AC 2007-875: SURVIVING ABET ACCREDITATION: SATISFYING THE DEMANDS OF CRITERION 3

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Abstract

Preparing an engineering program for an ABET accreditation visit can be both daunting and frustrating. The requirements of ABET Criterion 3, in particular, can be confusing and may even seem contradictory. This paper suggests some methods and approaches that address the Criterion 3 requirements for formulation and assessment of program outcomes. Additional thoughts for successful accreditation preparation are also included. The authors are both civil engineering program directors who have prepared their own programs for accreditation and are ABET evaluators with multiple accreditation visits to other programs.

I. Introduction

For some programs, preparing for an ABET accreditation visit is a daunting experience. The requirements of Criterion 3, in particular, can be confusing and may even seem contradictory. Consider the following hypothetical conversation between an engineering program director preparing for accreditation and an ABET expert:

Program Director: The ABET accreditation process is now based on a philosophy of continuous improvement. I can define for myself what I want my students to be able to accomplish at graduation, and then I just need to assess how my program is doing. I will simply set the bar really low and define outcomes that I know I can meet, and then I am certain to be accredited.
ABET Expert: Your strategy won't work. The accreditation criteria contain some minimum standards that must be incorporated into your program outcomes. These standards are specified in the Criterion 3 a-k outcomes and include requirements for math, science, lifelong learning, engineering design, professional responsibility, ethics, and contemporary issues. These requirements are not trivial.
Program: Then I will simply adopt the Criterion 3 a-k as my program outcomes.
Expert: Using the Criterion 3 a-k outcomes without modification is probably acceptable but is definitely unwise. This practice sends the message that there is nothing special about your program; that you have not given your educational outcomes much thought; and that you are willing to let an outside agency dictate what you expect your students to accomplish. It is better to develop program outcomes that reflect the unique nature of your program and embed the Criterion 3 a-k outcomes within them. Then you need to assess how your students perform with respect to your program outcomes.
Program: The assessment part is easy. The program outcomes are accomplished through the courses we teach, and every professor provides a direct assessment of student performance through course grades. It the students pass all of the courses, we can then conclude that they have met all of the outcomes.
Expert: You cannot use course grades alone to assess the achievement of your program outcomes. Unless there is a clear one-to-one correspondence between a given course and an associated program outcome, simply passing the course does not guarantee students' attainment of the outcome. If it is possible to pass a course while not accomplishing the associated outcome(s), then the course grade cannot possibly be a valid measure of outcome achievement.

Furthermore, if your professors grade on a curve, then the course grades have no absolute meaning and cannot be used as the basis for measuring performance against a standard.
Program: Okay, then I will administer surveys to my students with questions as to how well they feel they can meet specific outcomes.
Expert: Student self-assessment surveys are *indirect* measures of performance. They tell us how well students *think* they are learning, but they do not tell us how well students are actually learning. Thus surveys are not by themselves sufficient to determine whether an outcome is being attained. You really should provide some direct measures of student performance.
Program: This is an incredibly challenging requirement, and it sounds like a lot of work. Can't you just tell me what I need to do? Give me an example of how you assess outcomes at your school.
Expert: I can't really do that, as it would appear that I had a preconceived agenda or was trying to dictate how you must do your assessment. ABET is committed to allowing programs to devise their own methods of outcome assessment.
Program: Since I can't use course grades, I suppose I will have to develop an entirely new system of assessment to meet the accreditation requirements.
Expert: Not necessarily. Ideally, you are encouraged *not* to develop entirely new assessment systems to meet accreditation requirements. To the greatest extent possible, you can—and should—rely on data and indicators that already exist in your program.
Program: Well, how in the world am I supposed to do that?

This paper attempts to answer our hypothetical program director's questions and frustrations. The authors have both been civil engineering program chairs charged with preparing their own programs for accreditation; they also serve as ABET evaluators who have each conducted multiple accreditation visits. One author has developed and administered program evaluator training for the American Society of Civil Engineers. We will offer our thoughts and perspectives on what is required for successful compliance with Criterion 3. And at no extra charge, we will provide some broader advice to department chairs who are preparing for their accreditation visits.

II. An Assessment Process for Criterion 3

Although the outcomes-based ABET accreditation criteria have been in place for over seven years, many schools are still struggling with ABET Criteria 2 (Program Objectives) and 3 (Program Outcomes) as they prepare for accreditation visits. Program objectives are currently defined as "broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve."[1] The definition of objectives has changed several times over the past five years,[2,3] but the consistent theme has been what a program expects its graduates to be able to do several years after graduation. Outcomes, on the other hand, have consistently been defined as what a program expects its students to be able to do at the time of graduation. Because programs have control of and direct access to their students up until graduation, outcomes are more conducive to data gathering and assessment and have therefore received more attention and a higher level of expectations in the accreditation process.

While assessment processes will inevitably vary from program to program, the authors recommend the following general process for performing assessment of program outcomes:

- Develop program outcomes
- Document constituency input
- Identify where in the curriculum these outcomes are met
- Establish performance measures for each outcome
- Evaluate student performance against these measures and provide a rating
- Make and document decisions and changes based on the results

a. **Develop program outcomes:** Defining what your students can do at the time of graduation is an important task that should not be done in a vacuum. Program outcomes should be consistent with the mission of the college, the university, and the community it supports. The outcomes must also derive from the program objectives. While the ABET criteria only currently require constituency input for objectives, it would be wise nonetheless to consult with constituents directly on outcomes as well. Such consultations require that the program formally define its constituents. A typical list might include faculty, alumni, students, industry, the engineering profession, and graduate programs. It is up to the individual program to decide which constituents it serves. One common mistake is to overlook students as constituents and therefore neglect to seek their input. A second is to create an inconsistency between an outcome or objective and the list of constituents. For example, it would be inconsistent to list successful performance in graduate school as a program objective and then not include graduate programs as a program constituency.

Because the ABET Criterion 3 a-k outcomes must be embedded in the program outcomes, it should be very clear to an evaluator how this mapping is done. While a program is free to create outcomes in any manner it chooses, the evaluator is required to explicitly determine the degree to which each of the Criterion 3 a-k outcomes is being accomplished. In an effort to simplify their assessment systems, some programs define a small number of outcomes, which combine multiple Criterion 3 a-k outcomes into single program outcome. While this practice is not prohibited, it ironically tends to create *more work* for the program, because the demonstration that a given program outcome is being achieved must now also ensure that all embedded Criterion 3 a-k outcomes are being achieved. When several of Criterion 3 a-k outcomes are combined into a single program outcome, there is a significant danger that one or more a-k outcomes will be overlooked in the program assessment process. It is easier for both the program and the evaluator to avoid combining the Criterion 3 a-k outcomes. The best practice is to retain the Criterion 3 a-k outcomes as distinct program outcomes but tailor them to the program's unique character and priorities. For example, a program whose primary focus is structural engineering might take criterion 3j, "a knowledge of contemporary issues," and revise it to read "a knowledge of contemporary structural engineering issues." Similarly, if a program seeks to develop some additional ability in its graduates—say leadership, creativity, managerial skill, or ability to conduct research--the program is encouraged to create an associated program outcome. Such additional outcomes will also need to be assessed, but since they are unique to the program, they are unlikely to receive the same level of scrutiny as the Criterion 3 a-k outcomes.

b. **Document constituency input.** There are a variety of ways to obtain input from constituents, which include advisory board meetings, surveys, interviews or industry visits. The means is not as important as documenting the process. Minutes of advisory board and faculty meetings, summaries of survey results, and records of interviews are all great means of documentation. The documentation helps both a program director and an evaluator determine the extent to which constituencies were actually consulted and provides a record to show how their input was used to make changes to the outcomes. Such documentation is even more important for program objectives, because constituent input to objectives is required by Criterion 2. Once the program outcomes have been developed and formalized, constituent input should still be systematically collected over time. In a process of continuous improvement, changes to the objectives and outcomes themselves should occur occasionally. Without appropriate documentation, it will appear that these changes were ad hoc or were based only on anecdotal evidence.

c. **Identify where in the curriculum the outcomes are attained**. Most programs consist of a series of courses, requirements, and experiences that must be successfully completed in order to graduate. It is by taking these courses that the outcomes are attained. Each program should therefore attempt to identify in which courses the program outcomes are addressed and what students must actually do to demonstrate satisfactory attainment. The most common starting point for most programs is a matrix listing courses on one axis and outcomes on the other. Each course is then rated with respect to its contribution to a specific outcome. Table 1 shows part of a sample matrix, in which a dot signifies that the course contributes to an outcome and a blank cell indicates that it does not. The authors' preferred method is shown in Table 2, where a 1 to 5 rating is used instead of a dot. This technique allows the reader to distinguish whether a course's contribution to an outcome is major, minor, or somewhere in between.

The matrix has several benefits. It allows a program director to see which courses are contributing most toward each outcome, which in turn provides guidance for where the assessment of student performance should occur. The matrix also shows where there are no courses contributing to an outcome—a significant problem that should be addressed by either changing the outcome or making a curriculum change to better incorporate the outcome. It must be emphasized that a course-outcome matrix like the ones illustrated in Tables 1 and 2 does not constitute a demonstration of outcome achievement. It merely points toward the specific courses in which high-quality measurements of outcome achievement are most likely to be obtained.

The more specific documentation of this linkage can be provided through notebooks that collect samples of student work. The ABET *Accreditation Policy and Procedures* manual requires that programs provide "representative samples of student work that reveal the spectrum of educational outcome" for the accreditation visit—and some programs still collect these samples as a routine part of their assessment processes. Others create student portfolios or outcome notebooks that display examples of student work. These documents require discipline and effort to collect, but are indispensable if the evaluator questions the correlation shown in the program's course-outcome matrix. Every program needs to decide for itself how to best present its achievements.

d. **Establish performance measures for each outcome.** In order to assess student performance, there must be some data collection and analysis to support a conclusion. Many programs struggle with deciding which data to collect and how to ensure that the data are measurable, particularly with respect to non-quantitative outcomes like professional responsibility, knowledge of contemporary issues, and life-long learning. Some data are considered direct measures of student performance and are given greater credence, while others are indirect[4]. Two years ago, the ABET Engineering Accreditation Commission (EAC) provided explicit written guidance on the subject of direct vs. indirect measures—the so-called Criterion 3 White Paper.[5] Unfortunately, the white paper has since been removed from the ABET website, and its status is uncertain.

Civil Engineering Program Outcomes

		Course					
	Program Outcome	**CE300**	**CE364**	**CE371**	**CE380**	**CE400**	**CE404**
3a	**Knowledge of mathematics, science, and engineering**	•	•	•	•	•	•
3b	**Design & conduct experiments, analyze and interpret data**	•		•		•	•
3c	**Design a system, component, or process to meet desired needs**	•	•	•			•
3d	**Function on multi-disciplinary teams**				•		
3e	**Identify, formulate, and solve engineering problems**				•		
3f	**Understanding of professional ethical responsibility**		•	•			
3g	**Communicate effectively**	•	•	•	•		•

Table 1. A portion of a matrix that identifies which courses in the curriculum contribute to each program outcome.

Civil Engineering Program Outcomes

		Course					
	Program Outcome	**CE300**	**CE364**	**CE371**	**CE380**	**CE400**	**CE404**
3a	**Knowledge of mathematics, science, and engineering**	5	5	5	3	3	5
3b	**Design & conduct experiments, analyze and interpret data**	3	2	4	2	4	4
3c	**Design a system, component, or process to meet desired needs**	4	4	3	1	2	5
3d	**Function on multi-disciplinary teams**	1	1	2	3	1	1
3e	**Identify, formulate, and solve engineering problems**	1	1	2	5	2	1
3f	**Understanding of professional ethical responsibility**	1	3	4	1	1	1
3g	**Communicate effectively**	4	5	3	4	1	3

Assessed by Course Director: ***1=No Contribution 2=Small Contribution 3=Average Contribution 4=Large Contribution 5=Very Large Contribution***

Table 2. An improved matrix that uses a rating of 1 to 5 to assess the degree to which each course in the curriculum contributes to each program outcome.

Some examples of credible data which can be used as measures of outcome achievement are provided, in order of priority from best to worst, as follows:

- *Fundamentals of Engineering Exam results.* The FE exam is a standardized, nationally normed exam taken by engineering students across the country in a controlled environment. Since the test includes subjects such as mathematics, ethics, statics, fluid dynamics, and chemistry, the results correlate directly to some program outcomes. Where applicable, these data are statistically significant, free of instructor bias, and highly credible. The data are only valid if a large number of the students take the examination. If only a minority of a program's students take the FE exam, the credibility of the results is significantly diminished—but these results should be used nonetheless. It is important to the note that, to be used effectively for outcome assessment, exam results for specific subject areas should be applied to program outcomes that explicitly address these same subject areas; e.g., fluid mechanics exam results might be applied to an outcome relating to proficiency in hydraulic engineering. In general aggregate FE exam pass rates are *not* useful for outcomes assessment, with the possible exception of outcomes associated with preparation for professional practice.

- *Direct ratings from outside experts.* Many programs invite members of industry or local professional societies to observe student performance, especially on capstone designs or independent study projects. Such evaluations are credible because they are free of faculty bias and are typically provided by outside experts who have a vested interest in seeing well-educated engineers enter into society and the marketplace. By asking these visitors to complete a carefully crafted assessment instrument, valuable data can be obtained. When students are making presentations, programs can receive excellent feedback on students' communication skills. Outside experts' ratings are particularly useful for assessing students preparation for professional practice; e.g., their understanding of engineering ethics and professional roles and responsibilities. Some may argue that these ratings are just surveys, but because they are based on direct, objective, focused observations of student performance, they are appropriately regarded as direct measures. For programs that offer co-op opportunities or summer internships, performance feedback from employers is equally as valuable. The challenge is constructing a critiquing instrument that provides the right feedback in a format that is useful. A Likert scale format that forces responses into numerically-based descriptive categories can make even the most qualitative judgment into something quantitative. The use of rubrics can be useful to further quantify and define distinctions between categories.[6,7]

- *Performance of student work (embedded indicators).* Student performance in an activity—an exam, project, or assignment—that correlates directly to a specific outcome can be quite useful as a direct measure. These are often referred to as embedded indicators because they are already embedded in the program; faculty members are already evaluating the performance, often through a grade; and no new instrument needs to be created. Courses that receive a score of 4 or 5 on the matrix in Table 2 become the best source for these embedded indicators. The activity could be a test question, a homework assignment, a design problem, a group activity, an essay, or a presentation. It is only important that the score on the event correlates directly to a specific outcome. For Outcome 3a which is the "ability to apply mathematics, science and engineering," the final examination grade in a calculus course would be a good embedded indicator. For Outcome 3d, "the ability to work on a multi-disciplinary team", it may have to be a graded sub-element of a group project that evaluates the performance of the team. It may even be helpful to add an element to an existing group project that is specifically designed to evaluate this outcome. If no embedded indicator can be found in the curriculum for a particular outcome, then there may be a flaw in the curricular design that needs to be addressed. Note that using an embedded indicator as a measure of performance is different than simply using the grade for an entire course. A course grade typically aggregates many different aspects of student performance and thus can rarely be associated directly with one specific outcome[8]. In a course such as the culminating capstone design course, in which many program outcomes are likely to be addressed, it is possible to capture embedded indicator data for all (or most) program outcomes through this one course[9,10].

Embedded indicators are best viewed as a snapshot in time – a statistical sampling, rather than an absolute standard that every student must attain. Even the Criterion 3 White Paper[5] states, "Programs do not need to prove that each and every student has demonstrated achievement of (a) though (k), but they must show, even if by appropriate sampling, that there is convincing evidence to assume that all students have demonstrated achievement, to a level acceptable to the program, of every item listed in (a) through (k)." Success or failure on one embedded indicator should not be used as the sole basis for determining students' success or failure in achieving any given program outcome. There are presumably other requirements in the program that could indicate attainment of an outcome. Requiring every student to meet a specific standard on an embedded indicator would also be administratively problematic, as it would effectively establish a new set of graduation requirements.

- *Survey data.* The most common data collected are surveys administered to students, faculty, employers, or alumni that ask questions related to outcomes and objectives. While such data are helpful, they are considered indirect measures. The Criterion 3 White Paper[5] stated that such data are not sufficient to demonstrate attainment of an outcome. Some could argue that the validity of indirect measures depends on the outcome. For outcome 3e, for example, which is "the ability to identify, formulate and solve engineering problems," a student's opinion through a survey is not as convincing as the student's performance on a sample engineering problem. Outcome 3i, however, "a recognition of the need for, and an ability to engage in life-long learning" is measuring a student attitude. In this case, a survey response may be totally appropriate and sufficient. Many schools already have surveys in place, especially at the end of courses and immediately prior to graduation. To the maximum extent possible, programs should identify questions on those existing surveys that correlate to program outcomes and use these data. It is also probably less work to get a question added to an existing university survey than it is to write, distribute, and compile a new survey.

- *Course completion or grades.* While course grades are not sufficient, by themselves, to show attainment of an outcome[8], they can be useful and should be used in conjunction with other measures. Logically, a course grade can be a valid measure of outcome achievement if two conditions are met. First, the grades must be criterion-referenced; i.e., they must be assigned according to an absolute standard of student performance, rather than on a curve. Second, there must be a clear one-to-one correspondence between the course content and the outcome. Thus, for example, a student's grade in a structural design course could legitimately be used to demonstrate the student's achievement of an outcome requiring proficiency in structural engineering. Course grades can be particularly useful for courses outside the program that contribute to an outcome. Many programs require humanities, social science or English courses as a mandatory breadth component of the major. Many times these courses contribute to outcomes such as 3h (broad education to understand impact of engineering solutions) and 3j (knowledge of contemporary issues). It may be difficult to convince the departments that teach these courses to participate in the program's assessment processes or to develop their own embedded indicators. It may be that a course syllabus and course grades are the only data available. If so, such data should certainly be used.

e. **Evaluate student performance against these measures and provide a rating.** For each outcome, the program must decide which data to collect, based on what is currently available, what is needed to justify attainment, and the amount of effort required to obtain it. A combination of direct and indirect measures should be assembled for each outcome. Next, the program must define the desired standard of attainment. On an embedded indicator, it may be a course average of 70% or 80%. For a survey question, it may be an average student response of 4.0 on a question where the response scale ranges from 1 to 5. Programs may desire an additional standard such as no student or a very small percentage of the students offering a response of 1. The desired standard is often a judgment call. Programs should evaluate student performance against these measures and provide a rating. If the other steps are in place, this final one is merely a book-keeping chore. Figure 1 shows an example for Outcome 3b (design and conduct experiments).

In this example, there were two questions from existing surveys that support this outcome. The performance standard is at least an average student response of 4.0 on a 1 to 5 scale (1: Strongly disagree, 2: disagree, 3: neutral, 4: agree, 5: strongly agree). The benchmark was the average response by students to the same question over the previous five years. Four specific laboratory experiences were chosen as embedded indicators, with the students' laboratory reports specifically requiring the analysis and interpretation of data. Two of the indicators involved designing experiments, which are difficult to find in most civil engineering programs. In this program, there is an annual course assessment process, in which both the students and the professors rate the student performance with respect to each of the course objectives. The example lists the course objectives from CE371 (soil mechanics), CE380 (hydraulics and hydrology) and CE483 (reinforced concrete design) that correlate directly to laboratory activities. The performance measures also include completion of the mandatory physics (PH) and chemistry (CH) courses which have substantial laboratory components. These are taught outside the department and there is very little assessment data available. Nevertheless, the inclusion of these measures helps demonstrate the extent to which students have a breadth of laboratory experiences.

In this example, the program director gave the student attainment of this outcome an overall rating of 4 on a scale of 1 to 5. The rating is a judgment based on analyzing the data gathered. In this case, the program met all of the established performance measures, but some were just barely attained. A similar rating can be made for all of the program outcomes. Table 3 shows the ratings for the 3a-k outcomes for a program over a series of years. All too often, programs will collect raw data and leave it to the ABET evaluator to interpret. Assigning a rating to each of the outcomes forces the program director to analyze and synthesize the data and then make a conclusion.

This type of a system allows a program director to demonstrate the extent to which the students, as a group, are attaining the various outcomes. Although it is not required to show that every student meets the outcomes, the most reasonable means of reaching this conclusion is through the transcript process. The program director must argue that the evidence demonstrates that a student who successfully meets the graduation requirements for the program is also achieving the program outcomes, based on the type of evidence shown in Figure 1 and Table 3. A major part of the accreditation evaluation is the detailed analysis of six transcripts from students

OUTCOME 3B: GRADUATES CAN DESIGN AND CONDUCT EXPERIMENTS, AND ANALYZE AND INTERPRET DATA

Major Performance Measures:

1. Selected questions on Civil Engineering Senior Survey [CESS].
2. Selected questions on University Senior Survey [USS].
3. Successful completion of the lab components of CE 364, CE380, CE371 and CE483.
4. Selected embedded indicators from courses taken by all students

Survey Results:

Tool	#	Item	Std.	Bench mark	Avg. Resp.	Remarks
CESS	11	I can design and conduct experiments and interpret data.	4/5	4.33	4.37	0 of 38 disagreed.
USS	74	I can integrate theory and application through laboratory discovery.	4/5	4.15	4.06	1 of 38 disagreed

Embedded Indicators:

Course	Embedded Indicator	Performance Score	Performance Standard	Comments
CE300	Tension Lab	88.5%	80%	Strong Performance
CE371	Lab 2 (Soil Classification)	83.2%	80%	Satisfactory Performance
CE483	Lab 1 (Mix Design)*	82.8%	80%	Satisfactory Performance
CE460	Quality Control Plan*	93.0%	80%	Very Strong Performance

*=Design of experiment

Other Assessment Results:

- All students successfully completed the lab component of CE371, CE380, CE364 and CE483.
- All students successfully completed PH201, PH202, CH201 and CH202
- CE371, CE380 and CE483 all have course objectives that relate directly to this laboratory experience. The course directors rated the student performance in each of these course objectives to be at least satisfactory
  - ⇒ CE371: Course Objectives 1, 3, 4, 5, 6, 8, 9 ,10, 11 ,21, 22 (See CE371 Course Assessment)
  - ⇒ CE380 : Course Objectives 2, 5, 10, 17, 18 (See CE380 Course Assessment)
  - ⇒ CE483 : Course Objectives 16, 17, 18, 19 (See CE483 Course Assessment)

Consolidated Rating: 4

Figure 1. A sample assessment of a program outcome using performance measures with quantitative standards of performance

who have just graduated. This analysis is the appropriate means of demonstrating that every student meets the program requirements. Otherwise, why require it?

f. Make and document decisions and changes based on the results. The feedback loop is closed by using the assessment results to make changes in the program. If the changes are formally documented, then others can follow why they were made. If the assessment system is standardized and repeated on a periodic (usually annual) basis, the following year's data will help assess whether or not the previous year's changes were effective. Performing the assessment in a consistent standardized manner every year reduces the burden on the faculty. The methodology becomes understood and it takes far less time to repeat a process on successive iterations than it does the first time through.

Because an engineering program is comprised of courses, an annual program assessment can be enhanced by using a course assessment process[11]. A formal course assessment that is done on every course provides a means to collect program data and to make changes at the course level. While it would be different for every program, the format for the course assessment should be carefully designed to facilitate the easy roll-up of data, require minimum administrative burden on the faculty member, and force an analysis of the most critical areas. Course assessments also provide a means to involve more faculty members in the assessment process. The weakest programs tend to have one person whose major additional responsibility is accreditation preparation and the rest of the faculty do not participate. The strongest programs have a couple of people who guide the overall effort and provide the organizational structure for the assessment process, but maximize faculty involvement in completing the assessments and discussing the program changes.

#	Civil Engineering Program Outcomes	02	03	04	05	06
3a	Knowledge of mathematics, science, and engineering	5	4	4	4	4
3b	Design & conduct experiments, analyze and interpret data	5	4	4	4	4
3c	Design a system, component, or process to meet desired needs	4	4-	4-	3+	4-
3d	Function on multi-disciplinary teams	3	3+	4	4-	4
3e	Identify, formulate, and solve engineering problems	5	4	4	4	4
3f	Understanding of professional ethical responsibility	5	4	4+	4+	4+
3g	Communicate effectively	5	5	5	4+	4+
3h	Understand engineering solutions in a global and societal context	4	5	5	4+	4
3i	Ability to engage in life-long learning	3	3+	4	4	4
3j	Demonstrate knowledge of contemporary issues	5	4	4	4+	4+
3k	Use modern engineering tools to solve problems	4	4-	4-	4	4

Table 3. Sample ratings for program outcomes over a period of time

III. Additional Hints for Accreditation Preparation

The following are a potpourri of thoughts, observations and advice developed over several years, based on both program director and accreditation evaluator experience:

- *Attitude is important.* The accreditation process is administered by human beings who are making subjective judgments about a program. As such, the attitude displayed by the program director, faculty, advisory board and students will have an effect on the results. A positive attitude and a demonstrated desire to continuously improve the program could make a difference in a close-call evaluation.

- *The system is fairer than it initially appears.* Some may conclude that because the process is administered by human beings making subjective judgments, the system is unfair. Seemingly, an overaggressive evaluator with a personal agenda could provide a biased and unfair evaluation to an engineering program. The more realistic scenario is that a deficient program will be rated more favorably by an unprepared evaluator. While it is always possible that a program could fall victim to an overzealous evaluator, there are at least two levels of safeguards built into the system. Each accreditation team is led by an experienced team chief whose responsibility is to ensure consistency across the programs being evaluated. Through the series of team meetings that occur during a visit, a rogue evaluator is usually identified and coaxed back in line. After an evaluation, a program has the right to influence the final accreditation decision through written statements showing errors in fact, errors in judgment, or even describing how shortcomings have been fixed. The accreditation team's report (with the institution's "due process" input) is rigorously reviewed by the ABET staff and by the Engineering Accreditation Commission (EAC) at large. Final accreditation decisions are not made until the EAC Annual Meeting in July—six to ten months after the accreditation visit—so there is ample time for remedial action by the institution. As a result of this review process, the final accreditation decisions on many programs are changed, almost always for the better.

- *Make the self-study easy to follow.* The program self-study is the most important document in an accreditation visit. A good program evaluator will read it carefully and will attempt to have his questions answered in advance of a visit. Based on the self-study and the associated dialog between the program chair and the evaluator, an accreditation evaluation is about 90% complete before the evaluator ever visits the campus. The self-study should therefore be easy for the evaluator to follow. The format should follow the accreditation criteria exactly, so that the evaluator can easily go through it point by point and match it to the published standards.

- *Integrate the program criteria into your program outcomes.* Criterion 8 of the ABET Engineering Criteria requires that most engineering disciplines comply with separate discipline-specific program criteria. Many programs treat the program criteria as separate entities, distinct from the general Engineering Criteria, and only pay attention to them when preparing for an accreditation visit. The authors strongly recommend that programs incorporate the appropriate program criteria directly into their program objectives and outcomes. For example, the current Civil Engineering

Program Criteria require that graduates have proficiency in four recognized major civil engineering areas. We suggest that the program identify the specific four (or more) civil engineering areas that it has chosen to focus on and state these areas explicitly in one or more program outcomes. Having done so, the program will ensure its compliance with the program criteria as a routine and integral part of its annual assessment process and thus will not need to give these criteria any special emphasis in preparing for the accreditation visit.

- *Don't neglect the transcripts.* The six transcripts that accompany a self-study convey a lot of information about a program. They provide insight into the structure of the program, the degree to which prerequisites are followed, the effectiveness of academic counseling, the process for accepting transfer credits, the number of times a student can fail a course, and degree of complexity of a program. Because every program makes some changes over the years, it is quite likely that the students who recently graduated followed a somewhat different program than is currently published in the university course catalogue. The program director should send the evaluator the information on the program in effect for the class whose transcripts are being examined. Include any other documents such as counseling worksheets, prerequisite waivers, or transfer credit approval that will make the transcripts easier to follow and will enhance the perception that an effective monitoring system is in place. A program director should review these six transcripts in advance of sending them. It is always better if the evaluator is not the one to identify the shortcoming, and in some cases, the problem may be able to be fixed prior to submittal.

- *Don't embellish.* While all universities should be encouraged to portray their program in a positive light when preparing the self-study, be careful not to overstate any accomplishments or programs. An evaluator is often looking for particularly outstanding aspects of a program as well as shortcomings, and is likely to probe further on such areas, perhaps even in the interest of gleaning good ideas for her own program. If the program or accomplishment does not live up to its advertisement, the credibility of the rest of the self-study is compromised. Embellishments will sometimes attract questions from evaluators that would otherwise not be asked. It should also be noted that the credibility of a self-study is greatly enhanced by critical self-assessment. A program that is able to objectively identify its own shortcomings and has mapped out a plan to remediate them sends the message that it is well managed and is supportive of the concept of continuous improvement.

- *Consistency between catalogue, webpage, and program literature.* In the modern electronic age where course offerings, program outcomes and program requirements can be easily posted in many venues, it is important that these publications be consistent. This can be particularly challenging as changes are made all of the time and the publication schedule for the university course catalogue may be quite different from a department website. If there are differences, it is helpful to explain them in advance to the evaluator.

- *Make the assessment process systematic and sustainable.* It used to be common for programs to ignore accreditation requirements for the four years after a successful visit and then spend two years intensely preparing for the next visit. This often results in very complex, time-intensive assessment systems that work for a year or two, but take too much time and effort to be sustained over time. It is easier to develop a systematic assessment process that is done the same way every year. Similarly, a few carefully crafted, high-quality indicators for an outcome are preferable to a long list of assessment instruments covering every comprehensible aspect of the program and requiring monumental effort to assemble and maintain.

- *Include program activities other than courses.* While it has already been mentioned that it is worth capturing contributions to outcomes from courses taught outside the program, it can also be worthwhile to assess activities other than course work. ASCE student chapters can make contributions to understanding professional responsibility, lifelong learning and leadership. These activities often involve community service projects, lectures from practitioners, and interaction with local professional societies. Depending on the percentage of students participating, programs can assess and take credit for such activities. Attendance at voluntary F.E. exam preparatory sessions indicates recognition of lifelong learning and professional responsibility. Summer internships, coop programs and relationships with local industry all can potentially contribute.

- *Stay current.* Although EC2000 has been in effect for seven years and most programs are on their second round of accreditation under this system, the accreditation process continues to evolve and new changes are being made every year. Even in areas where there are no criteria changes, the guidance for successful assessment is modified. In many cases, the standards are getting higher as more schools gain experience and understanding with the accreditation process. In some cases, it is the program criteria (Criterion 8) that are changing. For civil engineers, ASCE Policy 465[12] and the accompanying body of knowledge[13] have brought far reaching changes to the program criteria[14]. Those programs not staying current will inevitably be caught by surprise. Without question, the best way to stay current is to become personally involved with ABET and its member societies that are charged with developing and implementing accreditation standards.

IV. Conclusions

While accreditation can be a daunting and frustrating experience for many programs, there are ways to make the process more manageable. This paper provides guidance on how to achieve that end, with particular emphasis on ensuring compliance with Criterion 3 (Outcomes). As the standards for outcomes assessment solidify and become better standardized and defined, programs can probably expect greater emphasis on Criterion 2 (Objectives). This criterion requires input from constituencies. Because students go in many different directions after graduation, it is far more difficult to obtain quantitative, measurable data on what graduates accomplish several years after graduation. As more programs struggle with this requirement and find innovative solutions, the de facto standard for compliance will inevitably be raised—even if the written standard does not change. In that event, the authors' admonition to stay current and to become personally involved with the professional societies charged with implementing accreditation standards will become even more important.

Disclaimers

Any opinions expressed here are based on the experiences of the authors and do not necessarily reflect the current policy of the supporting agencies.

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