How the Proposed Changes in ABET-EAC-Criteria 3and 5 Effects the Assessment Process?

Amir Karimi
The University of Texas at San Antonio Mechanical Engineering Department

Abstract

A proposal has been has under consideration in the last few years there to make major changes to requirements of ABET-Engineering Accreditation Commission's (EAC) criterion 3-student outcomes and criterion 5-curriculum. The proposed changes were posted on ABET website for public review and comments with a deadline of June 30, 2016. They were discussed and voted upon during the ABET summer commission meeting min July, 2016). The EAC commission approved the proposed changes with minor modifications. The proposed changes were forwarded to the ABET Engineering Area Delegation, which has the final approval authority for any criteria changes. The EAC recommended that the delegation consider another year of public review and comment to ensure all constituents have ample opportunity to consider these latest modifications and provide additional feedback. The Engineering Area Delegation had the option of considering the following three options: i) approve the proposed criteria as written and implement, ii) delay final approval for one year and seek additional public comment, as recommended by the commission, or iii) reject the proposal. At the end of October the Engineering delegation area members voted to place the proposed changes for another year of public viewing and seek input from constituencies. It can be anticipated that the proposed changes will be approved with additional minor changes in the near future. This paper highlights the proposed changes in criteria 3 and 5 and explains how these changes might affect engineering programs. It also discusses possible effects of the proposed changes on the assessment process.

Keywords

ABET-EAC Criterion 3, Criterion 5, Assessment, 2016 proposal for criterion 3 and criterion 5.

Introduction

Evaluation of engineering programs by ABET's Engineering Accreditation Commission (EAC) on the basis of student outcome assessment (EC-2000) began in late 1990s. During the last few years of 1990s programs were given the choice of being evaluated based on the old criteria or the newly established EC-2000 criteria. Since 2000, all engineering programs requesting accreditation for the first time or seeking re-accreditation by ABET-EAC must demonstrate that program meets a set of criteria that include both the general criteria for baccalaureate degree programs as well as the program criteria required by the program lead society (e.g., ASCE, IEEE, ASME).[1] The programs must also meet all the requirements listed in the Accreditation-Policy-and-Procedure-Manual of ABET.[2]

Since 2000, there has been minor changes to EAC general criteria and program criteria. Originally the ABET-EAC-2000 accreditation was based on 7 general criteria components and an additional program criteria. The general criteria consisted of (1) students, (2) Program Educational Objectives (PEO), (3) Program Outcome and Assessment, (4) Professional Components, (5) Faculty, (6) Facilities, and (7) Institutional Support and Financial Resources. For a number of years the attainment of program educational objectives (PEO) and the program outcomes (PO) were parts of the requirements of criterion 2 and criterion 3, respectively. Starting in the 2008-09 evaluation cycle, some changes were made to the general EAC requirements. The requirements for evaluation of PEOs and POs were removed from criteria 2 and 3 and became a part of requirements for an added criterion 4-Contineous Improvement. The title of Program Outcomes and Professional Components were changed to Student Outcomes (SO) and Curriculum, respectively. Since 2008-09 accreditation cycle, the EAC general criteria included the following eight (8) components: (1) students, (2) Program Educational Objectives (PEO), (3) Student Outcomes (SO) (4) Continuous Improvement, (5) Curriculum, (6) Faculty, (7) Facilities, and (8) Institutional Support.[3]

During 2012-13 evaluation cycle, ABET-EAC, removed the requirement of evaluation of program educational objectives from criterion 4-continuous improvement. The main reason for this change was that most institutions had a difficult time to satisfy this requirement. Program educational objectives are broad statements that describe what graduates are expected to attain within a few years of graduation. Institutions are not in control of graduates after they leave school and in most cases they lose contact with their graduates. Therefore it is quite difficult to collect data on whether the graduates are attaining the stated program educational objective. Table 1 shows the changes in the statements and requirements for criterion 4-continuous improvement from 2012-13 to 2013-14 evaluation cycles. Since 2012-13 accreditation cycle, programs have not been required to demonstrate the attainment of PEOs.

Table 1. Change in the requirements of Criterion 4, from 2012-13 to 2013-14 evaluation cycles.

Criterion 4- Continuous Improvements	
2012-13 Evaluation Cycle	**2013-14 Evaluation Cycle**
The program must regularly use appropriate, documented processes for assessing and evaluating the extent to which <u>both the program educational objectives and the student outcomes are being attained</u>. The results of these evaluations must be systematically utilized as input for the continuous improvement.	The program must regularly use appropriate, documented processes for assessing and evaluating the extent to which <u>the student outcomes are being attained</u>. The results of these evaluations must be systematically utilized as input for the continuous improvement of the program. Other available information may also be used to assist in the continuous improvement of the program.

In addition to changes to EAC general criteria, the lead technical societies for the specific programs have made changes to the program criteria. For example ASME is the lead society for the Mechanical Engineering (ME) programs. Table 2 shows changes for the curriculum requirement of ME Program Criteria.

Table 2. Changes in Curriculum requirements of ME Program Criteria

Changes in Curriculum requirements of ME Program Criteria		
2008-09 Accreditation Cycle	**2012-13 Accreditation Cycle**	**2013-14 Accreditation Cycle**
The program must demonstrate that graduates have the ability to: apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations) to model, analyze, design, and realize physical systems, components or processes; and work professionally in both thermal and mechanical systems areas	The curriculum must require students to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations); to model, analyze, design, and realize physical systems, components or processes; and prepare students to work professionally in both thermal and mechanical systems areas.	The curriculum must require students to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations); to model, analyze, design, and realize physical systems, components or processes; and prepare students to work professionally in either thermal or mechanical systems while requiring topics in each area.

Table 2 shows that until the 2008-09 accreditation cycle, engineering programs were required to demonstrate that graduates have the ability of applying principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations) to model, analyze, design, and realize physical systems, components or processes; and work professionally in both thermal and mechanical systems areas. Therefore this was an outcome based requirement, needing an assessment of student ability. Since 2012-13 accreditation cycle, programs are no longer are required to demonstrate that the graduate have the ability of meeting the stated requirements of the curriculum topics, but the programs must require the students to apply the requirement of the stated topics. Therefore, no more outcome assessment is necessary for the curriculum requirements of the ME Program Criteria. In the 2012-13 accreditation cycle programs had to prepare students to work professionally in both thermal and mechanical systems areas. This required students to complete design projects in both thermal and mechanical systems areas. This requirement was changed in 2013-14 accreditation cycle and the programs are now required to prepare students to work professionally in either thermal or mechanical systems while requiring topics in each area. Therefore, the design projects are only needed in one area, but students must still be exposed to topics in both areas.

Proposed Changes to Criterion 3 and Criterion 5

In late 2000s ABET started to harmonize the accreditation criteria among the four ABET commissions which include Applied Science Accreditation Commission (ASAC), Computing Accreditation Commission (CAC), Engineering Accreditation Commission (EAC), and Engineering Technology Accreditation Commission (ETAC). The commissions agreed on harmonization of five (5) criteria that included Criterion 1-Students, Criteria 2-Program Educational Objectives, Criterion 4-Continous Improvement, Criterion 7-Facilities, and Criterion

8-Institutional Support. This means that the requirements are the same for these criteria among all four commissions and any changes to these criteria require approval from all four commissions. Criterion 3-Student Outcomes, Criterion 5-Curriculum, and Criterion-6 Faculty are not harmonized; meaning that the requirements for these criteria are not the same for all four commissions, and each commission has the freedom of making changes to these three criteria for their own associated programs.

In 2009, when the Criteria Committee of EAC was completing the process of harmonizing the criteria across ABET's four commissions, EAC appointed a task force to start the review of Criterion 3. Main motivation for revising criterion 3 was that very few changes had been made to student outcomes (a-k), since 2000. There was a question whether student outcomes still meet the original intent, and most citations of shortcomings during the accreditation of programs were related to the assessment of student outcomes.

The taskforce for the revision of criterion 3 was assigned to develop a process that included:

- the identification of stakeholders and outreach to these groups,
- the examination of the number of shortcomings associated with Criterion 3,
- the review of correspondence received by ABET concerning Criterion 3,
- in-depth literature review of desired attributes for engineers, and
- development of several draft proposals for review to gather feedback from a broad range of constituents

Based on the original feedback received form the constituents, the task force identified 75 potential attributes to be considered for student outcomes. The potential attributes were grouped into five (5) categories identified as: technical, business, communication, professionalism, and individual skills. During this process it was realized that student outcomes must be tied to criterion 5-curriculum, hence requiring the revision of that criterion also. The EAC Criterion Committee prepared a draft version of revised criterion 3 and criterion 5. The Criterion Committee presented draft version to entire EAC commission during the July 2014 summer commission meeting. The EAC commission members suggested some changes to the draft versions and recommended that the committee seek additional comments from the deans, faculty members of engineering programs and industry. Between July 2014 and May 2015, ABET solicited input from engineering societies, deans, faculty, and industry. Based on the input received, the EAC Criteria Committee made changes to the 2014 draft version of criteria 3 and 5. The updated proposed criterion 3 and criterion 5 were presented to the entire EAC commission again in July 2015 for approval. After a long discussion, it was decided to table the proposal, and placing it for public viewing for additional period of time. The proposed changes were posted on ABET website for public review and comments by June 30, 2016 deadline. The EAC commission approved the proposed changes with minor modification. During the additional period the engineering educational communities paid close attention to the proposed changes to criteria 3 and 5. For example during the 2016 ASEE National meeting in New Orleans, a large session was organized to discuss the proposed changes to criterion 3 and criterion 5. The ABET-EAC representatives made comments regarding the proposed changes and other stakeholders participated in the discussion.

During 2015-16 public review, the EAC-Criteria Committee received approximately 250 input from public. Based on the input received, the committee made revisions to the newly proposed criterion 3 and criterion 5 and presented them to EAC commissioners again during the July 2016 (July 13-16).meeting of the EAC Commission. After some discussions and minor changes the EAC commission voted and approved the updated proposed criterion 3 and criterion 5 which is called the "first reading" for these criteria. However, EAC recommended that the first reading be placed for public review for an additional year.

2016 First Reading Proposal

The first reading of the proposed criterion 3 and criterion 5 was forwarded to the Engineering Area Delegation, which has the final approval authority for the approval of any changes to the criteria. The EAC had recommended that the delegation consider another year of public viewing and comments to ensure that all constituents have ample opportunity to consider these latest modifications, and provide any additional comments. The Engineering Area Delegation had the following three options: i) to approve the proposed criteria as written and implement, ii) delay final approval for one year and seek additional public comment, as recommended by the commission, or iii) reject the proposal. At the end of October, 2016, the Board of Delegates placed the first reading for public review and comments.[4] A side-by-side comparison of the criterion 3 and criterion 5 as submitted in 2015 and those proposed for the first reading in 2016 is posted on the ABET Web-site.[5]

Even though the first reading proposal is not approved by Board of Delegates yet, it can be anticipated that the proposal, with minor changes, be approved in near future. The following sections will highlights the changes in criteria 3 and 5 and explains how these changes might affect the engineering programs. A similar study was conducted a year earlier which was based on the proposed changes submitted by EAC commission in 2015.[6] This paper discusses the proposal submitted as the first reading in 2016.

The first part of the 2016 proposal deals with definitions. It states that "The Engineering Accreditation Commission of ABET recognizes that its constituents may consider certain terms to have certain meanings; however, it is necessary for the EAC to have consistent terminology. Thus, the EAC will use the following definitions in applying the criteria."

No definition was provided in the Original EC-2000 Criteria. ABET-EAC gradually started to add

- **Program Educational Objectives** Although institutions may use different terminology, for purposes of Criterion 2, program educational objectives are intended to be statements that describe the expected accomplishments of graduates during the first several years following graduation from the program

- **Student Outcomes** – Although institutions may use different terminology, for purposes of Criterion 3, program outcomes are intended to be statements that describe what students are expected to know or be able to do by the time of graduation from the program

The current four definitions stablished in the 2008-09 are:

- **Program Educational Objectives** – Program educational objectives are broad statements that describe what graduates are expected to attain within a few years of graduation. Program educational objectives are based on the needs of the program's constituencies.

- **Student Outcomes** – Student outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire as they progress through the program.

- **Assessment** – Assessment is one or more processes that identify, collect, and prepare data to evaluate the attainment of student outcomes. Effective assessment uses relevant direct, indirect, quantitative and qualitative measures as appropriate to the outcome being measured. Appropriate sampling methods may be used as part of an assessment process.

- **Evaluation** – Evaluation is one or more processes for interpreting the data and evidence accumulated through assessment processes. Evaluation determines the extent to which student outcomes are being attained. Evaluation results in decisions and actions regarding program improvement.

Tables 3 through 7 compares the terminology used in the current criterion 5 and those included in the 2016 first reading of criterion 5. These tables show that either the list of definitions are expanded to remove ambiguity or misunderstanding by the engineering programs. For example for the college-level mathematics, examples are included as types of acceptable courses or topics. Table 6 shows that in the 2016 first reading the definition of engineering design is expanded and examples are provided to clarify the misunderstandings by some engineering programs.

In the 2016 first reading proposal there are only seven outcomes for criterion 3, student outcomes as compared 11 outcomes in the current criterion 3, outcomes a-k. Some of the current student outcomes are moved into the requirements of criterion 5 in the 2016 first reading proposal. Table 8 compares the opening statement of current criterion 3 with that of 2016 first reading proposal.

Table. 3 Comparison of definition for Basic Science

Basic Science	
Current definition	**2016 first reading proposal**
Basic sciences are defined as biological, chemical, and physical sciences.	Basic sciences are *disciplines* focused on knowledge or understanding of the fundamental aspects of natural phenomena. Basic sciences consist of chemistry and physics and other natural sciences including life, earth, and space sciences.

Table 4. Comparison of definition for College Level Mathematics

College-Level Mathematics	
Current definition	**2016 first reading proposal**
No definition, but it is understood that it must be above pre-calculus	College-level mathematics consists of mathematics that requires a degree of mathematical sophistication at least equivalent to that of introductory calculus. For illustrative purposes, some examples of college-level mathematics include calculus, differential equations, probability, statistics, linear algebra, and discrete mathematics

Table 5. Comparison of definition for Engineering Science

Engineering Science	
Current definition	**2016 first reading proposal**
The engineering sciences have their roots in mathematics and basic sciences but carry knowledge further toward creative application. These studies provide a bridge between mathematics and basic sciences on the one hand and engineering practice on the other.	Engineering sciences are based on mathematics and basic sciences but carry knowledge further toward creative application needed to solve engineering problems. These studies provide a bridge between mathematics and basic sciences on the one hand and engineering practice on the other

Table 6. Comparison of definition for Engineering Design

Engineering Design	
Current definition	**2016 first reading proposal**
Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs.	Engineering design is the process of devising a system, component, or process to meet desired needs and specifications within constraints. It is an iterative, creative, decision-making process in which the basic sciences, mathematics, and engineering sciences are applied to convert resources into solutions. The process involves identifying opportunities, performing analysis and synthesis, generating multiple solutions, evaluating those solutions against requirements, considering risks, and making trade-offs to identify a high quality solution under the given circumstances. For illustrative purposes only, examples of possible constraints include accessibility, aesthetics, constructability, cost, ergonomics, functionality, interoperability, legal considerations, maintainability, manufacturability, policy, regulations, schedule, sustainability, or usability.

Table 7. Comparison of definition for Team

Team	
Current definition	**2016 first reading proposal**
No definition	A team consists of more than one person working toward a common goal and should include individuals of diverse backgrounds, skills, or perspectives consistent with ABET's policies and positions on diversity and inclusion

Table 8 comparison of the opening statements for criterion 3

Current statement	2016 first reading proposal
The program must have documented student outcomes that prepare graduates to attain the program educational objectives. Student outcomes are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.	The program must have documented student outcomes that support the program educational objectives. Attainment of these outcomes prepares graduates to enter the professional practice of engineering. Student outcomes are outcomes (1) through (7), plus any additional outcomes that may be articulated by the program.

Tables 9 shows the equivalencies of current student outcomes (a) through (k) with the seven student outcomes included in the 2016 first reading proposal for criterion 3. Note that the current student outcomes (a) and (e) are combined into a single student outcome (1) in the 2016 first reading proposal. Student outcome (c) is approximately the same as student outcome (2), except that the "manufacturability, and sustainability" requirements of the current student outcome now is included as one of the requirements of criterion 5-curriculum in the 2016 first draft proposal. Student outcome (b) in the current criterion 3 is partially equivalent to student outcome (3) in the 2016 proposal, except that "the ability to design of experiment" is no longer required. Current student outcome (g) is reworded and presented as student outcome (4) in the 2016 proposal. The current student outcomes (f) and (h) are combined and are presented as student outcom5 in the 2016 proposal. Student outcome (i) is reworded and is presented as student outcome (6) in the 2016 proposal. Student outcome (d) is reworded and is presented as student outcome (7) in the 2016 proposal. Student outcome (j) is not included in the 2016 proposal and student outcome (k) is a requirement of part (b) of criterion 5 in the 2016 proposal.

Table 10 compares the requirements of the current criterion 5 with those included in the 2016 first draft proposal. In the current requirements one year is defined as 32 semester credit hours for programs requiring 128 semester credit hours or more for the degree or 25% of total semester hours required for the degree if it is less than 128 hours. In the 2016 first draft proposal one year is defined as 30 credit hours regardless of the total numbers of hours required for the degree.

Table 9. Equivalencies of student outcome in the current and 2016 first draft proposal for criterion 3

Current Student Outcomes	2016 first reading proposal
SO (a) an ability to apply knowledge of mathematics, science, and engineering SO (e) an ability to identify, formulate, and solve engineering problems	SO-1 an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
SO (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	SO-2 an ability to apply the engineering design process to produce solutions that meet specified needs with consideration for public health and safety, and global, cultural, social, environmental, economic, and other factors as appropriate to the discipline
SO (b) an ability to design and conduct experiments, as well as to analyze and interpret data	SO-3 an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
SO (g) an ability to communicate effectively	SO-4 an ability to communicate effectively with a range of audiences.
SO (f) an understanding of professional and ethical responsibility SO (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	SO-5 an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
SO (i) a recognition of the need for, and an ability to engage in life-long learning	SO-6 an ability to recognize the ongoing need to acquire new knowledge, to choose appropriate learning strategies, and to apply this knowledge.
SO (d) an ability to function on multidisciplinary teams	SO (7) an ability to function effectively as a member or leader of a team that establishes goals, plans tasks, meets deadlines, and creates a collaborative and inclusive environment.
SO (j) a knowledge of contemporary issues	Not included
SO (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	Part of Criterion 5-(b)

Table 10. Comparison of the current requirements of criterion 5 with those for the 2016 proposal

Current criterion 5 requirements	2016 first reading proposal
a. one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline.	a. a minimum of 30 semester credit hours (or equivalent) of a combination of college-level mathematics and basic sciences with experimental experience appropriate to the program
b. one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study.	b. a minimum of 45 semester credit hours (or equivalent) of engineering topics appropriate to the program, consisting of engineering sciences and engineering design, <u>and utilizing modern engineering tools (SO k)</u>
c. a general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives	c. a broad education component that complements the technical content of the curriculum and is consistent with the program educational objectives
a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple <u>realistic</u> constraints	d. a culminating major engineering design experience based on the knowledge and skills acquired in earlier course work that incorporates appropriate engineering standards and multiple constraints

Effects of 2016 First Reading Proposal on the Assessment Process

Discussions in the previous indicated that majority of student outcomes (a) through (k) are configured into student outcomes (1) through (7) in the 2016 first reading proposal. Student outcome (j) is not a part of student outcomes in the 2016 first reading proposal. Outcome (k) has become a part of curriculum requirements, therefore an outcome assessment is not required. The ability to design of experiment is removed from student outcome (b). This suggest that number of student outcome assessments are reduced in the 2016 first reading proposal. However some student outcomes in the 2016 first reading proposal require more detail assessments. Examples are student outcomes (6) and (7) in the 2016 first reading proposal.

References

1. URL: http://www.abet.org/wp-content/uploads/2016/12/E001-17-18-EAC-Criteria-10-29-16-1.pdf
2. URL. http://www.abet.org/wp-content/uploads/2016/12/A001-17-18-Accreditation-Policy-and-Procedure-Manual-11-29-16.pdf

3. Manteufel, R. and Karimi, "Promoting Consistent Assessment of Student Learning Outcomes over Multiple Courses and Multiple Instructors in Continuous Program Improvement," *Proceedings of the* 2016 *ASEE Annual Conference and Exposition*, ID #: 16508, June 26-29, 2016, New Orleans, LA
4. URL:http://www.abet.org/blog/news/proposed-eac-criteria-changes-released-for-public-review-and-comment/
5. URL: *http://www.abet.org/wp-content/uploads/2016/08/EAC-Side-By-Side-Criteria.pdf*
6. Barr, R.E., "Proposed Changes to ABET Criteria 3 and 5," Proceedings of 2016 ASEE-GSW Section Conference, Paper number103, March 6-8, 2016, Fort Worth, Texas.

Amir Karimi

Amir Karimi is a Professor of Mechanical Engineering at The University of Texas at San Antonio (UTSA). He received his Ph.D. degree in Mechanical Engineering from the University of Kentucky in 1982. His teaching and research interests are in thermal sciences. He has served as the Department Chair, Associate Dean of Academic Affairs of Engineering, and the Associate Dean of Undergraduate Studies. Dr. Karimi is a Fellow of ASEE, a Fellow of ASME, senior member of AIAA, and holds membership in ASHRAE, and Sigma Xi. He has served as the ASEE Campus Representative, ASEE-GSW Section Campus Representative, and served as the Chair of ASEE Zone III (2005-07). He chaired the ASEE-GSW section during the 1996-97 academic year.