The Best Way to Learn About ABET Criteria is to Become a Program Evaluator

ABET and the FUTURE of ENGINEERING EDUCATION

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ECEDHA
Miramar Beach, Florida
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Topics

• Who is ABET?
• ABET update
• Basics of ABET Accreditation including:
  • Process
  • Guiding Principles
• Criteria Change Proposals
  • Process for Revising ABET Criteria
  • Proposed Criteria Revisions

Who Is ABET?
About ABET

• ABET is a forward-thinking purpose-driven organization that accredits college and university programs* in the disciplines of applied science, computing, engineering and engineering technology.

* Not institutions or graduates

ABET’s Core Purpose

With ABET accreditation, students, employers, and the society we serve can be confident that a program meets the quality standards that produce graduates prepared to enter a global workforce
ABET Organizational Design

- ABET is a federation of 35 professional and technical societies.
  - Develop program criteria
  - Appoint Board of Delegates representatives
  - Nominate commissioners
  - Recruit and assign program evaluators
- ABET relies on the services of almost 2,200 volunteer experts supported by 33 full-time and 10 part-time staff.

ABET’s 35 Member Societies
ABET Accreditation Statistics
As of 1 October 2016 ... 3,709 Programs

- Accredited programs by commission:
  - ASAC: 87  CAC: 461
  - EAC: 2550  ETAC: 629

<table>
<thead>
<tr>
<th>Commission</th>
<th>Domestic Programs</th>
<th>Domestic Institutions</th>
<th>Non-Domestic Programs</th>
<th>Non-Domestic Institutions</th>
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Global Accreditation Activities
As of 1 October 2016

1) Accredited 3,709 programs at 752 colleges and universities in 30 countries

2) Non-U.S. Programs
   • Accredited 574 programs at 121 institutions in 29 countries
   • Uniform accreditation criteria, policies, and procedures used for all visits, regardless of location

Global View
3,709 Programs at 752 Institutions in 30 Countries

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<th>Within U.S.</th>
<th>Outside U.S.</th>
<th>Total</th>
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<tr>
<td>Programs</td>
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<td>Institutions</td>
<td>631</td>
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ABET Accreditation ISO 9001:2008 certified
ABET Accredited Programs

- Austria
- Bahrain
- Chile
- China
- Colombia
- Ecuador
- Egypt
- India
- Indonesia
- Jordan
- Kazakhstan
- Kuwait
- Lebanon
- Mexico
- Morocco
- Oman
- Palestine
- Peru
- Philippines
- Portugal
- Qatar
- Russian Federation
- Saudi Arabia
- Singapore
- South Africa
- Spain
- Turkey
- United Arab Emirates
- Vietnam
- USA
ABET Accreditation Process

Objectives

• Assure that graduates of an accredited program are adequately prepared to enter and continue the practice of applied science, computing, engineering, and engineering technology
• Stimulate the improvement of technical education
• Encourage new and innovative approaches to technical education and its assessment

What Does It Involve?

• Programs prepare Self-Study Report for evaluation team
• Program review conducted by team of peer colleague
  • From academe, industry, and government (members of ABET Member Societies)
  • Review the Self-Study Report, conduct the review visit
• Results posted each year, October 1st
• Periodic re-evaluation (maximum 6 years)
• Identical processes used outside the U.S.
Criteria: The Guiding Principles of Accreditation Decisions

Overview of Criteria Goals

• Ensure the quality of educational programs
• Foster the systematic pursuit of quality improvement in educational programs
• Develop educational programs that satisfy the needs of constituents in a dynamic and competitive environment
Catalysts for Change in the ‘90s

- Proliferation of Criteria
- Need for Innovation in Programs
- Prescriptive Nature of Criteria
- Industry Call for Change

ABET Created a Paradigm Shift

- ABET introduced a new philosophy
- The conscious intention was to:
  - spend *less* effort examining what students were taught
  - spend *more* effort assessing what students learned.
Underlying Principle

• The process of accreditation is evidence-based and should drive decision-making to ensure excellence and enhance innovation in technical education.

• Evaluation centers on the evidence provided that supports achievement of each of the criterion

• Majority of evidence collected through assessment of student learning

Engineering Criteria 2000  (EC 2000)

• Philosophy: “Outcomes-Based”
  • Institutions and programs define mission and objectives to meet their constituents’ needs
  • Outcomes: preparation for professional practice
  • Demonstrate how criteria are being met
  • Wide national and international acceptance

• Commitment to Continuous Improvement
  • Process focus: outcomes and assessment linked to objectives; input from constituencies
  • Student, faculty, facilities, institutional support, and financial resources linked to program objectives
## Harmonization of Criteria

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<thead>
<tr>
<th>Criteria Common to All Commissions</th>
<th>Commission-Specific Criteria</th>
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<tr>
<td>Criterion 1 (Students)</td>
<td>Criterion 3 (Outcomes)</td>
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<td>Criterion 2 (PEO)</td>
<td>Criterion 5 (Curriculum)</td>
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<td>Criterion 4 (Continuous Improvement)</td>
<td>Criterion 6 (Faculty)</td>
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<td>Criterion 7 (Facilities)</td>
<td>Program Criteria</td>
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<td>Criterion 8 (Support)</td>
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## Program Criteria

- Each program seeking accreditation from the Engineering Accreditation Commission of ABET must demonstrate that it satisfies all Program Criteria implied by the program title.
Continuous Quality Improvement (CQI)

- ABET’s outcomes based criteria have been developed on the principles of continuous quality improvement.
- On-going process at institutions to improve quality of students’ educational experience
  - Systematic process: documented, repeatable
  - Assess performance against criteria
  - Take actions to improve program
- Accreditation is a part of CQI.
  - Verification that program meets certain level of quality, and CQI is part of the quality process.
Who May Propose Revisions? (1)

- Generally speaking, proposals for criteria changes (harmonized and non-harmonized) may come from any source
- ABET member societies will typically sponsor substantive changes to general or program criteria
- An accreditation commission itself may advocate for a change

Who May Propose Revisions? (2)

- Each of the four accreditation commissions has a standing committee known as the Criteria Committee
- All changes are deliberated upon by the commission’s criteria committee and recommendations are proposed for action at a meeting of the full commission
What Happens to Proposals That Pass? (3)

- The commission sends a recommendation to the Area Delegation of the Board of Delegates for “first reading”
- The Area Delegation may:
  - reject the commission proposal
  - request additional consideration by the commission
  - approve the commission proposal and release the proposed criteria change for a period of public review and comment

What Happens Then? (4)

- Comments are aggregated and reviewed by the commission criteria committee
- All proposed changes are deliberated upon by the criteria committee and recommendations are proposed for action at a meeting of a full commission
  - the commission may or may not make changes to the original proposal based upon comments received
What Happens Then? (5)

- The commission will submit the (potentially edited/revised) criteria change proposal to the Area Delegation of the Board of Delegates for “second reading”

What Happens Then? (6)

- The Area Delegation may:
  - reject the commission proposal
  - request additional consideration by the commission or request an additional period of public review and comment
  - approve the commission proposal and direct that the approved criteria:
    - become effective during the next accreditation cycle or
    - be phased in over a suitable period to allow programs seeking accreditation to develop an implementation plan
Proposed Criteria Revisions:
Works in Process at EAC & CAC

Evolution of EAC Criteria 3 & 5 (1)

• In 2009, EAC Criteria Committee was completing harmonization of criteria across ABET’s four commissions.

• The committee recognized that non-harmonized Criterion 3, Program Outcomes, had not been reviewed since its original formulation in the mid-1990s.

• EAC was receiving requests from constituent groups for additional outcomes to be included in Criterion 3.

• EAC leadership was aware that each year a substantial percentage of the shortcomings cited were associated with Criterion 3.
Evolution of EAC Criteria 3 & 5 (2)

- EAC convened a Criterion 3 task force to begin a review process.
- The task force developed a process for examining Criterion 3, including efforts to gain additional input from a broad range of constituents.
- EAC surveyed program evaluators during the 2010-11 cycle regarding the elements of Criterion 3 that led to citations of shortcoming.
- Shortcomings were reported in every component of Criterion 3, mostly at the weakness or concern level.
- Data revealed that programs had difficulty determining the extent of outcome attainment with several Criterion 3 elements.

Evolution of EAC Criteria 3 & 5 (3)

- The EAC undertook an outreach effort in 2012-13 to inform constituent groups that Criterion 3 was being reviewed and to solicit suggestions regarding changes.
- Some constituent groups informed the EAC that important outcomes were missing from Criterion 3; all suggestions brought the total to 75.
- At the same time the task force concluded that some of the 3(a)-3(k) components were interdependent, broad, and vague in scope, causing inconsistency in PEV interpretation of how well programs were complying with Criterion 3.
Evolution of EAC Criteria 3 & 5 (4)

- With information collected the task force evaluated the existing 3(a)-3(k) outcomes and those suggested by constituents, grouping them into six topic areas that would drive a possible major change to Criterion 3.
- This possible change would also serve to align ABET criteria more closely with Washington Accord graduate attributes referencing *project management* and *finance*.
- The Criterion 3 task force presented their findings to the full EAC in July 2013 and their work was transferred to the EAC Criteria Committee.

Evolution of EAC Criteria 3 & 5 (5)

- In July 2014, the EAC posted language articulating a potential revision to Criterion 3 on the ABET website and circulated this to constituent groups for informal comment in the fall of 2014.
- More than 100 comments were received from individuals and organizations.
Evolution of EAC Criteria 3 & 5 (6)

Further EAC discussions in 2014-15 resulted in addition of a seventh topic area, now providing that the following topic areas would be addressed:

1) Engineering problem solving,
2) Engineering design,
3) Measurement, testing, and quality assurance,
4) Communication skills,
5) Professional responsibility,
6) Professional growth, and
7) Teamwork and project management

Evolution of EAC Criteria 3 & 5 (7)

- With topic areas identified for a revised Criterion 3, the resulting language includes items that are considered more appropriately placed in Criterion 5, Curriculum
- As a result, revisions are also proposed to the language of Criterion 5.
Evolution of EAC Criteria 3 & 5 (8)

- The EAC’s Criteria Committee believes that all of the elements of the Criterion 3 that are applicable in 2015-16 are included in the proposed revisions to Criterion 3, Criterion 5, and Introduction section, along with some additional elements.
- Proposed changes are extensive in Criterion 3, and less so in Criterion 5.
- The proposed introductory section contains definitions that currently are embedded in Criterion 5; hence, the proposed Criterion 5 is shortened.

Evolution of EAC Criteria 3 & 5 (9)

- Ongoing communication efforts include:
  - Presentations to ABET Industrial and Academic Advisory Councils in 2013 and 2015
  - Presentations by ABET staff at several professional society meetings in 2014 and 2015
  - Inside Higher Ed update
  - ASEE Prism January 2016 display ad
  - Multiple issues of Catalyst (ABET e-newsletter)
  - NSPS PE Magazine (January/February 2016) issue
  - Prism “Last Word” letter by AAC authors in Mar 2014 issue.
  - Email blast to EAC institutional contacts in Fall 2014
  - Website description of WIP and portal for comment in Fall 2014
  - Report to ASEE Assoc Deans in 2014 and 2015
  - Update ticker on ABET website
  - In addition, a link on the ABET website was established so that constituents could provide comments directly.
Next Steps in the Evolution Process

- Several hundred comments were received during the 2015-16 and 2016-2017 accreditation cycles.
- All comments were read by the Criteria Committee and sub-groups were formed to handle various topics.
- The 2015 – 2016 Criteria Committee generated a new proposed revision and suggested that it be considered for a first reading.
- The EAC agreed with the Criteria Committee and voted to send the revisions to the Engineering Area Delegation and ask them to perform another first reading.

The tone of comments is more positive thus far during the 2016-17 cycle of review.

“The Kansas State Board of Technical Professions supports the proposed revisions to Criteria 3 and 5. The Board finds them to be more tightly written, more inclusive of professional considerations and less prone to misinterpretation.”

Please get on with it. This constant churning and churning is making us on the front lines of program assessment crazy. It’s death by paper cuts! Pick something and approve it. It won’t be 100% perfect, but in criteria 3 going from (a)-(k) to (1)-(7) is such a vast improvement that it will help us tremendously. Just get on with it!”
Comments are more focused on specific wording.

“...NSPE again requests that the definition of the word “team” in Criterion 3.7 be expanded by including the word “multidisciplinary” as a descriptor...”

“I like the new engineering design definition overall. I especially like that the last sentence starts with “For illustrative purposes only...” since it doesn’t try to imply that all constraints apply to all problems. The list of steps/tasks in the engineering design process is good, but I’d add a few more items (blue text below) and reorder/delete a little (red text below) for clarity and completeness:
The process involves identifying opportunities, developing requirements, generating multiple solutions, evaluating [cut “those”] solutions against requirements, refining solutions, performing analysis and synthesis, considering risks, and making trade-offs to identify a high quality solution under the given circumstances.”

The EAC Criteria Committee will follow its process to evaluate all comments.

- All comments are collected and read by the Criteria Committee.
- The Criteria Committee will identify themes in the comments.
- Sub-groups will be formed to analyze the themes and determine if any rewording is necessary.
- If the EAC approves the changes and asks the EAD to implement the new criteria, the Criteria Committee recommends that the earliest implementation be for the 2019-20 Accreditation Cycle.
Consider the following mapping between Student Outcomes (a) – (k) and 1-7 exist.

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<th>(a) – (k)</th>
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Current Introduction before I. GENERAL CRITERIA FOR BACCALAUREATE LEVEL PROGRAMS in EAC 2016-17 Criteria.

Current Criteria:
These criteria are intended to assure quality and to foster the systematic pursuit of improvement in the quality of engineering education that satisfies the needs of constituencies in a dynamic and competitive environment. It is the responsibility of the institution seeking accreditation of an engineering program to demonstrate clearly that the program meets the following criteria.

New Proposal:
These criteria apply to all accredited engineering programs. Furthermore, these criteria are intended to foster the systematic pursuit of improvement in the quality of engineering education that satisfies the needs of its constituencies in a dynamic and competitive environment. It is the responsibility of the institution seeking accreditation of an engineering program to demonstrate clearly that the program meets the following criteria.

The current criteria does not contain this paragraph. It is to introduce the definitions that apply only to the EAC.

New Proposal
The Engineering Accreditation Commission of ABET recognizes that its constituents may consider certain terms to have certain meanings; however, it is necessary for the Engineering Accreditation Commission to have consistent terminology. Thus, the Engineering Accreditation Commission will use the following definitions in applying the criteria:
The current basic science definition (2016-17) is contained in General Criterion 5. Curriculum

Current Criteria
Basic sciences are defined as biological, chemical, and physical sciences.

New Proposal
Basic Science – 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.

The current criteria do not contain a definition of college-level mathematics.

New Proposal
College-Level Mathematics – 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.
The current engineering sciences definition (2016-17) is contained in General Criterion 5. Curriculum

Current Criteria
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.

New Proposal
Engineering Science – 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.

The current engineering design definition (2016-17) is contained in General Criterion 5. Curriculum

Current Criteria
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.
New Proposal

Engineering Design – 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.

The current criteria do not contain a definition of teams.

New Proposal

Team – 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.

The current definition of one year (2016-17) is contained in General Criterion 5. Curriculum

Current Criteria
One year is the lesser of 32 semester hours (or equivalent) or one-fourth of the total credits required for graduation.

New Proposal
The definition of one Academic Year was deleted. The requirement is addressed by using the designation of a semester credit hour.
Current Introduction to General Criterion 3: Student Outcomes, 2016-17

**Current Criteria**
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.

**New Proposal**
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.

Current Student Outcomes 2016-17

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

2. An ability to apply knowledge of mathematics, science, and engineering.

3. An ability to identify, formulate, and solve engineering problems.

4. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

**New Proposal**
(1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
New Proposal

(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.

Current Student Outcomes 2016-17

(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

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

New Proposal

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

3. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
Current Student Outcomes 2016-17  

*(g) an ability to communicate effectively*

New Proposal  
4. An ability to communicate effectively with a range of audiences.

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Current Student Outcomes 2016-17  

*(f) an understanding of professional and ethical responsibility  
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context*

New Proposal  
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.
Current Student Outcomes 2016-17

(i) a recognition of the need for, and an ability to engage in life-long learning

New Proposal

(6) An ability to recognize the ongoing need to acquire new knowledge, to choose appropriate learning strategies, and to apply this knowledge.

Current Student Outcomes 2016-17

(d) an ability to function on multidisciplinary teams

New Proposal

(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.
Current Student Outcomes 2016-17

(j) a knowledge of contemporary issues

Newest
The words “contemporary issues” are not used.
There is not a direct mapping to this outcome.
Yet, students should have knowledge of contemporary issues given the engineering design definition and the multifaceted context of a problem, as well as C5’s requirement for standards/constraints.
So it manifests itself in a much more relevant way in the revision.
Current General Criterion 5: Curriculum, 2016-17

The curriculum requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The faculty must ensure that the program curriculum devotes adequate attention and time to each component, consistent with the outcomes and objectives of the program and institution. The professional component must include:

New Proposal
The curriculum requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The program curriculum must provide adequate content for each area, consistent with the student outcomes and program educational objectives, to ensure that students are prepared to enter the practice of engineering. The curriculum must include:

(a) one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline. Basic sciences are defined as biological, chemical, and physical sciences.

New Proposal
(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.

Remember that the definition of one year was removed, and that college-level mathematics and basic sciences have already been defined.
Current General Criterion 5: Curriculum, 2016-17

(b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study. 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 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.

New Proposal
(b) a minimum of 45 semester credit hours (or equivalent) of engineering topics appropriate to the program, consisting of engineering sciences and engineering design, and utilizing modern engineering tools.

Remember that the definition of one year was removed and that engineering science and engineering design have already been defined.

Current General Criterion 5: Curriculum, 2016-17

(c) a general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives.

New Proposal
(c) a broad education component that complements the technical content of the curriculum and is consistent with the program educational objectives.
Current General Criterion 5: Curriculum, 2016-17

Students must be prepared for engineering practice through 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 realistic constraints.

New Proposal

(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.

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Because of the overlap, programs may choose to use some of what they are already collecting to demonstrate the new criteria. Programs are also free to evaluate and streamline their current processes.
The EAC recommends one year from adoption of the new criteria until implementation.

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<tr>
<th>Proposed Criteria out for Review</th>
<th>Approval by EAC</th>
<th>Approval by EAD</th>
<th>Programs Prepare</th>
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<td>Summer, 2017</td>
<td>Fall, 2017</td>
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**Questions? (let’s take a break)**
Computing and Computer Science Accreditation

What You Should Take Away From This ECEDHA Meeting

Accrediting Programs in Computing

- CAC
  - Computer Science
  - Information Technology
  - Information Systems
  - Other general computing programs with specialized names/focus areas:
    - Game Design
    - Computer Networking
    - Cybersecurity (proposed)

- EAC
  - Computer Engineering
  - Software Engineering
Accreditation Criteria

Criteria Structure

- General Criteria:
  - CAC General Criteria: Applicable to all computing programs
  - EAC General Criteria: Applicable to all engineering programs
- Program Criteria:
  - Additional criteria required for programs of certain specific types
  - Within CAC – CS, IS and IT program criteria
  - Within EAC – SE and Computer Engineering program criteria
Proposed Criteria Changes: Overview

Cautionary Note

• Current criteria remain in force
• Draft-for-comment is still a work in progress
  • It will change before it is approved for use
• Current Plan
  • Present updated version to CAC in July 2017 meeting
  • Ask for approval of updated version and a rollout plan
  • If CAC approves this version and rollout plan, they will be presented to ABET’s Computing Area Delegation (CAD) in October
  • If CAD approves, the updated version and rollout plan will be announced
Computing Accreditation Criteria: Changes Overview

- Revisions to Existing Criteria:
  - CAC General Criteria revisions
    - Criterion 3: Student Outcomes
    - Criterion 5: Curriculum
    - Similar to changes within EAC
  - Significant changes to CS Program Criteria
    - Alignment with CS 2013
  - Stylistic changes to IS and IT Program Criteria
- New Cybersecurity Program Criteria:
  - CAC Program Criteria
  - In consideration of CSEC 2017 effort

Work To Date

- Four years of deliberations
- Many drafts
- General, CS, IT, and IS criteria revision
  - Currently revision is in "public review and comment" period
  - Feedback requested at ABET website
  - Final approval by CAC will be sought this summer
- Cybersecurity criteria in preparation
  - Initial approval by CAC will be sought this summer
Proposed Changes to General Criteria 3 and 5

Criteria 3/5 Changes

- Small number of specified student outcomes
- Shifting of some of the previous Criterion 3 to Criterion 5
- Addition of a “hard” technical requirement in cybersecurity
Review - Definitions

• Program Educational Objectives (PEOs)
  • Statements of what graduates are expected to attain within a few years of graduation.

• Student Outcomes (SOs)
  • Statements of what students are expected to know and be able to do by the time of graduation.
    • Must prepare graduates to attain the program educational objectives.
    • Program must assess SOs and use the results for continuous improvement.

• Program Attributes
  • Characteristics of discipline that must be enabled by program
  • Assessment of program attributes not required.

Outcomes Vs. Attributes

Currently
• Programs must have Student Outcomes
• CAC does not specify:
  • What the outcomes must be
  • How many outcomes there must be
  • Curriculum requirements are embedded in the criterion in the form of a list of attributes (that must be "enabled")

The program must have documented student outcomes that prepare graduates to attain the program educational objectives....

The program must enable students to attain, by the time of graduation:
(a) An ability to apply knowledge of computing and mathematics appropriate to the student outcomes and to the discipline.
(b) An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution....
(c) .........

Not outcomes
The Problem

- Criterion 3’s title says “Student Outcomes”
  - Criterion requires student outcomes
  - But lists curricular items that are not outcomes
  - Inconsistent with other ABET commissions
  - Has generated a great deal of confusion for all of our constituencies over the years!

Proposed Solution: Criterion 3, Student Outcomes

1. An ability to analyze a problem, and to identify computing requirements appropriate to its solution
2. An ability to design, implement, and evaluate a computer-based solution to meet a given set of computing requirements in the context of the discipline.
3. An ability to communicate effectively with a range of audiences about technical information
4. An ability to make informed judgments in computing practice based on legal and ethical principles
5. An ability to function effectively on teams to establish goals, plan tasks, meet deadlines, manage risk and produce deliverables.
Proposed Solution: Criterion 5, Curriculum

- The program’s requirements must be consistent with its program educational objectives and designed in such a way that each of the student outcomes can be attained.
- The curriculum requirements specify subject areas, but do not prescribe specific courses. The program must include each of the following in a manner appropriate to its discipline:
  - At least a year of fundamental and advanced topics in computing
  - College-level mathematics
  - Techniques, skills and tools necessary for computing practice
  - Information assurance and security
  - Consideration of the impacts of computing solutions in global, economic, environmental and societal contexts

Move curricular items from Criterion 3 to Criterion 5

Program Criteria Changes
Program Criteria Changes

- CS Criteria Changes:
  - Alignment with CS2013 and recent developments in CS education
- Stylistic changes to IS and IT Criteria
  - Not presented today
  - You can find these criteria at:

CS Criteria Changes: Motivation

- CS criteria need to reflect and integrate with proposed changes to General Criteria
- As CS discipline continues to evolve, its program criteria need to evolve with it
- CS2013
  - Updated CS body of knowledge
CS Criterion 3 - Proposed

In addition to General Criteria required outcomes

6. An ability to apply theory in the design and implementation of computer-based solutions.

7. An ability to reason about and explain computer-based solutions at multiple levels of abstraction.

Some Observations re. CS2013

- Deemphasizes Computer Architecture and Organization
- Introduces Information Assurance and Security as a new knowledge area
- Introduces Parallel and Distributed Computing as a new knowledge area.
- Recommends that all CS students should be involved in at least one substantial project
- Does not specify amount of mathematics and science that all students should complete, with the exception of Discrete Structures
Goal of Criteria Committee

- Update CS Criterion 5, Curriculum criteria to reflect core CS2013 requirements while:
  - Establishing feasible requirements that can be met by a variety of CS programs of varying sizes and types of institution.
  - Identifying required subject areas rather than required courses
  - Allowing programs additional flexibility in meeting math and science requirements

CS Criterion 5 – Proposed

a. Computer science: At least one and one-third years that must include:
   1. Computer science fundamentals including algorithms and complexity, computer science theory, concepts of programming languages and software development.
   2. Some coverage of computer architecture and organization, information management, network and communication, operating systems, and parallel and distributed computing.
   4. In-depth coverage of at least one high-level language.
   5. A substantial project requiring application of knowledge and skills acquired in earlier course work.
CS Criterion 5 - Proposed

b. Mathematics: At least one-half academic year of college-level mathematics that must include discrete mathematics. The additional mathematics might consist of courses in areas such as calculus, linear algebra, numerical methods, probability, statistics, number theory, or symbolic logic.

c. Science: Natural science course work that develops an understanding of the scientific method, provides exposure to laboratory work, and provides students with an opportunity to experience this mode of inquiry in courses appropriate for science or engineering majors.

Proposed Criteria Status

• Public Review and Comment Period
  • For General and CS/IS/IT Program Criteria
• Criteria Committee
  • Considering comments and other feedback
  • Revised version will be posted on the ABET site in the next few weeks
  • Additional comments will be solicited
Criteria Changes – Final Note

• Current criteria remain in force
• Draft-for-comment is still a work in progress
  • It will change before it is approved for use
• Current Plan
  • Present updated version to CAC in July 2017 meeting
  • Ask for approval of updated version and a rollout plan
  • If CAC approves, this version and rollout plan will be presented to ABET’s Computing Area Delegation (CAD)
  • If CAD approves, the updated version and rollout plan will be announced
Background

- Cyber Education Project (CEP)
- ACM Joint Task Force on Cybersecurity Education (CSEC 2017)
- ABET Accreditation
  - Cybersecurity (CAC)
  - Cybersecurity Engineering (EAC)
Cyber Education Project (CEP)

- Grassroots project
  - Among several institutions to work on undergraduate cybersecurity curriculum standards and accreditation
- CEP effort
  - Around 2.5 years of substantial engagement with the CS, IS, IT, IA, and cyber communities
- Participants included
  - University of Alabama, Purdue, Union County College, George Washington University, and others

CEP Output

- CEP Work Products
  - Draft Learning Objectives
  - Draft Accreditation Criteria
- CEP Successor Efforts
  - ACM Joint Task Force
  - CSAB Lead Program Society for Cybersecurity
  - Engineering Efforts
ACM Joint Task Force for Cybersecurity Education

- Includes ACM, IEEE-CS and AIS
- Developing a cybersecurity education model curriculum
  - Originated with CEP Learning Outcomes
  - CSEC2017 v. 0.5 Report, January 2017
    - [https://www.csec2017.org/csec2017-v-0-5](https://www.csec2017.org/csec2017-v-0-5)
Cybersecurity Criteria Overview

- Based on CSEC 2017 draft recommendations
- Computing-based but supplemented with other areas
- Stylized to fit CAC approach

Cybersecurity Criteria Overview (cont.)

- General Criteria
  - Same as General Criteria in Proposed CAC Criteria (presented earlier)
- Cybersecurity Program Criteria
  - Criterion 3 Student Outcomes
  - Criterion 5 Curriculum
  - Criterion 6 Faculty
The program must have documented and publicly stated student outcomes that include (1) through (5) below and any additional outcomes required by applicable Program Criteria. The program may define additional student outcomes at its discretion.

1. An ability to analyze a problem, and to identify and define the computing requirements appropriate to its solution.
2. An ability to design, implement, and evaluate a computer-based solution to meet a given set of computing requirements in the context of the discipline.
3. An ability to communicate effectively with a range of audiences about technical information.
4. An ability to make informed judgments in computing practice based on legal and ethical principles.
5. An ability to function effectively on teams to establish goals, plan tasks, meet deadlines, manage risk, and produce deliverables.

The program’s requirements must be consistent with its program educational objectives and designed in such a way that each of the student outcomes can be attained.

The curriculum requirements specify subject areas, but do not prescribe specific courses. The program must include each of the following in a manner appropriate to its discipline:

- At least one academic year of up-to-date coverage of fundamental and advanced computing topics that provides both breadth and depth.
- College-level mathematics.
- Current techniques, skills, and tools necessary for computing practice.
- Information assurance and security principles and practices.
- Concepts involving the local and global impact of computing solutions on individuals, organizations, and society.
Cybersecurity Program Criteria: Overview

PROGRAM CRITERIA FOR CYBERSECURITY AND SIMILARLY NAMED COMPUTING PROGRAMS

Lead Society: CSAB

These program criteria apply to computing programs using cybersecurity, computer security, cyber operations, information assurance, information security, or similar terms in their titles.

Cybersecurity Program Criteria: Criterion 3, Student Outcomes

In addition to outcomes 1 through 5, the following outcomes are required:

6. An ability to apply security principles and practices to the environment, hardware, software, and human aspects of a system.

7. An ability to analyze and evaluate systems with respect to maintaining operations in the presence of risks and threats.
Cybersecurity Program Criteria: Criterion 5, Curriculum

The curriculum requirements specify subject areas, but do not prescribe specific courses. These requirements include:

(a) At least 45 semester (or equivalent) credit hours of computing and cybersecurity course work. The course work must cover:
   • Application of the crosscutting concepts of confidentiality, integrity, availability, risk, and adversarial thinking.
   • Fundamental topics from each of the following:
     • Data Security: protection of data at rest and in transit.
     • Software Security: development and use of software that reliably preserve the security properties of the information and systems they protect.
     • System Security: establishing and maintaining the security properties of systems, including those of interconnected components.
     • Human Security: protecting individuals’ personal data, their privacy and threat mitigation combined with the study of human behavior as it relates to cybersecurity.
     • Organizational Security: protecting organizations from cybersecurity threats and managing risk to support the successful accomplishment of the organization’s mission.
     • Societal Security: aspects of cybersecurity that can broadly impact society as a whole for better or for worse.
   • Advanced cybersecurity topics that build on crosscutting concepts and fundamental topics to provide depth.
   • (b) At least 6 semester (or equivalent) credit hours of mathematics that must include discrete mathematics and statistics.

Cybersecurity Criteria: Timeline

- July 2017
  • Draft Criteria submitted to CAC for approval
- October 2017 (or earlier)
  • Assuming CAC approval, Draft Criteria submitted to ABET’s Computing Area Delegation (CAD) for approval
- November 2017
  • Assuming CAD approval, draft Criteria posted to ABET website for Public Review and Comment (first reading)
- July 2018 and October 2018
  • Revised Criteria submitted to CAC and CAD approval for second reading
A Fork in the Road …..?

Background & Context

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>* Articulated a vision for a &quot;Cyber Sciences&quot; ABET program criteria, created multiple artifacts in support of vision, socialized vision</td>
</tr>
<tr>
<td>Nov 2015</td>
<td>CEP Accreditation Committee</td>
</tr>
<tr>
<td></td>
<td>* Published &quot;alpha&quot; draft of an accreditation criteria</td>
</tr>
<tr>
<td>Feb 2016</td>
<td>CEP Accreditation committee</td>
</tr>
<tr>
<td></td>
<td>* Released final report</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 2016</td>
<td>CSAB &amp; ABET/CAC</td>
</tr>
<tr>
<td></td>
<td>* Established committee to create CAC &quot;Cybersecurity&quot; computing program criteria</td>
</tr>
<tr>
<td>Mar 7 2017</td>
<td>CSAB &amp; ABET/CAC</td>
</tr>
<tr>
<td></td>
<td>* Published CAC criteria</td>
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<td>Summer 2017 (target)</td>
<td>CAC commission</td>
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<tr>
<td></td>
<td>* Approved first reading of CSAB criteria</td>
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<tr>
<td>Summer/Fall 2017 (target)</td>
<td>PD's trained</td>
</tr>
<tr>
<td>Fall 2017 (target)</td>
<td>4 institutions &quot;pilot&quot; the criteria</td>
</tr>
<tr>
<td>Summer 2018 (target)</td>
<td>CAC commission</td>
</tr>
<tr>
<td></td>
<td>* Approved second reading or adoption</td>
</tr>
<tr>
<td></td>
<td>* Approved accreditation of 4 pilot programs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 2016</td>
<td>CEA</td>
</tr>
<tr>
<td></td>
<td>* Established committee to create an EAC &quot;cybersecurity&quot; engineering program criteria</td>
</tr>
<tr>
<td>July 2016</td>
<td>CEA</td>
</tr>
<tr>
<td></td>
<td>* Published draft EAC &quot;cybersecurity&quot; engineering criteria for advancement to ABET for adoption</td>
</tr>
<tr>
<td>Sept 2016</td>
<td>CEA</td>
</tr>
<tr>
<td></td>
<td>* Reviewed EAC criteria with CSAB/CAC Criteria subcommittee on cybersecurity program criteria - affirmed EAC draft 1 and CSAB as cooperating society</td>
</tr>
<tr>
<td></td>
<td>* IEEE formally requested CSAB join IEEE as cooperating society</td>
</tr>
<tr>
<td>Oct 2016</td>
<td>CSAB request/CSAB be designated as a co-lead society</td>
</tr>
<tr>
<td>Jan 2017</td>
<td>INCOSE request/INCOSE be designated as a co-lead society</td>
</tr>
<tr>
<td></td>
<td>Next steps - to follow</td>
</tr>
</tbody>
</table>

Early Stage Cyber Engineering Discussion
Articulate text as new criteria or as revision of IEEE criteria?

- July 2016 CEAA directed articulation as a new criteria – primarily to improve readability/usability
- ABET guidance (January 2017) toward 1st reading:
  - October 2017 for revision to existing IEEE criteria
  - October 2018 for New Criteria
  - Time period for adoption post 1st reading is same for both approaches.
  - For same text: Articulation via a new criteria 1 year later than revision method
- Articulation via revising criteria does not preclude at a future time, “moving” the text from with IEEE criteria to a new “cybersecurity” engineering criteria.
- Concern observed that CSAB and INCOSE would view this approach negatively if they are not designated as co-lead … with unanticipated ramifications

Articulated as New Criteria

IEEE PROGRAM CRITERIA FOR SECURITY, CYBERSECURITY, INFORMATION ASSURANCE AND SIMILARLY NAMED ENGINEERING PROGRAMS
DRAFT, NOT FOR USE OR DISTRIBUTION

These program criteria apply to engineering programs that include "security", "cybersecurity", "information assurance" or similar modifiers in their titles.

1. Curriculum
The structure of the curriculum must provide both breadth and depth across the range of engineering topics implied by the title of the program.

The curriculum must
- Include probability, statistics, and cryptographic topics including applications appropriate to the program.
- Include discrete math and specialized math appropriate to the program, such as, abstract algebra, information theory, number theory, complexity theory, finite fields.
- Include engineering topics necessary to analyze and design complex devices, software, and systems containing hardware, software and human components.
- Provide both breadth and depth across the range of engineering and computer science topics necessary for the:
  1) application of security principles and practices to the design, implementation, and operations of the physical, software, and human components of the system as appropriate to the program
  2) application of protective technologies and forensic techniques
  3) analyzing and evaluation of components and systems with respect to security and to maintaining operations in the presence of risks and threats
  4) consideration of legal, regulatory, privacy, ethics, and human behavior topics as appropriate to the program

2. Faculty
The program must demonstrate that faculty members teaching core engineering topics understand methods of engineering design and problem solving and engineering practice with specific relevance to security.
New Criteria Creation & Adoption Process (1/11/17 Understanding)

Meeting Schedule:
- EAC Executive Committee: Jan, April, July, Sept
- Engineering Area Delegation (EAD): March, Oct
- EAC Criteria Committee: July

CEAA Cybersecurity Accreditation Committee: Signification Discussion Items

<table>
<thead>
<tr>
<th>Discussion Item</th>
<th>Selected Discussion Points or Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Refinement and level setting of the committee goals</td>
<td>Add experience PEVs with cybersecurity experience from Industry and Government. Add liaisons from CAC and IEEE-CS Security &amp; Privacy Technical Committee.</td>
</tr>
<tr>
<td>2. Committee Setup Items:</td>
<td>Security Engineer target is NOT existing EE programs with a “security concentration.”</td>
</tr>
<tr>
<td>a) Who, outside of the committee members, should be engaged?</td>
<td>a) Yes – Change engineering focus to include broader set of solution considerations appropriate to the security engineering role.</td>
</tr>
<tr>
<td>b) How should the initial draft set of topics be determined?</td>
<td>b) Yes – A set of broad security topics.</td>
</tr>
<tr>
<td>c) What form of criteria expression should be considered?</td>
<td>c) Yes – Include math topics associated with security field, i.e., cryptography.</td>
</tr>
<tr>
<td>d) What, if anything, should this committee do or not do with respect to the CSAB/CAC cybersecurity criteria?</td>
<td></td>
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<tr>
<td>e) What are we missing?</td>
<td></td>
</tr>
<tr>
<td>3. Is criteria target “Security Engineer” or an “EE” with cybersecurity knowledge?</td>
<td></td>
</tr>
<tr>
<td>a) Security Engineer - target is NOT existing EE programs with a “security concentration.”</td>
<td></td>
</tr>
<tr>
<td>b) “Security Engineer” - target is NOT existing EE programs with a “security concentration.”</td>
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</tr>
<tr>
<td>4. Should cybersecurity program criteria include</td>
<td></td>
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<tr>
<td>a) “Engineering topics”? If Yes, what topics?</td>
<td>a) Yes – Change engineering focus to include broader set of solution considerations appropriate to the security engineering role.</td>
</tr>
<tr>
<td>b) “Security topics”? If Yes, what topics? Few broad topics vs several specific topics.</td>
<td>b) Yes – A set of broad security topics.</td>
</tr>
<tr>
<td>c) Include specific math topics? If Yes, what topics?</td>
<td>c) Yes – Include math topics associated with security field, i.e., cryptography.</td>
</tr>
<tr>
<td>5. What are “Security Engineering” Faculty Requirements?</td>
<td></td>
</tr>
<tr>
<td>a) Potential need to ensure programs not housed within an existing engineering department to have engineering skills within the faculty.</td>
<td></td>
</tr>
<tr>
<td>b) Not a criteria content question – but an ABET logistical and political consideration – recommend standalone.</td>
<td></td>
</tr>
<tr>
<td>6. Should this be a stand-alone program criteria, i.e., Cybersecurity Engineer OR be within the current EE program criteria?</td>
<td></td>
</tr>
<tr>
<td>a) Not criteria content question – but an ABET logistical and political consideration – recommend standalone.</td>
<td></td>
</tr>
</tbody>
</table>
Resources

Program Assessment Workshops
Intensive, Interactive Daylong Workshops

Website: www.abet.org

ABET Symposium

- April of each year
- Over 70 sessions
- Four educational tracks
  - Accreditation track
  - Self-Study Reports

THANK YOU
The Best Way to Learn About Criteria is to Become a Program Evaluator

Questions?

accreditation@abet.org
or
jsussman@abet.org