Planning for Accreditation under ABET Engineering Criteria 2000

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Abstract:

Academic quality is a way of describing how well the learning opportunities available to students help them to achieve their award. It is about making sure that appropriate and effective teaching, support, assessment and learning opportunities are provided for them. Quality assurance refers to a range of review procedures designed to safeguard academic standards and promote learning opportunities for students of acceptable quality (Academic quality handbook, 2010). For employers, graduate schools, certifications, and registration boards to

graduate from an accredited program signifies an adequate preparation for the entry into the professional field. Accreditation is the voluntary process of being a certified by meeting the minimum requirements designated by an accrediting agency. It is simply an assurance that a program or an institution meets the established quality standards.

Faculty of Engineering at Tripoli university is planning to ably for accreditation under Accreditation Board for Engineering and Technology (ABET), this paper presents a simple plan to allow one or all our engineering programs to begin preparing for ABET Criteria 2000. The plan based on the policy, procedure and the criteria under ABET 2011 – 2012 cycle.

The ABET is a non-governmental, peer-review process that insures the quality of the postsecondary education students receive. The plan is build on the selection of program objectives for an engineering program and moves through selection of outcomes, outcome indicators and criteria, and the development of systematic processes for program assessment and improvement. This paper describes reference guides that may facilitate use of policy and procedure of the ABET Engineering Criteria 2000.

Introduction :

The Faculty of Engineering at Tripoli University is planning to apply for accreditation, they choose to ably under The Accreditation Board for Engineering and Technology (ABET). ABET was established in June 1932 under the name Engineers' Council for Professional Development (ECPD) as the only agency responsible for accreditation of

educational programs leading to degrees in engineering in the United Statees of America. In 1980, ECPD was renamed the Accreditation Board for Engineering and Technology (ABET) to be more representative to its emphasis on accreditation. The ABET is a non-governmental, peer-review process that assures the quality of the postsecondary education students receive. Educational institutions or programs volunteer to underg this review periodically to determine if certain criteria are being met (1). ABET carries out its accreditation mission through its commissions and the Accreditation Council. The commissions include the: Applied Science Accreditation Commission (ASAC), Computing Accreditation Commission (CAC), Engineering Accreditation Commission (EAC), and Technology Accreditation Commission (TAC) [(3).]

ABET currently accredits 3100 engineering programs at more than 600 college and university worldwide.

Programs will be considered for accreditation if they are offered by an institution of higher education in one of the following categories [(3)]:

1- Institutions currently accredited by a regional or national institutional accrediting agency or formally approved by a State authority recognized by the U.S. Department of Education.
2- Institutions holding appropriate approval by a State authority to offer only engineering, engineering technology, computing, or applied science programs or a combination thereof, and not offering programs in any other field or discipline; or other

institutions offering programs whose accreditation would further the objectives of ABET.

3- Institutions that comply with paragraph (2) and operate a branch campus under the direct supervision and control of the home campus, and conduct a program that is substantially equivalent to one located on the home campus. The Faculty of Engineering at Tripoli University complies with this category as it is approved by the Libyan authority to offer engineering and computing program. The Faculty of engineering also operates a branch campus (Jafara branch) under the direct supervision and control of the home campus.

Accreditation :

Academic quality is a way of describing how well the learning opportunities available to students help them to achieve their award. It is about making sure that appropriate and effective teaching, support, assessment and learning opportunities are provided for them. Quality assurance refers to a range of review procedures designed to safeguard academic standards and promote learning opportunities for students of acceptable quality [(6)].

Quality assurance in higher education is by no means a national concern. There is an increasing interest all over the world in quality and standards, reflecting both the rapid growth of higher education and its cost to the public and the private purse. Accordingly, if Libya is to achieve its aspiration to be one of the dynamic and knowledge-based

economy in the world, then higher education will need to demonstrate that it takes the quality of its programs and awards seriously and is willing to put into place the means of assuring and demonstrating that quality.

Quality assurance is a generic term in higher education which lends itself to many interpretations: It is not possible to use one definition to cover all circumstances.

Similarly, the word standard is employed in a variety of ways across the world, ranging from statements of narrowly defined regulatory requirements to more generalized descriptions of good practice. The words also have very different meanings in the local contexts of national higher education systems[(9)].

Accreditation is a process in which certification of competency, authority, or credibility is presented. One example of accreditation is the accreditation of testing laboratories and certification specialists that are permitted to issue official certificates of compliance with established standards, such as physical, chemical, forensic, quality, and security standards [(12)].

Educational accreditation is a type of quality assurance process under which services and operations of educational institutions or programs are evaluated by an external body to determine if applicable standards are met. If standards are met, accredited status is granted by the agency [(11)].

In most countries in the world, the function of educational accreditation for higher education is conducted by a government organization, such as a ministry of education. In the United States, however, the quality assurance process is independent of government and performed by private membership associations.

The Accreditation Board for Engineering and Technology (ABET) is the agency responsible for accreditation of educational programs leading to degrees in engineering in United State of America.

PLAN FOR ACCREDITATION UNDER ABET ENGINEERING CRITERIA 2000:

The accreditation preparation plan is a series of steps that the members of a department within the engineering division of a university can follow to help them prepare for their first general accreditation review under ABET Engineering Criteria 2000. According to Leonard, et al. (1998), it is estimated that preparation for a first accreditation visit under the requirements of Criteria 2000 is likely to take three or four years. Moreover, maintaining accreditation under Criteria 2000 will require careful oversight of processes for evaluation, assessment, and improvement that must continue to operate through time.

Under ABET educational programs leading to degrees rather than institutions, departments, or degrees are accredited. This means that program title of an accredited program must be properly descriptive of the content of the program and be shown on the graduating student's transcript and in the institution's literature. The engineering programs must include the word "engineering" in the program title.

An institution cannot use the same program title to identify both an accredited program and a non-accredited program. Although the selection of program titles is the prerogative of the educational institution, the proliferation of program titles is discouraged because different titles for essentially the same programs are confusing or misleading to the public, including students, prospective students, and employers.

Programs to be considered for accreditation are college level programs that embrace engineering, technology, computing, or applied science. All programs include sound foundations in science and mathematics.

OBJECTIVE OF ACCREDITATION :

The ABET accreditation process is a voluntary system of accreditation that assures that graduates of an accredited program are prepared adequately to enter and continue the practice of engineering. It stimulates the improvement of engineering education and encourages new and innovative approaches to engineering education. Finally it identifies these programs to the public.

BASIC ACCREDITATION CRITERIA:

It is the responsibility of the institution seeking accreditation of an engineering program to demonstrate clearly that the program meets all the (8) eight criteria's.

Criteria 1 Student: deal with the quality and performance of the students and graduates. The institution must evaluate, advice, and monitor students to determine its success in meeting program objectives[(4)].

Criteria 2 Program Educational Objectives: It has to state that each engineering program must have in place detailed published educational objectives that are consistent with the mission of the institution and these criteria, a process based on the needs of the program's various constituencies in which the objectives are determined and periodically evaluated, a curriculum and process that ensures the achievement of these objectives and a system of ongoing evaluation that demonstrates achievement of these objectives and uses the results to improve the effectiveness of the program [(4)].

Criteria 3 Program Outcomes and Assessment: Engineering programs must demonstrate that their graduates have [(4)].

(1) An ability to apply knowledge of mathematics, science, and engineering.
(2) An ability to design and conduct experiments, as well as to analyze and interpret data.
(3) An ability to design a system, component, or process to meet desired needs.
(4) An ability to function on multi-disciplinary teams.
(5) An ability to identify, formulate, and solve engineering problems.
(6) An understanding of professional and ethical responsibility.
(7) An ability to communicate effectively.

(8) The broad education necessary to understand the impact of engineering solutions in a global and societal context.
(9) Recognition of the need for, and an ability to engage in life-long learning.
(10) Knowledge of contemporary issues.
(11) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Each program must have an assessment process with documented results which are applied to the further development and improvement of the program. The assessment process must demonstrate that the outcomes important to the mission of the institution and the objectives of the program [(4)].

Criteria 4 Professional Component: The Professional Component requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The engineering faculty must assure that the program curriculum devotes adequate attention and time to each component, consistent with the objectives of the program and institution. Students must be prepared for engineering practice through the curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier coursework and incorporating engineering standards and realistic constraints that include most of the following considerations: economic; environmental; sustainability; manufacturability; ethical; health and safety; social; and political. The professional component must include [(4)].

1- One year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline.
2- One and one-half years of engineering topics, to include engineering sciences and engineering design appropriate to the student's field of study.
3- A general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives [(4)].

Criteria 5 Faculty: The faculty is the heart of any educational program. The faculty must be of sufficient number; and must have the competencies to cover all of the curricular areas of the program. There must be sufficient faculty to accommodate adequate levels of student-faculty interaction, student advising and counseling, university service activities, professional development, and interactions with industrial and professional practitioners, as well as employers of students [(4)].

The faculty must have sufficient qualifications and must ensure the proper guidance of the program and its evaluation and development. The overall competence of the faculty may be judged by such factors as education, diversity of backgrounds, engineering experience, teaching experience, ability to communicate, enthusiasm for developing more effective programs, level of scholarship, participation in professional societies, and registration as Professional Engineers[(4)].

Criteria 6 Facilities: Classrooms, laboratories, and associated equipment must be adequate to accomplish the program objectives and

provide an atmosphere conducive to learning. Appropriate facilities must be available to foster faculty-student interaction and to create a climate that encourages professional development and professional activities. Programs must provide opportunities for students to learn the use of modern engineering tools. Computing and information infrastructures must be in place to support the scholarly activities of the students and faculty and the educational objectives of the institution [(4)].

Criteria 7 Institutional Support and Financial Resources: Institutional support, financial resources, and constructive leadership must be adequate to assure the quality and continuity of the engineering program. Resources must be sufficient to attract, retain, and provide for the continued professional development of a well-qualified faculty. Resources also must be sufficient to acquire, maintain, and operate facilities and equipment appropriate for the engineering program. In addition, support personnel and institutional services must be adequate to meet program needs [(4)].

Criteria 8 Program Criteria: Each program must satisfy applicable Program Criteria. Program Criteria provide the specificity needed for interpretation of the basic level criteria as applicable to a given discipline. Requirements stipulated in the Program Criteria are limited to the areas of curricular topics and faculty qualifications. If a program, by virtue of its title, becomes subject to two or more sets of Program Criteria, then that program must satisfy each set of Program Criteria; however, overlapping requirements need to be satisfied only once [(4)].

In 1996, the ABET Board of Directors adopted a new set of standards, called Engineering Criteria 2000 (EC2000). EC2000 shifted the basis for accreditation from inputs, such as what is taught, to outputs - what is learned. As a starting point it is important to identify what has remained unchanged and, how Criteria 2000 is different.

What remains unchanged?

1. Required professional component of 1 year of Mathematics / Basic Sciences and 1½ year of Engineering Topics.
2. Need for documented processes for admissions, transfer, and graduation of students.
3. Need for General Education component that complements the technical content of the program.
4. Emphasis on the number, qualifications, experience, and diversity of faculty.
5. Adequacy of classroom, laboratories, and computing facilities.
6. Strength of institutional support and leadership of program.
7. Adequacy of financial resources for facilities, maintenance of equipment, and development of faculty.

What is new in ABET 2000?

1. No required minimum Humanities/Social Sciences credits (although your institution may have minimum credit requirements in Humanities and/or Social Sciences).
2. Calculus, General Chemistry and Calculus-based Physics are not explicitly required.
3. Need to define outcomes corresponding to university/program objectives and measure them.
4. Use of assessment results to guide curriculum reform and to further improve the program.

Although ABET no longer requires programs to satisfy minimums in Humanities and Social Sciences, these courses will still remain in engineering curricula in order to comply with some of the outcomes expected in Criterion 3 and to provide general education span. Clearly, engineering disciplines will require a substantial amount of Calculus. However, programs are free to consider other mathematics coursework instead of Calculus if that supports their individual program objectives.

The accreditation preparation plan consists of six steps:
1 - Adopt Program Objectives.
2 - Adopt Program Outcomes, Outcome Indicators, and Criteria.
3- Adopt Ongoing Processes for Review, Assessment, and Continuous Improvement.
4 - Insure Adequacy of Professional Component.
5 - Document Previous Evaluation and Assessment Efforts.
6 - Conduct Cycles of Accreditation-Related Activities.

1 - Adopting Program Objectives :

It is the basis in the accreditation preparation process with respect to ABET Engineering Criteria 2000 which require that an engineering program have in place a set of educational objectives selected by each department members (staff – student – employees – stakeholders) for each program, which must be consistent with the mission of the institution, with the needs of the program's various population, and with Criteria 2000.

Program objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

The program educational objectives may include two types of objectives:

(1) Objectives for which there is a documented relationship to the institutional mission and/or to any special needs of the program's component.

(2) Educational objectives consistent with ABET 2000 basic level Criteria (student, Program Educational Objectives, Program Outcomes and Assessment, Professional Component, Faculty, Facilities, Institutional Support and Financial Resources, Program Criteria) [(4)].

These educational objectives must be published in such a manner that they are readily available for review by interested members of the general public.

To ensure compliance to Criterion 2, the following steps should be taken. First, determine if your program has formally approved and officially published educational objectives. If you do not have program objectives that are formally approved and published, a special faculty meeting should be arranged to discuss and agree on a set of objectives. Before finalizing the list of objectives, verify that the program's objectives are consistent with the University's objectives.

Once approved by the faculty, these objectives should be published (the appropriate place for disseminating objectives is through the University bulletin. Moreover, there must be a plan to periodically review these objectives and ensure that they serve the needs of the population you serve.

2 - Adopting Program Outcomes, Outcome Indicators, and Criteria :

A program outcome is a statement which describes one element of what the faculty of a program intend for graduates to know, to think, or to be able to do when these graduates have completed all of the program's requirements. Program outcomes has to satisfy three major aspects knowledge, skills (which consists of intellectual, practical and general skills) and values and attributes. The outcomes has to be SMART (which means Specific, Measurable, Attainable, Relevant and Timely) [(8)]. ABET Criteria 2000 require the measurement of outcomes that are important to the mission of the institution and the objectives of the program, taking in consideration the 11 outcomes listed in Criterion 3 which are :

Rogers (2005) said that "In program assessment planning, it is important to let common sense prevail. You can't do everything. Processes must be established that capitalize on what is already being done and complement the work of the faculty. Decisions will need to be made. Just as faculty cannot teach the universe of all concepts and skills related to a single course, programs cannot assess everything that they believe students should know or be able to do. As decisions are made and as assessment and evaluation process are developed, think systematically

and for the long term. Identify where you want to be at some time in the future and work backwards" [(10)].

An outcome indicator is an assessment method to measure student's achievement of course outcomes. It is a qualitative or quantitative device to determine the degree to which program outcomes have been achieved [(9)]. There are direct and indirect assessment methods to measure student's achievement of course outcomes. The direct measures based on student scores on assignments, quizzes, exams, and other instruments of direct assessment. The indirect assessment methods include student course evaluation surveys, alumni surveys, or job placement statistics.

A typical course assessment will contain a combination of direct and indirect methods. Once all of the data is collected, it can be normalized and averaged for each course outcome, and the final result will indicate whether the student achieved that course outcome.

A criterion is the value of an outcome indicator (such as a test score or questionnaire response) which the program faculty has agreed to use to represent accomplishment of one or more program objectives.

The plan employs a very simple two step group to choose program outcomes.

Step 1, all faculty members are asked to consider the program educational objectives, and the mission of the institution and needs of program constituents, and then identify candidate program outcomes. These candidate program outcomes are placed on a "long list."

Step 2, the curriculum or assessment committee (if the program has such a committee), or the faculty as a whole, selects a "short list" of program outcomes from the "long list" of candidate outcomes.

Outcome indicators may be quantitative or qualitative. Typical outcome indicators may also be classified by the aspect of learning that they focus on, such as attitude, behavioral change, and performance.

Similarly, the choices of criterion value for each outcome indicator should be made by a program's curriculum or assessment committee and formally adopted by the faculty.

3-Adopting Ongoing Processes for Review, Assessment, and Continuous Improvement :

There are two key processes that must be established in preparing for accreditation under Criteria 2000. The first process is a procedure to review and evaluate the appropriateness of the set of program educational objectives. The second process is a procedure to measure program outcomes, assess program performance, and use assessment results to further develop and improve the program.

Criterion 2 requires that a process be put into place to insure that institution mission, needs of program constituents, Criteria 2000 requirements, and findings from ongoing program assessment are periodically reviewed. Information gathered from the review of these four sources must be used through time to refine the program educational objectives [(3).]

Criterion 3 requires that a related process be put in place to measure program outcomes that reflect program educational objectives. Criterion 3 also requires that findings from outcomes assessment be used to enhance the program [(3).]

The program educational objectives process and the program outcomes and assessment process must generate information the faculty can use to make informed choices concerning the adequacy of program educational objectives and the performance of the program in relation to selected outcomes. The faculty can then use this information to develop and improve the program. Moreover, the processes must be designed to produce documentation like committee and faculty meeting minutes which provides a record of program performance in terms of outcome indicator values, assessment efforts, and continuous improvement accomplishments. Nevertheless, the processes are operated across time with periodically changing program leadership and faculty member involvement. Therefore, the processes should be self-documenting, and they must be relatively easy to administer and use.

When two or more engineering programs at the same institution are preparing for accreditation under Criteria 2000, there can be significant sharing of accreditation-related evaluation and assessment efforts among the programs. Two types of sharing are suggested: periodic discussion of accreditation-related topics among departments, and use of common processes and/or instruments to gather stakeholder information.

An ABET program coordinator should be appointed for each accredited engineering program. Periodically, these individuals should

meet to discuss the progress of their program faculties in preparing for accreditation review. Items for discussion should include evaluation and assessment procedures under development; program outcomes, outcome measures, and indicators under consideration; how to be successful in making program changes within the bounds of institutional bureaucracy, and interactions with stakeholders-especially representatives of key employers of program graduates. These discussions provide opportunities for internal benchmarking of best local practices. The information sharing can also reduce the number of false starts in process development and measure selection, and help the faculties to feel more confident in the appropriateness of their accreditation-related actions.

As they work together, the ABET program coordinators will likely find assessment-related activities that they can do in parallel with the assistance and financial support of the institution.

Examples include alumni surveys administered and summarized by the institution's Office of Assessment, telephone/fax surveys of key employers conducted by one or more students funded by the engineering unit administrator, and focus group sessions with key program constituents facilitated by the institution's specialist(s) in survey research.

4 - Insuring Adequacy of the Professional Component:

Criterion 4 requires that the engineering faculty assure that the program curriculum devotes adequate attention and time to each component, consistent with the objectives of the program and institution [(4)]. Program graduates must be prepared for engineering practice through

the curriculum finishing in a major design experience. There are three subject area components in this criterion: 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. No required minimum Humanities/Social Sciences credits (although the institution may have minimum credit requirements in Humanities and/or Social Sciences). Although ABET no longer requires programs to satisfy minimums in Humanities and Social Sciences, these courses will still remain in engineering curricula in order to comply with some of the outcomes expected in Criterion 3 & 4 and to provide general education breadth. To satisfy criteria 4 of the ABET implies that universities main purpose of education is not only to prepare students for successful careers but also to provide them with the knowledge and skills to develop a rational, well-rounded and successful personal identity. Besides, University should help students to gain an appreciative understanding of the natural and cultural environments in which they live and their roles in the society and community services. Humanities component should be divided into core compulsory courses and elective courses.

The compulsory courses may contain: English Language, Communication and Presentation Skills, Technical Writing, Fundamentals of Management Accounting, Economics, Computer programming, Humanities and Engineering, Risk Management and Environment.

Elective courses may contain Marketing, Service Management, Selections of Life-long Skills, Ethics and Legislation.

The faculty must document that they have developed and teach a curriculum which has a combination of course work in mathematics and science, engineering science and engineering design, as well as general education which is appropriate to the discipline, and consistent with program and institutional objectives. Typical documentation includes minutes of curriculum committee and faculty meetings where curriculum development and refinement have been discussed, course syllabi, course files, and might student portfolios.

5 - Document Previous Evaluation and Assessment Efforts :

Looking back through time, the faculty is almost certain to find that they discussed their perceptions of how their students were performing and /or considered inputs from one or more stakeholder groups, like alumni or employers of graduates, each time they decided to change their program curricula. However, the gathering and evaluating of performance data and stakeholder inputs were likely done on an ad hoc basis and almost certainly not carefully documented. Once the faculty have formally adopted the program educational objectives evaluation process and the program outcomes and assessment process, and as time is available to the faculty members charged with this obligation, recent faculty efforts in curriculum development and improvement should be recorded. This recording of historical effort is important for two reasons. First, the documentation effort will provide a trail of activity that the faculty can use as they consider the current status of their program, what changes they have made in the recent past, and what could be expected to be successful in terms of future curriculum changes. Second, the effort

will help to provide evidence to outside parties such as ABET program evaluators of the faculty's commitment to their curriculum and its ongoing enhancement.

6 - Conducting Ongoing Cycles of Accreditation-Related Activity :

By the time an engineering program has completed Stage 4 of the plan, all of the structural and process machinery required by ABET Criteria 2000 is in place. However, criterion 2 call for a system of ongoing evaluation that demonstrates achievement of these objectives and uses the results to improve the effectiveness of the program which ensure and demonstrates achievement of the educational objectives and uses the results to improve the effectiveness of the program. Criterion 3 requires 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 [(1)].

At least 3 of a list of five levels of status of implementation of Criteria 2000 assessment and process requirements needs to be implemented or the program should not request evaluation under Criteria 2000. The five levels are:

1- A systematic approach is in place, including assessment/ improvement cycles, with some evidence of integration.
2- All major elements of the criteria are included.
3- Constituencies are clearly involved.
4- Documentable outcomes in all areas are evident.

5- Positive trends in many major areas are becoming apparent, and some evidence shows that results are being influenced by the approach.

Conclusion:

According to Leonard, et al. (1998) it is estimated that preparation for a first accreditation visit under the requirements of Criteria 2000 is likely to take three or four years. Faculty of Engineering Tripoli University has a major infrastructure work which will satisfy most of Criteria 6 so they have to calculate the time necessary to finish the infrastructure and works simultaneously by committing to a detailed plan to meet the requirement of such a high standard accreditation board. This plan can be used as a starting point.

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