

Engineering Program Accreditation: ABET Engineering Criteria 2000

Kurt C.K. Lo

*Civil and Environmental Engineering Department, California Polytechnic State University, California, USA
Tel: 1-805-756-1442 Fax: 1-805-756-6330, klo@calpoly.edu*

Abstract: In order to meet the challenge of global competition in the twenty-first century, the American industry has long called for new qualities in engineering education so that the future engineers will be able to deal with tomorrow's rapidly evolving working environment. To achieve this goal, the Accreditation Board for Engineering and Technology (ABET), after almost a decade of endeavor, approved the Engineering Criteria 2000 (EC 2000) in November 1996 for accrediting engineering programs in the United States and made the new criteria effective beginning in the fall of 2001. The ABET EC 2000 emphasizes a number of new requirements such as multidisciplinary teamwork and global and environmental awareness. The development of the new criteria is also a response to the shifting of national mood toward higher education from providing more services to ensuring the effectiveness of existing education. Under the new accreditation criteria, each engineering program is required to develop its own assessment process to evaluate the achievement of program objectives and the effectiveness of student learning. This student outcomes assessment becomes the core of the new criteria. The actual outcomes assessment process involves not only the currently enrolled students but also the alumni and industry employers. This study introduces the new ABET EC 2000 and provides an instructor's perspective of the new criteria.

Keywords: engineering, accreditation, EC2000, ICEE2000.

1. Introduction - the Changing World

With the arrival of the new millennium in its full glory the world is experiencing an epochal change in itself. This change encompasses a full spectrum of technological, economic, social, cultural, and environmental changes. Yet, it is rapid, drastic and ubiquitous. Subsequently, this change places a profound impact on industry and causes a significant change in the way it produces - the engineering practice. The change of engineering is basically a response of the industry for its own survival to a fierce market competition and the explosion of information technology. To this end, the industry raises its demand for a new generation of engineers who are equipped with new skills and minds and able to deal with a changing new world. Engineering education stands at the forefront to take the challenge and strives to meet the demand. A new engineering accreditation system adaptable to the demand of this changing world is then ushered into the 21st century.

2. Conception and Realization of Engineering Education Reform

It is since the early years of this century that engineering leaders in academe and industry have periodically conducted evaluations of the engineering education in the United States. In witness of a significant ongoing change in engineering practice as the result of a rapidly changing world, in 1991, the Board on Engineering Education (BEE) of the National Research Council, a principal operating agency of the National Academy of Sciences and the National Academy of Engineering, both of which are responsible to advise the federal government on scientific and technical issues, was charged with a task to achieve an engineering education system that reflects the needs and realities of the United State and the world in the 21st century. The new engineering education system must foster the following characteristics of the industry as resulted from the changing world:

- A restructure of technology and management to meet global market competition;
- The rapid advancement of information technology; and
- An awareness of social and environmental concerns in an engineering context.

In 1993, the BEE organized four regional symposia at which the viewpoints of a wide range of engineering faculty, administrators, policy makers in industry and government, and representatives of professional societies and student

associations on engineering education reform were raised and well discussed. A later report based on the consensus of the symposia participants was published in 1995. There are two key issues emphasized in the report. First, the culture of engineering education must adapt to a changing environment, national and global, within which engineering education is conducted. Secondly, engineering education institutions must develop a self-evaluation system by which educational objectives that are consistent with their institutional mission are determined and necessary improvement to achieve those objectives can be made.

In response to the call for new qualities in engineering education, the Accreditation Board for Engineering and Technology (ABET) in 1992 formed the Accreditation Process Review Committee (APRC), which consisted of leaders from industry, engineering schools, and professional societies and was charged to outline a quality-oriented flexible accreditation system. The APRC concluded in its study that a collective effort and consensus among all engineering constituencies is vital to a successful solution of this issue. Therefore, in 1994, ABET sponsored three workshops with the supports from the National Science Foundation and industry to further discuss the three key issues identified by the APRC for a new engineering accreditation system:

- i. The excessive length and specificity of the accreditation criteria;
- ii. The difficulty in attracting mid-career professionals from industry and research universities to participate as leaders in the accreditation process; and
- iii. The complexity and length of the accreditation process.

The recommendations by the workshop participants later became the blueprint of the ABET Engineering Criteria 2000 (EC 2000).

3. Chronology of ABET Engineering Criteria 2000

In 1995, ABET and its Engineering Accreditation Commission developed, modified, and approved the general criteria of EC 2000 for external review and comments. After a one-year comment period, on November 2, 1996, ABET finally approved the EC 2000's general criteria, a bold new standard for accrediting engineering programs in the United States. The individual program criteria were developed and reviewed by each professional society during 1996 and 1997 and were approved by ABET in 1997.

The new criteria were given a two-year period for pilot studies in 1996 and 1997, and five pilot visits were completed. Then, a three-year phase-in visitation started in the fall of 1998. First round of phase-in visits were completed during the 1998-99 academic year; 12 institutions and 54 programs were evaluated. Another 45 institutions and 239 programs are to be evaluated during the 1999-2000 academic year as the second round of phase-in visits. Beginning in the fall of 2001, the new ABET EC 2000 will become effective in full for the accreditation of engineering programs in the United States.

4. ABET Engineering Criteria 2000

The ABET Engineering Criteria 2000 consists of the following eight criteria:

- Criterion 1. Students;
- Criterion 2. Program Educational Objectives;
- Criterion 3. Program Outcomes and Assessment;
- Criterion 4. Professional Component;
- Criterion 5. Faculty;
- Criterion 6. Facilities;
- Criterion 7. Institutional Support and Financial Resources; and
- Criterion 8. Program Criteria.

Unlike the old bean-counting criteria which emphasized on detailed course descriptions, unit requirements, mandated number of faculty members and so on, the new criteria which evaluates an engineering program from a qualitative point of view provides a program with more flexibility to develop its own uniqueness in engineering education and meet its constituencies' demands.

The core of EC 2000 is focused on Criterion 2 and Criterion 3 as follows:

Criterion 2: Program Educational Objectives

Each engineering program for which an institution seeks accreditation

or re-accreditation must have in place:

- a) detailed, published educational objectives that are consistent with the mission of the institution and these criteria;
- b) a process based on the needs of the program's various constituencies in which the objectives are determined and periodically evaluated;
- c) a curriculum and process that ensures the achievement of these objectives; and
- d) a system of ongoing evaluation that demonstrates achievement of these objectives and uses the results to improve the effectiveness of the program.

Criterion 3: Program Outcomes and Assessment

Each program must demonstrate that their graduates 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;
- d) an ability to function on multidisciplinary team;
- 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/societal context;
- i) a recognition of the need for and an ability to engage in lifelong learning;
- j) a knowledge of contemporary issues; and,
- k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The program outcomes describe the knowledge and abilities that students are expected to know and to perform by the time of graduation. Each outcome should address one area of knowledge or ability and should be supportive of one or more educational objectives.

Once a program has established its program objectives and expected student outcomes, it can strive for improvement and further program development through a well-designed outcomes assessment process.

5. Outcomes Assessment

The development of EC 2000 also indicates the shifting of national mood toward higher education from providing more services and resources to ensuring an effective utilization of existing educational resources. Under the new accreditation criteria, an engineering program seeking accreditation must develop an assessment process to evaluate the achievement of its educational objectives and expected student outcomes. The intention of this new outcomes-assessment based evaluation system is to assist each engineering program to be adaptable to the changing nature of the engineering world in the future.

The actual outcomes assessment process is a looped self-improving process. Based on their needs, program constituencies including the faculty, students, alumni, and industry employers first form the program objectives and expected student outcomes. From the results of student outcomes assessment the objectives are evaluated for their achievement levels and improvement. This process reiterates by taking the feedback from various constituencies regarding the improvement and assessment results for a second round program evaluation.

6. Conclusions - Implementation of ABET EC 2000

The ABET's EC 2000 is a response to the fundamental changes in engineering practice and the challenges to engineering education in the 21st century. The faculty, students, and industry each as an integral part of an

engineering program should take an active role in this revolutionary engineering education reform. There are some additional thoughts for the implementation of EC 2000:

1. A necessary action

A major change of engineering education contents and process is indeed necessary in order to reflect the engineering nature in the future and provide the society with quality products for future needs - a new generation of engineers.

2. A worthwhile effort

Although implementing the new criteria requires a continuous collective endeavor of the faculty, industry, and students, it is well worth the effort which in turn will benefit the engineering profession and the entire society as new engineers will be the driven force of many transformations and betterment of next century. Moreover, the preparation for EC 2000 provides all stakeholders in engineering accreditation an opportunity to work together and thoroughly examine the entire engineering education system.

3. An enthusiastic involvement

The success of a new system never works out by itself. An active attitude of all members involved determines the fate of a new system. The mission, educational objectives and expected student outcomes of a program must be developed by a full participation of all program constituencies. The outcomes assessment must also be conducted by an enthusiastic involvement of the various sectors in the process. Only if the students and alumni, industry employers and advisors, and faculty members conscientiously recognize the necessity and importance of this engineering education reform, EC 2000 could receive serious consideration and be implemented successfully in its full intent.

Acknowledgement

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