate the implications of the data. If the results of a survey or a questionnaire are found to be ambiguous or not useful for their intended purpose, they can be changed. Curriculum changes, updates, and modifications are important to maintain the relevance of ECE education. A continual process of modernization and accommodation of new technology and techniques must

be done. This process must be reflected in the textbooks, course content, and laboratory exposure. Industrial constituents are particularly important in this area.

Commitment to the program improvement process is incumbent upon all constituents. The success of graduates from the USA ECE department is the final measure of the success of their education. All constituents benefit from this, and, in all of the assessing, evaluating, and testing, that fact must remain most important.

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