An Inside View on ABET Engineering Accreditor Training

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Abstract

This paper presents a view of ABET engineering accreditor training from the perspective of an engineering professor from small comprehensive college who is helping prepare a Computer Engineering program for accreditation. The foundation of the paper is based on the author's observations while participating in an ABET accreditor training course at an ASEE conference where 95% of the participants were ABET accreditors. A comparison of ABET evaluation standards as they have changed from the prescribed requirements of the past to the more self-determined measurements of the newer ABET standards yields much insight into the accreditation process. A plan for organizing required documentation, resources, and people is included. The degree to which an engineering program has matured to an "ABET-ready" status must be established to spare a department and college from the financial and emotional costs of planning, funding, and facilitating an ABET accreditation review before a program is ready. Such specifics as having clear objectives, verifiable outcomes, and a fully developed comprehensive curriculum are also discussed. Principles such as self-evaluation, continuous improvement, and life-long learning are critical.

I. Introduction

ABET is: *"The Accreditation Board for Engineering and Technology; a federation of 31 professional engineering and technical societies. Since 1932, ABET has provided quality assurance of education through accreditation. ABET accredits more than 2500 engineering, engineering technology, computing and applied science programs at over 550 colleges and universities nationally. ABET is recognized by the Council on Higher Education Accreditation."* [1]

ABET has traditionally accredited two types of programs: Engineering and Engineering Technology, and has more recently added accreditation of Computer Science programs. ABET has different criteria and a separate commission for each (see Fig. 1).

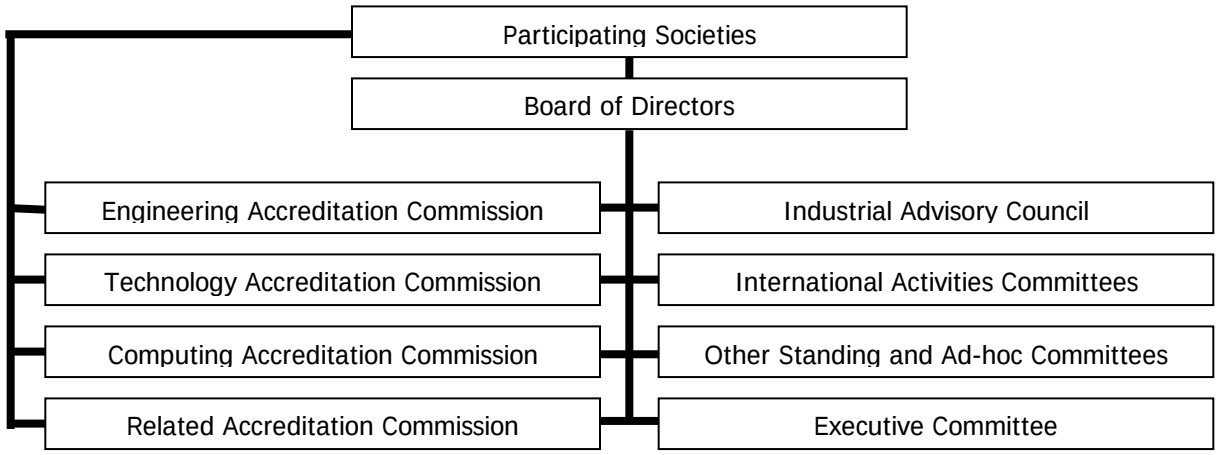

Figure 1. Structure of the Accreditation Board for Engineering and Technology (ABET). [1]

This paper presents the perspective of an Elizabethtown College professor who is helping prepare a Computer Engineering program for accreditation. The program is jointly administered by the departments of Computer Science and Physics & Engineering, and is the first at the college to be considered for ABET accreditation. Although much of the discussion is based on the author's observations while participating in an ABET accreditor training course, the author also has prior ABET experience helping accredit engineering technology programs at Purdue University.

II. "ABET 2000", The New Accreditation Standards

Any examination of the evolution of ABET accreditation standards over recent years will always address the changes made in "ABET 2000" over "ABET 98"; most notably, a change from somewhat "prescribed" requirements to more "self-determined" measurements. For ABET 2000, a program must:

1) Set goals.
2) Have an internal assessment process involving all significant contributors to the program.
3) Document assessment results (based on "Outcomes").
4) Demonstrate that results are used to continuously improve the program.

For "Continuous Improvement", departments must not only emphasize a commitment to continuous improvement, but must establish "traceable" achievements (based on "Outcomes") that demonstrate a continuous verifiable commitment of the program and its participants to improvement. This differs from ABET 98, which addressed maintaining quality by simply requiring re-accreditation every six years. [2]

ABET expects a program to be defined by:

- **Curriculum**
- **Objectives**
- **Outcomes**

Different "**Curriculum**" requirements are defined by ABET for each type of program. For example, the expectations for a Computer Engineering program are:

"The structure of the curriculum must provide both breadth and depth across a range of engineering topics implied by the topic. The program must demonstrate that graduates have: knowledge of probability and statistics, including applications appropriate to the program names and objectives; and knowledge of mathematics through differential equations and integral calculus, 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. Computer Engineering programs must also demonstrate that graduates have a knowledge of discrete mathematics." [3]

Some specifics on curricula are:

- Don't allow prerequisites to be skipped. [2]
- It's ok to require courses that aren't typically required for a program – just explain why. [2]
- Make sure the curriculum has a major design component that has a "culminating experience" based on knowledge and skills acquired in earlier coursework. [3]
- The program's "Professional Component" must include at least one year of college math and science, one and one-half years of engineering sciences and design, and general education that compliments the program's and institution's objectives. [3]

"**Objectives"** should be clearly evident in the program's vision and mission statements and should not be defined as: "our objective is to produce outcomes." It's ok to have split objectives such as: "equal emphasis is put on preparing students for graduate school or professional employment." Also objectives that uniquely define a program as something different from the norm should be clearly stated (e.g., "the program is strengthened by being taught in a multi-disciplinary setting"). Giving students the tools for life-long learning is always a good objective.[2]

"**Outcomes**" are arguably the most important part of the ABET 2000 definition of a program. All graduates must meet all ABET 2000 outcomes. Typically the faculty assesses outcomes for most of a program's *major* course requirements, and surveying graduates is not considered a good way to assess outcomes. Outcomes are specified in the "*Criteria for Accrediting Engineering Programs*" as "Criterion 3": [3]

(a) An ability to apply knowledge of mathematics, science and engineering.
(b) An ability to design and construct experiments, as well as to analyze and interpret data.
(c) An ability to design a system, component, or process to meet desired needs.
(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) A broad education necessary to understand the impact of engineering solutions in a global and societal context.
(i) A recognition of the need for, and an ability to engage in life-long learning.
(j) A knowledge of contemporary issues.
(k) An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

Each program should also specify whether or not these criteria are equally weighted and why, and all criteria must be met by some part of the program. Some important principles that can be sometimes overlooked in engineering programs are emphasis on communication skills and instilling an ethos of life-long learning with appreciation of studies in the humanities. Participation in field trips and volunteer work can also be considered. Table 1 shows a draft of an ABET outcomes assessment for the Elizabethtown College Computer Engineering Program; the courses with assigned scores are those taught by the author.

III. Are you ready for ABET?

The degree to which any program has matured to an "ABET-ready" status must be established to spare a department and college from the financial and emotional costs of planning, funding, and facilitating an ABET accreditation review before a program is ready. A few questions that must be answered are:

1) Are there enough graduates every year from a program to consider the program mature enough for accreditation? "Eight per year is small."[2] Transcripts of recent graduates must indicate the name of the program being considered for accreditation and accreditors will want to review a sampling of 6 to 10 transcripts.[2]

2) Is the program sufficiently staffed? The criteria ABET uses for this is the "FTE" (Full Time Equivalent). An FTE may be a composite of contributions from several faculty members. For example, a Computer Science professor and a Physics professor, each dedicating half of their teaching load "contact-hours" to a program, could be considered as one FTE. ABET will judge if there are enough faculty for student-faculty interaction, advising, service activities, professional development, and interaction with industry. Faculty qualifications will also be assessed.[3]

Table 1. Draft of ABET outcomes assessment for the Elizabethtown College Computer Engineering Program

Course	Credit/ Contact	Required	ABET *Outcomes* Assessment Scored from 0 to 5*											Comments
			a	b	c	d	e	f	g	h	i	j	k	
EGR 100 • Intro to Engineering I	2/4	YES												
EGR 110 • Intro to Engineering II	2/4	YES												
CS 121 • Computer Science I (C+ programming I)	4/4	YES												
CS 122 • Computer Science II (C+ programming II)	4/4	YES												
EGR 210 • Circuit Analysis (analog circuits I)	4/6	YES												
EGR 220 • Electronics (analog circuits II)	4/6	YES												
CS 221 • Data Structures	4/4	YES												
CS/EGR 230 • Microcomputer Architecture	4/4	YES	4	2	5	2	5	3	4	3	5	5	5	board-level design
Phys 302 • Electromagnetism	3/3	YES												
EGR 310 • Signals and Systems	3/3	YES												
CS/EGR 332 • Computer Org. and Digital Design I	4/4	YES	5	4	5	2	5	3	3	1	4	4	5	includes intro to assembly
CS/EGR 333 • Digital Design II and Interfacing	4/6	YES	5	5	5	4	5	4	4	2	4	4	5	includes 80251 assembly
CS/EGR 342 • Computer Networking	4/4	NO												common elective
CS 375 • Artificial Intelligence	4/4	NO	5	5	5	3	5	5	5	5	5	5	5	common elective
EGR 410 • Control Systems	3/3	YES												
CS/EGR 421 • Compiler Design	4/4	NO												common elective
CS/EGR 422 • Operating Systems	4/4	YES												
CS/EGR 433 • Advanced Computer Engineering	4/6	YES	5	5	5	4	5	4	4	2	4	5	5	
EGR 491 • Senior Project	4/x	YES	5	5	5	1	5	4	5	3	5	5	5	

* Scores only shown for courses taught by author

3) Will it be clear to ABET exactly how the program is administered so they can send the appropriate accreditors? For example, a Computer Engineering program jointly administered by both Computer Science and Physics & Engineering departments could require a special combination of accreditors. Also, who establishes the content of programs? Is it Department Chairs, Program Coordinators, or both?

4) Is there enough equipment to support the program? If a lack of equipment is a concern, make sure to include acquiring new equipment as part of the program's "Continuous Improvement Plan"; and be prepared to demonstrate how added equipment has improved the program in the past.[2]

5) Have learning "Outcomes" been achieved regardless of any lack of resources? (i.e., money, equipment, faculty, etc.)[2]

6) Is the college or university that offers the program fully accredited? [2]

7) Has the college or university pledged enough resources (money and people) to the accreditation process? Self-study and preparation of accreditation documents takes much time and effort.

8) Has a "Self-Study" of the program been completed? ABET publishes a *Self-Study Guide*[4] which provides much insight into the readiness of a program for accreditation.

9) Is anyone involved with the program aware of exactly what the accreditors will be doing? ABET consultants or possibly ABET can provide the following literature:

   A. Engineering Criteria 2000, Manual of Evaluation Process.[5]
   B. Program Evaluator Report, Engineering Criteria 2000 Instructions.[6]
   C. Engineering Criteria 2000 Check sheet.[7]

10) Is the faculty ready to document their course content? (i.e., syllabi, sample grading, etc.)

IV. Conclusions

The original contribution of this paper to engineering education is in the author's discussion of his engineering accreditation experiences. Hopefully these observations and insights will help those preparing a program for ABET accreditation -- a process requiring considerable commitment and effort by both departments and institutions. In a nutshell, the documentation for a program should begin with: "We have x faculty with y skills to provide our program; here are the details." And in general a program should: (1) Say what it will do, (2) Advertise what it will do, (3) Collect data to support what it does, and (4) Use data to prove objectives, outcomes, and continuous improvement are achieved.[2] Detailed information on how to prepare for ABET accreditation is available from ABET.[1,3,4,5,6,7]

Bibliography

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