Preparing for an Accreditation Visit
Using ABET Engineering Criteria 2000

James R. Rowland
Dept. of Electrical Engineering
and Computer Science
University of Kansas
Lawrence, KS 66045

Abstract

Engineering Criteria 2000 contains two kinds of items: (1) Requirements which must be satisfied as well as (2) Other evidence mentioned that may be used is are not required. Since the new criteria include a number of items of both kinds not considered directly in the present Topics Criteria, a longer lead time is needed for the initial preparation. These items are grouped in this paper and a common-sense time schedule suggested for implementation in preparing for an accreditation visit under Engineering Criteria 2000 for programs in electrical engineering and computer engineering at the University of Kansas in the Fall of 2000. A particular emphasis is placed on the program outcomes and assessment criterion. Comparisons with the Topics Criteria are presented and recommendations made on avoiding some common problems. Selected information from a working symposium in April 1997 at Rose-Hulman on best assessment practices in engineering education is also included.

Introduction

The new criteria feature program educational objectives, the measurement of program outcomes, and a system of ongoing evaluation to improve the program’s effectiveness [1]. An assessment process with documented results is required for this feedback strategy. Programs must demonstrate that their graduates have abilities in several specific areas, including an ability to function on multi-disciplinary teams, an ability to engage in life-long learning, and a knowledge of contemporary issues.

Engineering Criteria 2000 (EC 2000) requests a paradigm shift that raises the standards to meet the engineering needs of the 21st century, according to Phillips [2]. In an ABET Vision for Change, Peterson [3] noted that future graduates will require an awareness of economic, social, and environmental concerns, an understanding of customer focus, and continuous quality improvement concepts.

A working symposium was held April 11 and 12, 1997 at Rose-Hulman on best assessment practices in engineering education. Of the approximately 50 sessions and workshops during the two-day period, I participated in eight sessions and two workshops, including sessions on multi-disciplinary teams [4], use of the FE exam for outcomes assessment [5], assessment of the senior design experience [6], web page portfolios [7], outcomes assessment for curricular change [8], and the development and implementation of a continuous-improvement assessment plan [9]. My two workshops were an assessment plan development guide using an established set of steps [10] and the design of survey questionnaires to identify the critical education and support processes most in need of improvement [11].

This paper points out what is new in EC 2000, either as requirements or as non-required but suggested other evidence that may be used, and describes how engineering faculty might plan to address these aspects of accreditation. The new required and non-required items are grouped into three categories and a timetable suggested for considering them.

Non-Required Other Evidence

EC2000 contains two kinds of items: (1) Requirements which must be satisfied and (2) Other evidence mentioned that may be used but are not required. The Engineering Accrediting Commission (EAC) continually stresses that they are not mandating how a program assess its outcomes, only that it does assess and document the results.

An example of requirements is in Criteria 3 on programs outcomes and assessment where “Engineering programs must demonstrate that their graduates have”...the abilities, understanding, education, recognition, and/or knowledge listed there in Items(a) through (k).

An example of non-required other evidence also appears in Criteria 3 as: “Evidence that may be used includes, but is not limited to, the following: student portfolios, including design projects; nationally-normed subject content examinations; alumni surveys that document professional accomplishments and career development activities; employer surveys, and placement data of graduates.”

Models for Comparison

The basic level criteria consist of eight criteria on students, program educational objectives, program outcomes and assessment, professional component,
faculty, facilities, institutional support and financial resources, and program criteria. To interpret the extent of the efforts required to meet EC2000, two models were considered: (1) a coarse-grained model with only eight items corresponding to the eight criteria and (2) a fine-grained model which identified 32 separate items under the basic level Criteria.

For the coarse-grained model, only the criteria on program educational objectives, program outcomes and assessment, and professional component contained, in part, new requirements and/or new suggested items. The other five criteria are contained within the present Topics criteria. Table 1 shows all eight items of the course grained model for completeness. Not all items contain only requirements, i.e., one or more items also contain non-required other evidence which may be used. This model will not be considered further here.

For the fine-grained model, four items were listed under program educational objectives, 18 under program outcomes and assessment, five under professional component, and one each under the five other criteria. Of these 32 items, there are 16 items which do not appear within the present Topics Criteria. These 16 items are grouped into three categories and a suggested timetable given for their consideration in Table 2.

Table 1. Items in the Course-Grained Model
1. Students
2. Program educational objectives
3. Program outcomes and assessment
4. Professional component
5. Faculty
6. Facilities
7. Institutional support and financial resources
8. Program criteria

Table 2. Items in the Fine-Grained Model of EC2000 which do not appear in the Topics Criteria

Category I: Immediate action needed
1. Detailed published educational objectives
2. An improvement process based on constituency needs
3. A curriculum and process to achieve these objectives
4. A system of on-going evaluation to improve the program’s effectiveness
5. An assessment process that demonstrates the important outcomes are being measured

Category II: Items to be addressed within the next year
6. Multi-disciplinary team experiences
7. Broad education necessary to understand the impact of engineering solutions in a global/societal context
8. A recognition of the need for and an ability to engage in life-long learning
9. A knowledge of contemporary issues
10. An enhancement of the major design experience
11. A consideration of using student portfolios, including design projects (not required but may be useful...)

Category III: Items to be addressed within two years
12. A general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives.
13. Nationally-normed subject content examination as non-required other evidence
14. Alumni surveys as non-required other evidence
15. Employer surveys as non-required other evidence
16. Placement data of graduates as non-required other evidence

Immediate Action Needed

The most pressing five items in the fine-grained model pertain to the program educational objectives criterion and the measurements related to these objectives. It is urgent that action on these Category I items be initiated immediately, preferably three or more years in advance of the ABET visit. Such early action is necessary for the publication of the educational objectives in undergraduate catalogs, in advisement guides, and in other materials being distributed about the program.

Program objectives for the present accreditation criteria are reported in Volume II in Section XI, Item B. An assessment of those objectives, requested in XI.C, asks for a statement describing how success in meeting program objectives is measured and the extent to which those measurements demonstrate the desired results. Also requested is an explanation on how the program objectives relate to the institutional goals and why they are suitable for the context of the program. EC2000 goes well beyond the present criteria by requiring documented results and evidence that these results are being applied for the further development and improvement of the program. In effect, a closed-loop control strategy based on measured outputs is required to improve the program.

Sando [10] described how to create goals, objectives, performance criteria, practices, methods for assessment, feedback channels, and evaluation. The development of performance criteria is based on measurable program outcomes. EC2000 states that “the assessment process must demonstrate that the outcomes important to the mission of the institution and the objectives of the program are being measured.”

Johnson [11] presented a process of collecting performance data, transforming it into performance indicators, comparing these with strategic goals, calculating differences, and determining improvement actions. A survey could be designed to identify attributes important to both faculty and students and
how well students feel these needs are being met. He suggested plotting relative importance (faculty) versus relative satisfaction (student). Attributes with above average importance and below-average satisfaction are those which deserve special attention for improvement. This represents one example of a continuous-improvement algorithm for engineering programs.

**Category II Items**

Selected new or expanded requirements which should be the next highest in order of priority in the fine-grained model are, student multi-disciplinary team experiences, the broad education necessary to understand the impact of engineering solutions in a global/societal context, a recognition of the need for and an ability to engage in life-long learning, a knowledge of contemporary issues, an enhancement of the major design experience and planning for student portfolios (not required). If the ABET visit is scheduled for three or more years hence, this category of items should be addressed within the next six months to one year, possibly in concert with a general curriculum revision.

Student portfolios must include design projects, but it is suggested that they also contain a resume showing summer jobs or internships, undergraduate research experiences, and participation in extracurricular activities and descriptions of plans after graduation and how this program has contributed. Other student-generated materials on the impact of engineering solutions in a global/societal context, appreciation of the need for life-long learning, and/or a knowledge of contemporary issues are recommended.

Multi-disciplinary team activities can best be scheduled as part of the major design experience but may be present as well earlier in the curriculum. Broader engineering projects including students from several engineering programs need to be planned for the major design experience course. Students from several engineering programs may work alongside each other on different aspects of an overall design project. While students emphasize the knowledge gained from their own programs, they benefit as well by participating in the multi-disciplinary team experience. Projects may also involve non-engineering students from programs in business, geophysics, mathematics, physics, chemistry, and biology, among others.

The major design experience must include most of the following considerations: economic, environmental, sustainability, manufacturability, ethical, health and safety, social, and political. This list expands the present requirements: Criteria 2000 specifies that these ideas must be interwoven into the curriculum, including the major design experience. Life-long learning can also be promoted by assigning library/computer searches of the technical literature, by encouraging membership and active participation in technical and professional societies, and by encouraging participation in short courses.

**Other Items**

Other new items include subject content examinations, alumni and employer surveys, placement data, and a general education component. This remaining category of items should be addressed within one to two years but well before the ABET visit. Evidence that the important outcomes are being measured for program assessment include the student portfolios described earlier, nationally-normed subject content examinations, alumni surveys that document professional accomplishments and career development activities, employer surveys, and placement data of graduates. The professional component must include one year of college level mathematics and basic sciences, one and one-half years of engineering topics, and a general education component that complements the technical content of the curriculum.

The requirement that students must take subject content examinations which are nationally-normed poses a problem. One possibility is to require the Fundamentals of Engineering (FE) exam [4]. Another is to report Graduate Record Exam (GRE) results of program graduates. Some faculty have expressed apprehension about requiring the FE exam because it may unduly tend to influence areas of emphasis within the curriculum.

Alumni and employer surveys are required to assess the career development of graduates and to verify that programs are producing graduates with the desired abilities. Industrial advisory boards can provide advice on employer surveys with regard to the kinds of questions to be asked and an acceptable frequency of these surveys. Both questions pertaining to specific programs and questions common to all engineering programs can be combined on the survey form. Placement data of graduates can be assembled annually by engineering career service centers within the universities. Obviously, those companies which continue to hire the graduates of a program become part of the employer survey.

Finally, the professional component criterion specifies a general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives.

**Comparisons with Topics Criteria**

EC2000 focuses on establishing an assessment process of program outcomes to provide continual improvements to engineering education programs.
Program objectives are required under the Topics Criteria, but EC2000 has stronger requirements both on documenting outcomes and on the use of those outcomes to drive the educational system toward further improvements.

Several specifics from the present criteria remain under EC2000: one year of math and basic science, one and one-half years of engineering topics, and a general education component are required. Details which are in the Topics Criteria but do not appear in EC2000 are the depth requirement and specified half-year of coursework in humanities and social science and the breadth requirement for at least one engineering course outside the major disciplinary area. However, EC2000 does have requirements that encompass some of these ideas from the Topics Criteria, such as the general education component just mentioned and the breadth requirement necessary to understand the impact of engineering solutions in a global/societal context. Being able to function on multi-disciplinary teams also promotes a breadth experience for students.

Conclusions

The main contribution of this paper has been to recommend that preparation for an ABET visit under EC 2000 be viewed sequentially as a common sense approach. A fine-grained model of 32 items was proposed with the 16 items different from the present Topics Criteria to be addressed in groups of five or six over the next one to two years. Specifically, the program objectives and related measurements are most pressing and should be addressed first. Next, selected new or expanded requirements on multi-disciplinary teams, global/societal considerations, life-long learning, contemporary issues, and the major design experience and whether to use student portfolios (non-required) should be addressed, preferably within the next six months to one year but no later than two years before the ABET visit. Finally, a third category of items include not only the general education component (required) but also the following four non-required other items which may used as evidence: nationally-normed subject content examinations, alumni surveys, employer surveys, and placement data of graduates. Items in Category III should be considered within the next one to two years.

Preparing for an ABET visit under EC2000 can appear overwhelming at first, but it can be accomplished most easily with a realistic timetable. Once the assessment process prescribed by EC2000 is in place for a program, the steady-state system of ongoing evaluation should require far less effort to maintain and improve.

References

About the Author

Jim Rowland has served as an ABET program evaluator during 14 visits since 1985 and has helped during this period to prepare accreditation materials for electrical engineering and computer engineering programs at the University of Kansas. It is important to note that the observations and recommendations in this paper are not to be regarded as official ABET information on EC 2000. Instead, the ideas here are based on experiences in preparing for previous ABET visits, on experiences as a program evaluator under present and past criteria, and on a continuing study of EC2000 [1].