

## **AC 2007-439: PROPOSED BEST PRACTICES FOR PREPARING BIOENGINEERING AND BIOMEDICAL ENGINEERING PROGRAMS FOR ABET ACCREDITATION**

### **Susan Blanchard, Florida Gulf Coast University**

SUSAN M. BLANCHARD is Founding Director of the U.A. Whitaker School of Engineering and Professor of Bioengineering at Florida Gulf Coast University. She received her M.S. and Ph.D. degrees in Biomedical Engineering from Duke University in 1980 and 1982, respectively, and her A.B. in Biology from Oberlin College in 1968. She is a Fellow of the Institute of Electrical and Electronics Engineers, the Biomedical Engineering Society, and the American Institute for Medical and Biological Engineering and is an ABET Program Evaluator.

### **James Sweeney, Florida Gulf Coast University**

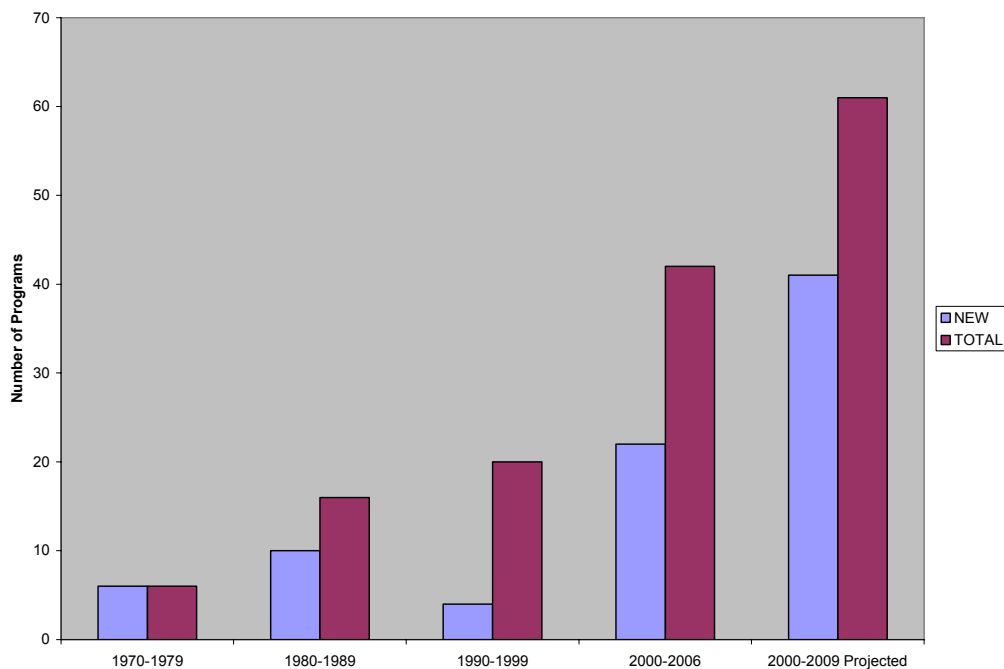
JAMES D. SWEENEY is Professor and Chair of the Department of Bioengineering at Florida Gulf Coast University. He received his Ph.D. and M.S. degrees in Biomedical Engineering from Case Western Reserve University in 1988 and 1983, respectively, and his Sc.B. Engineering degree (Biomedical Engineering) from Brown University in 1979. He is a Senior Member of the Institute of Electrical and Electronics Engineers, a Fellow of the American Institute for Medical and Biological Engineering, and an ABET Program Evaluator.

# Proposed Best Practices for Preparing Bioengineering and Biomedical Engineering Programs for ABET Accreditation

## Introduction

When Enderle *et al.* published “The ABCs of Preparing for ABET” in 2003, they reported that there were 24 ABET accredited programs in bioengineering and biomedical engineering (BME).<sup>1</sup> Today, there are 42 with 22 of those programs (52.4%, Figure 1) having been accredited from 2000 until the present and six accredited in 2006 (Table 1).<sup>2</sup> The number of bioengineering and biomedical engineering programs accredited by the Accreditation Board for Engineering and Technology, Inc. (ABET, [www.abet.org](http://www.abet.org)) continues to grow as the number of undergraduate programs increases. Of the more than 80 undergraduate programs listed in The Whitaker Foundation’s Biomedical Engineering Curriculum Database, fourteen were formed in 2003 or later with the total number of biomedical engineering departments now numbering around 75.<sup>3, 4</sup> Seven new BME programs were visited in fall 2006.<sup>5</sup> Assuming that the new programs formed in 2003 and 2004 will have graduates in 2007 and 2008, respectively, and are prepared for the accreditation process, seven new programs will have ABET accreditation visits in fall 2007 and five more in fall 2008. If all of the new programs visited in fall 2006 through fall 2008 are successful, there will be a total of 61 ABET-accredited BME programs by summer 2009 with two-thirds of those representing new programs (Figure 1). This paper addresses accreditation issues and strategies from the perspective of new programs, including a number of proposed “best practices” gleaned in part from a survey of recently accredited bioengineering and biomedical engineering programs. This information should also be useful to existing programs that are preparing for re-accreditation visits.

**Figure 1: ABET-Accredited Bioengineering and Biomedical Engineering Programs<sup>2</sup>**



**Table 1: Recently Accredited Bioengineering and Biomedical Engineering Programs<sup>2</sup>**

Year Accredited	University	Program	Next General Review (NGR) following first visit
2000	The University of Toledo*	Bioengineering BS	2005-2006
2001	University of Pittsburgh*	Bioengineering BS	2005-2006**
2002	University of California, San Diego	Bioengineering (Biotechnology) BS	2007-2008
	Drexel University	Biomedical Engineering BS	2007-2008
2003	The University of Akron	Biomedical Engineering BS	2007-2008**
	University of Tennessee at Knoxville*	Biomedical Engineering BSBME	2005-2006**
	University of Wisconsin-Madison*	Biomedical Engineering BS	2006-2007**
	Worcester Polytechnic Institute	Biomedical Engineering BS	2008-2009
2004	University of Hartford	Biomedical Engineering BS	2009-2010
	University of Minnesota-Twin Cities	Biomedical Engineering BBmE	2007-2008**
	University of Rochester	Biomedical Engineering BS	2009-2010
	Virginia Commonwealth University*	Biomedical Engineering BS	2006-2007**
2005	Brown University*	Biomedical Engineering BS	2006-2007**
	Georgia Institute of Technology	Biomedical Engineering BSBME	2008-2009**
	Michigan Technological University	Biomedical Engineering BS	2010-2011
	North Carolina State University at Raleigh	Biomedical Engineering BS	2010-2011
2006	University of Cincinnati	Biomedical Engineering BS	2010-2011**
	Florida International University	Biomedical Engineering BS	2008-2009**
	University of Michigan	Biomedical Engineering BSE	2011-2012
	State University of New York at Stony Brook	Biomedical Engineering BE	2011-2012
	Oregon State University	Bioengineering BS	2008-2009**
	Western New England College	Biomedical Engineering BS	2011-2012

\*Programs having second visits in fall 2005 or fall 2006.

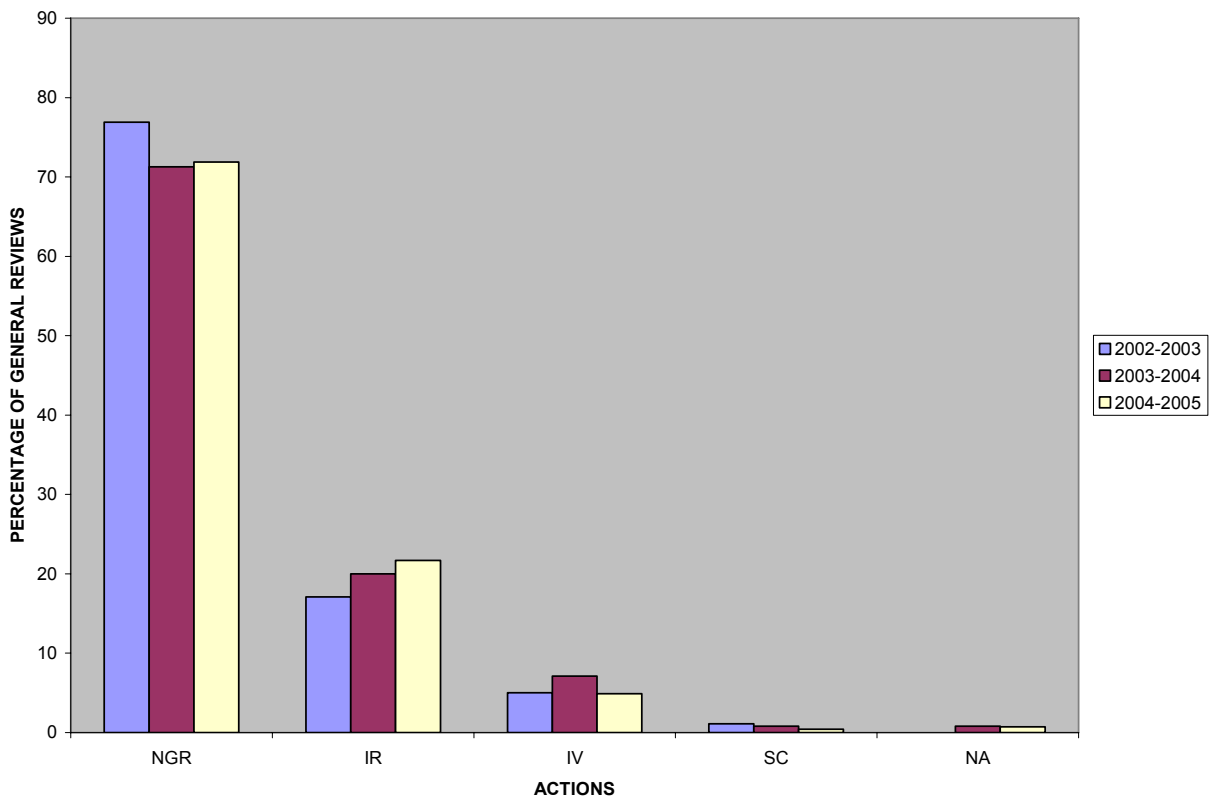
\*\*Programs likely to have been visited as single programs.

### ABET Accreditation Results and Issues for All Engineering Programs

Each year, ABET publishes the criteria for accrediting engineering programs and makes this information available online.<sup>6</sup> ABET also publishes a summary of accreditation statistics, which represent the actions taken following due process, for the previous year's accreditation cycle.<sup>7-9</sup> This means that these actions were still in place when the Engineering Accreditation Commission (EAC) had its annual summer meeting and after the institution and program gave their 14-day response to errors in fact and their 30-day due-process response to the Draft Statement of the ABET team's findings and the Final Statement was issued by ABET. During the time between the campus visit and the EAC's meeting, many unsatisfactory issues are resolved by the programs that were visited and are no longer problems at the end of this process. Over the last three years for which data are available (Figure 2), over 70% of the engineering programs that were visited received Next General Review (NGR, i.e. the program was in full compliance with the applicable criteria) and less than 2% received Show Cause (SC, action that involves not re-accrediting an existing program if the problem is still unresolved after one year) or Not to Accredite (NA, immediate action that involves not accrediting a new program or not re-accrediting an existing program after a SC evaluation).<sup>7-9</sup> Programs only receive NGRs if there are no U.A. deficiencies (a criterion, policy, or procedure is not satisfied) or weaknesses (the program lacks strength of compliance to ensure that a criterion, policy, or procedure will not be

compromised), and these programs will generally not be revisited again for six years. Having an NGR is the goal of every program that has an ABET visit! Programs that earn deficiencies receive either a Show Cause or a Not to Accredite. Programs that earn one or more weaknesses will either have an Interim Report (IR) or Interim Visit (IV) due in two years. **New engineering programs that have deficiencies at the end of due process will not be accredited whereas new programs that have weaknesses that remain at the end of due process are accredited and will have either an interim report or interim visit to demonstrate that the weaknesses have been resolved.** Note that the percentage of programs receiving IRs has gradually increased over the three-year period shown in Figure 2 with the actual number of programs required to write interim reports rising from 48 to 51 to 58. The number of programs having interim visits has changed little from 14 in 2002-2003 to 18 in 2003-2004 and 13 in 2004-2005.

**Figure 2: Actions Following General Reviews of All Engineering Programs<sup>7-9</sup>**



### **ABET Accreditation Issues for Bioengineering and Biomedical Engineering Programs**

A survey (Table 2) was sent to 16 of the 22 bioengineering and biomedical engineering programs that were accredited between 2000 and 2006 (Table 1) to gain insights into best practices for preparing new BME programs for accreditation visits. The six programs that had second visits in fall 2005 and 2006 were excluded from the survey. Thirteen responses (81% of those surveyed) were received. Sixty-two percent (62%) of the BME programs that responded had challenges with Criterion 3 Program Outcomes and Assessment, 46% with Criterion 2 Program Educational

Objectives, and 25% with Criterion 8 Program Criteria. Only one BME program that responded to the survey had difficulty with Criterion 1 Students (an issue with degree auditing), one had difficulty with Criterion 5 Faculty (due to having a small faculty), and two had difficulty with Criterion 4 Professional Component (one with regard to incorporating multiple design constraints and another with having sufficient hours of engineering topics).

**Table 2: Survey Sent to New BME Programs**

Questions
What is the one most important piece of advice that you would give to new programs to help them prepare for a successful ABET accreditation visit?
What is the one thing that you wished you had done differently in terms of preparing for your first ABET accreditation visit?
Did you have your self-study reviewed by someone with experience as an ABET evaluator before you submitted it to ABET? If so, when during your preparation process?
Did you have a mock ABET site visit prior to the actual ABET review? 1. If so, was this visit just for your program or was it part of a mock visit for all engineering programs? 2. What were the three most important things that you learned from the mock visit?
Was your program visited by ABET as a single program (with a team chair and two evaluators) or was it part of an accreditation visit for multiple programs? What advantages or disadvantages do you think occurred, if any, because of the format for your visit?
Which of the eight ABET criteria for accrediting engineering programs were the most challenging for your program in terms of achieving accreditation?
How difficult was it to get your faculty involved in the accreditation process? In what ways were they involved?
Is there anything else you would like to share with new programs that would help them to be better prepared for their first accreditation visit?

During the 2005-2006 evaluation year (when six new BME programs were accredited, Table 1), ~60% of all engineering programs that were visited (across all disciplines and without regard to whether the programs were new or previously accredited) had shortcomings (concern, weakness, or deficiency) with regard to Criterion 3 and ~ 52% had problems with Criterion 2 before due process.<sup>10</sup> More engineering programs received weaknesses for Criterion 3 than for Criterion 2, and the percentage of engineering programs with weaknesses in these areas was much larger (28-32%) than the next highest percentage (Criterion 4 at ~8%). Criterion 5 and Criterion 8 had the next highest percentage of weaknesses at ~6%. Thus, new BME programs struggle with much the same issues as all engineering programs (Criteria 2, 3, 4, 5, and 8) with Criteria 2 and 3 being the most challenging, which is very similar to the national average, and Criterion 8 being somewhat higher for BME programs than for other engineering programs (an interesting issue that is discussed below).

The results from the survey of Table 2, considered and supplemented somewhat based on the authors' experiences at our previous institutions and the process that we are following at our current institution where we are two years into building a new bioengineering program, have been used to develop a list of proposed best practices for BME programs preparing for a first ABET accreditation visit. Selected anonymous quotes from survey respondents are included in *italics*.

## **Proposed Best Practices for Preparing New Bioengineering and Biomedical Engineering Programs for an ABET Accreditation Visit.**

### **1. Involve and learn from all of the program's constituents as early as possible and then on a regular and timely basis.**

*... “truly involve your constituents in the entire process (and document their involvement)” ...*

While the ABET engineering criteria speak to constituent involvement directly only under Criterion 2, requiring that engineering programs “... must have in place ... a process based on the needs of the program's various constituencies in which the objectives are determined and periodically evaluated,”<sup>6</sup> involving and learning from all of the program's constituents as early, broadly, and often as possible can pay dividends. Advisory boards are a common means for regularly bringing together representatives of the program's constituencies, not only for formulating, regularly reviewing, and evaluating attainment of the program's educational objectives (Criterion 2) but also for identifying, refining, and assessing the desired graduating student skill sets that form the foundation of the program outcomes (Criterion 3). Advisory boards, in fact, can be a marvelous “sounding board” for helping with continuous improvement across all eight criteria. Student representation on departmental ABET or curriculum committees and/or through departmental student councils helps to ensure that their voices are also heard.

At our own institution, for example, the B.S. in Bioengineering was initially developed by the Founding Director of the U.A. Whitaker School of Engineering (WSOE) in spring 2005 with input from other faculty at the university and from faculty in other BME programs. Newly hired engineering faculty, adjunct faculty, and other faculty from the College of Health Professions and the College of Arts and Sciences at Florida Gulf Coast University (FGCU) participated in an academic retreat in August 2005 to review and revise the proposed curriculum and to begin developing Program Educational Objectives (PEOs) and Program Outcomes (POs). The curriculum and PEOs were also discussed and revised by the WSOE Advisory Board, which includes representatives from BME graduate programs and industry, at their first annual meeting in November 2005, and the curriculum, PEOs, and POs were discussed and revised again at the October 2006 meeting of the WSOE Advisory Board. During the fall of 2005, the first students entered the engineering program at FGCU and the first faculty arrived on campus. The WSOE Curriculum Committee was formed with representatives from the faculty and the student body and reviewed the B.S. in Bioengineering. Thus, within the first two years of establishing the program, the curriculum, PEOs, and POs were developed and reviewed by faculty, students, and prospective employers representing industry and graduate schools. This process has been documented through the materials associated with the faculty's academic retreats, the WSOE Advisory Board meetings, and the minutes of the WSOE Curriculum Committee (Table 3).

### **2. Integrate Criterion 8 and ABET 3a-3k when formulating the Program Outcomes.**

*... “We had the eight criteria pretty well covered as I recall, but it was the Program Criteria that nearly did us in.” ...*

Criterion 3 states that “engineering programs must demonstrate that their students attain:” which is followed by outcomes (a) through (k).<sup>6</sup> The simplest way to demonstrate fulfillment of this requirement is to begin with the ABET-defined outcomes when initially formulating the program’s own outcomes. It is also possible to include and/or adapt POs to address Criterion 8 (Table 3, bold italics).

**Table 3: PEOs and POs for FGCU’s B.S. in Bioengineering**

<p><b>PEOs:</b> The Department of Bioengineering in the WSOE School of Engineering at FGCU will produce graduates who:</p> <ul style="list-style-type: none"> <li>• are technically competent bioengineers, prepared to be leaders and valued contributors in their professions and communities,</li> <li>• possess the necessary attributes, learning skills, and entrepreneurial/business outlook to adapt to and be competitive in a changing global society and technological world,</li> <li>• are capable of communicating and working collaboratively as professionals in a diverse, interdisciplinary environment, and</li> <li>• are well prepared for careers in the medical device, health care, or biotechnology fields, as well as for graduate studies or professional training.</li> </ul> <p><i>Draft of first three PEOs developed by Bioengineering Working Group and other participants in School of Engineering Retreat, 8/12/05.</i>  <i>Approved by the WSOE Curriculum Committee, 9/2/05.</i>  <i>Revised by WSOE SOE Advisory Board, 11/04/05.</i>  <i>Revised by Bioengineering Working Group to add fourth PEO, 8/11/06.</i>  <i>Modified (Founding Director) to change “multidisciplinary” to “interdisciplinary,” 10/1/06.</i>  <i>Revised by Bioengineering Working Group during the WSOE Advisory Board meeting on 10/27/06.</i>  <i>Approved by the WSOE Curriculum Committee, 11/1/06.</i></p> <p><b>POs:</b> Graduates of the program will attain:</p> <ol style="list-style-type: none"> <li>a. <b><i>an ability to apply knowledge of advanced mathematics (including differential equations and statistics), science (including biology and physiology), and engineering to solve problems, especially those at the interface of engineering and biology;</i></b></li> <li>b. an ability to design and conduct experiments, as well as <b><i>to make measurements on</i></b> and to analyze <b><i>and interpret data from living systems, addressing the problems associated with the interaction between living and non-living materials and systems;</i></b></li> <li>c. an ability to design a system, component, or processes to meet desired bioengineering needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, regulatory, manufacturability, and sustainability;</li> <li>d. an ability to function on and assume leadership roles in diverse, multi-disciplinary teams;</li> <li>e. an ability to identify, formulate, and solve bioengineering problems;</li> <li>f. an understanding of professional and ethical responsibility;</li> <li>g. an ability to communicate effectively, especially in an interdisciplinary environment;</li> <li>h. the broad education, including service learning and entrepreneurship, necessary to understand the impact of bioengineering solutions in a rapidly changing global, economic, environmental, and societal context;</li> <li>i. a recognition of the need for, and an ability to engage in life-long learning;</li> <li>j. a knowledge of contemporary issues, especially those impacting Southwest Florida;</li> <li>k. an ability to use the techniques, skills, and modern engineering tools necessary for bioengineering practice;</li> <li>l. an understanding of entrepreneurship and the ability to write a business plan; and</li> <li>m. an ability to define a community problem and to use an engineering design process to deliver a solution.</li> </ol> <p style="text-align: center;"><b><i>From Program Criteria for Bioengineering and Biomedical Engineering Programs</i></b></p> <p><i>Drafted by Bioengineering Working Group, 8/12/05.</i>  <i>Revised by Bioengineering Working Group, 8/11/06.</i>  <i>Revised to include common outcomes and to better incorporate ABET program criteria (Chair, Founding Director), 10/2/06.</i>  <i>Revised by Bioengineering Working Group during the WSOE Advisory Board meeting on 10/27/06.</i>  <i>Approved by the WSOE Curriculum Committee, 11/1/06.</i></p>
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The criteria for bioengineering and biomedical engineering programs differ from those of many other engineering disciplines in that there is a clear expectation in the wording of Criterion 8 for

higher levels of learning. This can be demonstrated by comparing the current criteria for bioengineering and biomedical engineering with the current and proposed criteria for mechanical engineering and civil engineering programs (Table 4) from the perspective of Bloom’s Taxonomy<sup>11, 12</sup> as it was revised by Anderson and Krathwold.<sup>13, 14</sup> The old terminology for Bloom’s Taxonomy included competence levels that went from knowledge to comprehension, application, analysis, synthesis, and, finally, evaluation. The revised taxonomy begins with remembering and goes to understanding, applying, analyzing, evaluating, and, finally, creating. Note that the wording for bioengineering and biomedical engineering programs states that “the program must demonstrate that graduates have” levels of knowledge that are all above the basic one of remembering. It is sensible then to conclude that listing the courses that students take does not by itself provide sufficient evidence to demonstrate that students have attained the required levels of knowledge. Including and integrating the program criteria and ABET’s 3a-3k into the program’s own outcomes provides one direct method for ensuring that they are assessed as part of the process for assessing all of the POs. “Mapping” courses in the curriculum (i.e. assessment of student learning in selected areas within a course) to the program outcomes and then the program outcomes to the program educational objectives can be used to confirm that course-based learning should (if sufficient) support assessment and evaluation of Criteria 2, 3, and 8.

**Table 4: Program Criteria from the Perspective of Bloom’s Taxonomy, Revised**<sup>13, 14</sup>

BIOENGINEERING AND BIOMEDICAL ENGINEERING	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 program must demonstrate that graduates have: an understanding of biology and physiology ( <b>Understanding</b> ), and the capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve the problems at the interface of engineering and biology ( <b>Applying</b> ); the ability to make measurements on ( <b>Applying</b> ) and interpret data from living systems ( <b>Applying</b> ), addressing the problems associated with the interaction between living and non-living materials and systems ( <b>Evaluating</b> ).
MECHANICAL	The program must demonstrate that graduates have: knowledge of chemistry and calculus-based physics with depth in at least one ( <b>Remembering</b> ); the ability to apply advanced mathematics through multivariate calculus and differential equations ( <b>Applying</b> ); familiarity with statistics and linear algebra ( <b>Remembering</b> ); the ability to work professionally in both thermal and mechanical systems areas including the design ( <b>Creating</b> ) and realization of such systems ( <b>Applying</b> ).
PROPOSED REVISION TO PROGRAM CRITERIA FOR MECHANICAL (for 2008-2009 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 ( <b>Analyzing</b> ), design ( <b>Creating</b> ), and realize physical systems, components or processes ( <b>Applying</b> ); and have the ability to work professionally in both thermal and mechanical systems areas ( <b>Applying</b> ).
CIVIL	The program must demonstrate that graduates have: proficiency in mathematics through differential equations, probability and statistics, calculus-based physics, and general chemistry ( <b>Remembering</b> ); proficiency in a minimum of four (4) recognized major civil engineering areas ( <b>Remembering</b> ); the ability to conduct laboratory experiments and to critically analyze and interpret data in more than one of the recognized major civil engineering areas; the ability to perform civil engineering design by means of design experiences integrated throughout the professional component of the curriculum ( <b>Creating</b> ); and an understanding of professional practice issues such as: procurement of work, bidding versus quality-based selection processes, how the design professionals and the construction professions interact to construct a project, the importance of professional licensure and continuing education, and/or other professional practice issues ( <b>Understanding</b> ).
PROPOSED REVISION TO PROGRAM CRITERIA FOR CIVIL (for 2008-2009 cycle)	The program must demonstrate that graduates can apply knowledge of mathematics through differential equations, calculus-based physics, chemistry, and at least one additional area of science, consistent with the program educational objectives ( <b>Applying</b> ); can apply knowledge of four technical areas appropriate to civil engineering ( <b>Applying</b> ); can conduct civil engineering experiments to analyze and interpret the resulting data ( <b>Applying</b> ); can design a system, component, or process in more than one civil engineering context ( <b>Creating</b> ); can explain basic concepts in management, business, public policy, and leadership ( <b>Understanding</b> ); and can explain the importance of professional licensure ( <b>Understanding</b> ).



**3. Build what will become the self-study report piece by piece as soon as you begin offering the curriculum, using a format that aligns easily with how the report will eventually be reviewed.**

*... “start the documentation (everything from self-study to portfolios) early on in the process... even though the documents will look very different by the time you submit them” ...*

ABET’s procedures and recommendations are contained within the “Engineering Self-study Questionnaire” document that ABET posts as a downloadable form within the “Resources for Programs” section of their web site.<sup>15</sup> While this document can serve as an important guidepost for organizing and preparing the self-study report well in advance of its actual submission, so too can the procedures and worksheets used by program evaluators (PEVs) at the time of an actual general review. The “E62 PEV Worksheet” (which ABET generally posts to their web site within a zipped “PEV Workbook” file in the “Program Evaluators” section of their web site)<sup>16</sup> can be useful as a reference for ensuring that a self-study report is organized (with main and sub-headers) in a manner that will assist an evaluator in locating all of the key sections that are to be evaluated (without needing to search back and forth in a document that is organized in some other manner). In development of the policies and procedures for a new undergraduate program, many of the sections of what will eventually become a self-study report can be easily incorporated into early drafts. Criterion 1 Students, for example, includes documentation of procedures for evaluating student performance, advising of students, monitoring of students’ progress, and policies for acceptance and course validation for transfer students. Table “I-1 Basic Level Curriculum” of the self-study Appendix I-A materials can also be used from the earliest stages of course and curriculum development as a cross-check that the overall curriculum should meet ABET credit hour requirements for general education, math and sciences, and engineering.

**4. Design and use assessment and evaluation systems that are strategic and sustainable.**

*... “begin early designing a system that is sustainable” ...*

ABET’s Criterion 3 states “there must be ... an assessment process, with documented results, that demonstrates that these programs are being measured and indicates the degree to which the outcomes are achieved. There must be evidence that the results of this process are applied to the further development of the program.”<sup>6</sup> ABET further states: “Assessment is one or more processes that identify, collect, and prepare data to evaluate the achievement of program outcomes and program educational objectives. Evaluation is one or more processes for interpreting the data and evidence accumulated through assessment practices. Evaluation determines the extent to which program outcomes or program educational objectives are being achieved,[sic] and results in decisions and actions to improve the program.”<sup>17</sup>

Several recent ASEE papers have addressed how rubrics<sup>18-22</sup> and other methods<sup>23-26</sup> can be used to assess POs. In each case, the goal is to provide the program with sufficient information to allow it to make informed decisions about whether the POs are being met without making the task so onerous that the faculty are reluctant to participate. ABET has developed a web site to

help educate faculty about best practices in assessment<sup>27</sup> and to encourage the adoption of strategic and selective assessment practices to avoid overwhelming faculty with this process.<sup>28</sup>

**5. Practice continuous improvement from day one. Make all needed changes to improve the program in a timely fashion and be sure to assess all program outcomes by the senior year of the graduating class. Establish a system for revisiting all POs periodically, but not necessarily annually, from that time forward.**

*... “start early enough that you can close the loop on all outcomes at least once and a second time if any of the outcomes are not met” ...*

Initiating “closing the loop” (i.e. converting assessment and evaluation into action)<sup>29</sup> on assessment and evaluation of the program outcomes of Criterion 3 and 8 by the summer before your first graduating students enter their senior year can leave you with an opportunity to fine tune the program outcomes themselves and to practice continuous improvement (make changes) while your first graduates are still in their senior courses (particularly in capstone design).

**6. Address Criterion 2 even before there are graduates by gathering, assessing, and evaluating pertinent information from employers of interns and co-op students. Carry out a (very) early survey of your first graduates in the summer that you submit your self-study report if you are immediately applying for accreditation.**

*... “ criterion #2 (was challenging) because we did not have lots of longitudinal data from our recent graduates (they were recent!)” ...*

Criterion 2 requires in part that programs must have in place a curriculum that “fosters” accomplishments of graduates, as well as a process of ongoing evaluation of the extent to which graduates attain the program’s educational objectives. Tapping into your university’s ongoing process(es) for assessing the career progression of graduates can help with establishing systems for tracking and receiving critical feedback from your new alumni. Senior exit surveys, particularly those that a program can tailor to their own needs for feedback, can be used to bridge that moment in time at graduation when your students (and the skill sets they are expected to have achieved via your Criterion 3 program outcomes) become your alumni (whose future career accomplishments under your Criterion 2 program educational objectives must be evaluated over time). **Student** internship and co-op experiences prior to graduation can potentially provide useful and powerful assessment data sets on their skill sets as “junior engineers” in the work force – essentially letting you get advance notice on how one would expect them to then progress in their post-graduate careers.<sup>30</sup> Assessment and evaluation of actual career and professional accomplishments of **graduates** is still essential in order to meet Criterion 2.

**7. Make sure that the faculty and the program’s leadership who will implement and run accreditation efforts are appropriately trained and informed.**

*... “the faculty must be involved in establishing the department mission, program educational objectives, in providing coursework exemplars and comments on the preparedness of students and in assessing if their course met its individual objectives” ...*

*... “send the person who be responsible for coordinating the ABET efforts to two training workshops. 1) ABET Faculty Workshop on Assessing Program Outcomes, and 2) Program Evaluator Training Workshop” ...*

*... “we felt pretty prepared, but had a “rookie” view of what things like “feedback loops” and “assessments” really were, in terms of what ABET considered them. ”*

While it is ideal if at least one faculty member in a program has direct experience with ABET and accreditation as, for example, a program evaluator, many other mechanisms exist for a program’s accreditation leadership to gain training and experience beyond the level that simple readings of the criteria and self-study instructions will yield. ABET offers and promotes a number of assessment training workshops for faculty as well as administrators (e.g. see the “get help with assessment”<sup>27</sup> and “workshops”<sup>31</sup> sections of the ABET web site). Program leadership can benefit as well from attending a Program Evaluator Training Workshop,<sup>32</sup> even if not intending to become an evaluator themselves. Individual faculty also can be readily informed of ABET practices and expectations through in-house training, often via annual or semi-annual retreats. This would be especially helpful for faculty who teach required undergraduate courses since they generally have some responsibilities for collecting materials used for assessment of student achievement in their class(es) if the learning outcomes for their class(es) are used to assess fulfillment of Criterion 3 POs.

FGCU has an advantage that many new BME programs may not have in that the bioengineering program is one of three new undergraduate programs in a new school of engineering that has started from scratch in terms of engineering faculty. The Founding Director is an ABET PEV for bioengineering and biomedical engineering programs as is the Chair of the Department of Bioengineering. Two of the other eight faculty who are currently on campus are also ABET PEVs but in other disciplines (civil engineering and industrial and systems engineering). In addition, all three non-PEV faculty who were on campus in fall 2006 attended the ABET Faculty Workshop on Assessing Program Outcomes that was held in October and the new faculty who will arrive in 2007 will also be given the opportunity to attend similar workshops. The end result of this approach is that all of the WSOE faculty are familiar with the language of assessment<sup>33</sup> and are committed to the accreditation process.

## **8. Share experiences and best practices with colleagues at your institution.**

*... “there are a lot of things (that) are institution specific, so we gained a lot by trying to make use of best practices developed in ... other departments” ...*

*... “a college level assessment team is very useful in terms of sharing best practices” ...*

New bioengineering and biomedical engineering programs starting up at institutions with other pre-existing (and previously accredited) engineering programs should not overlook the opportunity to adopt best practices (potentially across all eight criteria) already developed by their engineering colleagues, their college administration, and university offices such as alumni relations.

**9. Prepare the first full draft of the self-study and have a mock site visit at least one full year before the scheduled ABET visit.**

... “get an outside perspective on your program and quality systems the year prior to the visit” ...

The year heading into submission of your first self-study report goes very, very fast! Having a draft version of the document reviewed by an outside expert (sometimes long distance but often through an on-campus “mock” review either of just your program or perhaps of all programs in your college that are scheduled for a general review on the same timetable) can leave you with sufficient time to practice true continuous improvement, “closing the loop” on your assessment and evaluation efforts for one more full academic year before your review and with the benefit of expert advice. An alternative approach for programs with sufficient expertise in their college is to have an expert from another department or the Dean’s office perform a similar external review.

**10. Organize material for the mock and actual site visits to demonstrate how the POs (which also address Criterion 8) and PEOs were assessed and met and that the design component of Criterion 4 was assessed and has been met.**

... “Start early. Think seriously about assessment. Keep detailed records.” ...

The “ABCs of Preparing for ABET” still hold true.<sup>1</sup> Careful and logical organization of materials for mock and/or actual reviews will most likely pay off – especially so that it is clear how assessment, evaluation, and use of results for continuous improvements have been carried out and in documenting that expectations under Criterion 4 Professional Component have been met.<sup>21, 22, 34</sup>

**11. “It ain’t over until it’s over.” Yogi Berra**

... “A big piece of advice is to keep on working on it after the ABET team has left - there is a lot that can be fixed up before the evaluation is final.” ...

The action that results from an ABET accreditation visit (NGR, IR, IV, NA, etc.) does not become final until the EAC has its annual summer meeting in the summer following the visit (Figure 2). Until that time, programs can work with ABET through the Team Chair for their visit to try to resolve shortcomings and potentially to improve the final results of the accreditation visit, e.g. possibly change the final action from NA to IR or IV or change from IR to NGR).

**Disclaimer:** The authors are both ABET PEVs for Bioengineering and Biomedical Engineering programs; however, no information from visits the authors have made as ABET PEVs or developed for the ABET accreditation visits at their previous institutions was used to prepare this paper. In addition, the content of this paper has not been reviewed or endorsed by ABET, Inc. or by the Accreditation Activities Committee of the Biomedical Engineering Society and is the sole responsibility of the authors. Having disclaimed all that, the authors still hope that the readers will find the content of the paper to be useful.

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