

EC2000 CRITERION 2: A PROCEDURE FOR CREATING, ASSESSING, AND DOCUMENTING PROGRAM EDUCATIONAL OBJECTIVES

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Introduction

Criterion 2 [Program Educational Objectives (PEO)] is arguably the most important part of ABET EC2000. PEO embody the broad vision for an engineering program that drives the overall accreditation process. They also provide a crucial nexus point for the assessment of each program, the point at which the programmatic issues of the other EC2000 criteria—curriculum, faculty, facilities, etc.—are considered within the larger context of the needs of key constituencies of the program and the mission of the institution. Criterion 2 plays an essential role in EC2000's goal of encouraging continuous improvement in engineering programs and of providing the opportunity for people involved in those programs to define what continuous improvement means for their own programs.

Despite this crucial role, very little attention has been paid to Criterion 2 in the engineering literature. For example, in the ASEE Conference Proceedings from 1998-2000, only four papers addressed Criterion 2 in any detail, and in each of those the treatment was a brief part of a consideration of all EC2000 criteria, inadequate to provide meaningful guidance to programs trying to manage Criterion 2. In contrast, 52 articles dealt with some aspect of Criterion 3 (Outcomes a-k).

The lack of attention given to Criterion 2 can be explained in several ways. One is that engineering faculty are much more comfortable dealing with the familiar issues of faculty, facilities, and financing than with institutional mission and needs of program constituencies. But perhaps a more telling reason is that Criterion 2 is by far the least concrete of the EC2000 criteria. Unlike Criterion 3, for example, which provides a structure by detailing curricular requirements in Outcomes a-k, Criterion 2 provides little in the way of concrete guidelines for what should be included in the PEO, nor for the processes of generating and assessing them.

Instead of discouraging conversation about Criterion 2 in the engineering literature, its lack of concreteness ought to be the impetus for that conversation. In this paper, we describe a two-part procedure for operationally defining Criterion 2, a procedure we have developed and used as a guide for diverse engineering programs within North Carolina State University College of Engineering. Our goal is to provide these programs a set of guidelines for generating and assessing their PEO and for creating the associated documents they must present to ABET evaluators. We will discuss the procedure first and then show how it has been applied to three aspects of Criterion 2: the features of the PEO, the process of determining and assessing the PEO, and documents related to the PEO to be provided to ABET visitors. Finally, we will briefly address the logistics of managing Criterion 2 in a large college of engineering.

A Procedure for Managing Criterion 2

Here is the way ABET presents Criterion 2 in [Criteria for Accrediting Engineering Programs](#).

Criterion 2. Program Educational Objectives

Each engineering program for which an institution seeks accreditation or reaccreditation must have in place:

- (a) detailed published educational objectives that are consistent with the mission of the institution and these criteria
- (b) a process based on the needs of the program's various constituencies in which the objectives are determined and periodically evaluated
- (c) a curriculum and process that ensures the achievement of these objectives
- (d) a system of ongoing evaluation that demonstrates achievement of these objectives and uses the results to improve the effectiveness of the program.¹

This description indicates that each program must produce a set of educational objectives, define a process for generating and evaluating them, ensure that the elements of the program are in place for achieving the objectives, and see that the entire process leads to improvement in the program. It does not say precisely how all of these tasks are to be achieved, however, nor does it specify what documents should be presented to the ABET evaluators so that they can assess the degree to which Criterion 2 is satisfied.

At NC State, we felt that it was important to provide the programs within the college a clearer set of directions to work with than that in ABET's description of Criterion 2. Not only would such directions be helpful to the individual programs, but they would also provide some consistency across the college. To accomplish this task, we engaged in a two-part procedure, first interpreting ABET materials related to Criterion 2 and then applying the interpretation in a set of guidelines.

Interpretation was necessary in order to flesh out the particulars of Criterion 2. We examined the other ABET documents treating the PEO, notably *Engineering Criteria 2000: Program Self-Study Instructions* and *Engineering Criteria 2000: Manual of Evaluation Process*. These documents provide more information about Criterion 2, but they do not offer explicit details of how to manage it. The next step was to take the details yielded by the interpretation and turn them into suggested procedures for programs to use in managing Criterion 2. Our intention was to offer not algorithms but heuristics, not formulas but guidelines. Though many faculty in the programs would have preferred algorithms, the heuristics gave them something relatively concrete to work with.

The sections that follow contain explanatory material we presented to the ABET coordinators for each instructional program related to (a) characteristics of program educational objectives, (b) determining and assessing PEO, and (c) documents that should be submitted as products of the assessment process.

Characteristics of Program Educational Objectives

Program educational objectives are broad goals for each program. They should be:

- **consistent with the mission of the institution.** They should reflect pertinent parts of the mission statements and long-range plans of the university, college of engineering, and department.
- **consistent with the needs of key constituencies.** They should address the concerns of the major stakeholders in the program, such as students, employers, industry advisory boards, etc.
- **comprehensive.** They should be broad and overarching, providing a vision for the whole program.
- **consistent with the other EC2000 criteria.** They should be compatible with the language of Criterion 1 and Criteria 3-8.
- **clearly defined.** They should be delineated with enough detail to make their relevance to the program unmistakable.
- **measurable.** They should be written in a way that allows for qualitative and quantitative assessment.

- **flexible.** They should not narrow or unduly limit possibilities for the program but should be adaptable to future changes in the needs of constituencies and mission of the institution.
- **published.** They should be made public, for example, placed on the program's web site, included in brochures about the program, printed in newsletters sent to alumni and employers, and given to students upon entry into the program.²

The set of characteristics can be used as guides for creating PEO, especially as the features have been elaborated. They are not enough, however. Perhaps the best guide is a sample set of PEO that exemplify the features. The sample shown in Appendix 1 was produced by one of the programs in our college of engineering and was made available to the other programs as an example of PEO that possess the features set forth by ABET.

Notice that the objectives in Appendix 1 are *comprehensive*, offering a broad view of the goals of the program as a whole. In particular, they avoid simply restating the outcomes from Criterion 3 a-k, as we have noticed in the PEO of some other programs. They are also *detailed*: in most of the objectives a general term is set forth—such as preparing students for entry into successful careers or encouraging an understanding of the professional and ethical obligations of the engineer—and then defined by stating more specifically what the general term means. The objectives are *measurable*, in that most of them are directly related to outcomes from other criteria. Finally, they are *flexible*, detailed but still broad enough to see the program through most shifts in the needs of constituencies and the mission of the institution.

Determining and Assessing the Program Educational Objectives

The ABET materials we looked at make it clear that each program should have well defined and effectively implemented procedures in place for generating and assessing PEO, although they don't specify what those procedures should be. This lack of detail suggests that ABET does not want to impose one process on programs, but rather wish to give each program the flexibility to design its own. There are, however, certain general standards that emerge from the ABET literature. The process of determining and assessing Program Educational Objectives should:

- **provide for a high degree of involvement of broad and appropriate constituencies of the program.** These key constituencies should, which might include alumni, employers, and students, play an important role in both generating and assessing the PEO.
- **take seriously the mission of the institution.** This means assembling the mission statements and long-range plans and any other pertinent documents for the university, college of engineering, and department and reading those documents carefully to identify the specific language and general ideas that should be included in the PEO.
- **provide for periodic assessment of the PEO.** Assessment cycles should occur with enough frequency to give programs a good sense of the extent to which they are achieving their objectives and to act on what they find.
- **provide the means for applying the results of assessment to improving the program.** Perhaps the most important element of EC2000 is the requirement that each program should have an operational and effective feedback loop whereby any problems revealed by assessment are turned into opportunities for enhancing the program.
- **be part of a broader system of assessment of EC2000 criteria.** The assessment of the PEO should be linked to Criterion 3, curricular standards, and other pertinent criteria for evaluating programs.²

A process for creating and evaluating each program's achievement of the PEO should meet these general standards. Combining these standards with the desired characteristics of PEO gave us a much better understanding of both the means and the end, the process and the product that the process must generate. To translate this understanding into a procedure that programs could follow, we defined the following tasks. Tasks 1-8 relate to determining PEO and Tasks 9-12 to assessing them.

1. **List of key constituencies.** Constituencies are the various categories of people who have some vital interest in the program because they are in some way affected by it, such as students, faculty, employers, recent graduates, parents of students, etc. Programs should determine the *key* constituents, those who would be most valuable in the process of establishing objectives.
2. **Description of the individuals or groups who will serve as representatives of the constituencies.** Most constituencies are too large to be used as a whole, so the program needs to identify suitable representatives for the groups and/or describe methods, such as a survey, for gaining the participation of the representatives.
3. **Analysis of the institutional mission as it is related to the program.** Gather key documents outlining the institutional mission: mission statements, long-range plans, etc. of the university, college of engineering, and department. Read through these documents marking the passages pertinent to the goals of the program. The point is to identify the ways in which the objectives of the program should reflect the mission of the institution and also the ways in which the program may play a role in enabling the institution to achieve its mission.
4. **Step-by-step plan for generating objectives.** Detail the process the program intends to follow, including proposed dates and times for various meetings, deadlines for gathering various kinds of information, and the parties responsible for getting tasks done. Set up the plan so that it involves the key constituencies as much as reasonably and productively possible in framing the PEO.
5. **Final list of objectives based on a variety of inputs.** The objectives should be broad, comprehensive goals that the program strives to reach, specific enough to be measurable but flexible enough to meet the needs of the various constituencies involved. The objectives represent a vision for the program, the goals it sets for itself to achieve. They should be clearly tied to the mission of the institution and to constituent needs. (See Appendix 1.)
6. **Description of the relationship between the PEO and the needs of key constituencies and the institutional mission.** A crucial aspect of Criterion 2 is to show that through its PEO the program is responding to the needs of the key constituencies and serving to further the mission of the university, the college, and the department. Using either list or graphic form, describe these links. Review the materials generated through contact with constituent groups and the analysis of mission statements and note any themes and wording from those sources that are found in your PEO. Be sure to be as specific as possible, detailing the various sources for each objective.
7. **Description of the relationship between the PEO and other ABET criteria.** Because they provide a critical node for the broader EC2000 process and because their assessment will depend to a certain extent on the assessment of the other EC2000 criteria, it is important to show how the objectives are related to the other criteria. One way of doing this is to create a matrix linking the objectives to a-k in Criteria 3 and the rest of the criteria. This matrix will provide a broad view of the whole program as an integrated system.
8. **Process log, recording all activities related to determining PEO.** One of the most far-reaching changes in EC2000 is an emphasis on process. It is crucial, then, that the program be able to account for the processes that are involved in its work related to the PEO as well as all the other ABET criteria. *This log could also be very helpful for writing various reports for ABET evaluators.* Include dates, times and participants for meetings; minutes or other descriptions of what was done and why; informal but important conversations with members of constituencies; etc.
9. **Procedure for periodic review of the objectives.** An important part of the process encouraged by Criterion 2 is the periodic review of the PEO. The review is both a broad assessment of the program

(in terms of the objectives) and a reexamination of the objectives themselves. The procedure generated by the program should:

- (a) establish review cycles,
- (b) describe the various kinds of data that will be used for reviews (probably a mix of qualitative and quantitative data, which may include data from assessments of the other criteria),
- (c) outline a detailed review process that will include key constituencies (the program may use a revised version of the procedure for establishing the objectives), and
- (d) present a clear method for using the data for continual improvement of the program (a closed feedback loop for making curricular and other decisions) and for updating the objectives in response to changes in the particular field of engineering, the needs of the constituencies, and the mission of the institution.

10. **Reports for each of the review cycles.** Each formal review associated with Criterion 2 should be summarized in a report. That report may:

- (a) chronicle the review process,
- (b) present the primary data gathered for the process,
- (c) describe the evaluative outcomes of the review in terms of each of the objectives, and
- (d) show how the outcomes of the review were incorporated into the larger process of the continual improvement of the program and/or led to an updating of the objectives.

11. **Description of the program as a working system of interrelated parts leading toward the continual improvement of the program.** One of the most important goals of EC2000 is to encourage faculty to take a systemic (as well as systematic) view of engineering education. This means seeing their program as a unified collection of parts: a highly integrated system of faculty, courses, and curriculum, all driven by the PEO, which are themselves influenced by the needs of the key constituencies and the mission of the institution. Therefore, a crucial step in the larger accreditation process is to show that the program has such a system in place, a system that leads to the sustained and continual improvement of the program.

Here are the primary components of the system for each program:

- the institutional mission (university, college, department)
- the needs of the key constituents of the program
- the requirements (if any) of particular professional accrediting agencies for the program
- the PEO
- the college administration (insofar as it helps to support the objectives),
- the departmental administration (also insofar as it helps to support the objectives)
- the curricular outcomes defined under Criterion 3
- the courses in the curriculum
- the faculty teaching in the program
- the facilities
- the financial resources
- information pertinent criteria

It is important to demonstrate how these various parts are related to each other in two ways: (1) how each part either influences the goal of the whole OR contributes to attaining that goal and (2) how each part is connected to a larger process of continual improvement of the program through various forms of assessment and review, such as:

- periodic reviews of educational program objectives
- assessment of curricular outcomes under Criterion 3
- reviews of institutional and financial support
- various faculty reviews, including decisions related to tenure and promotion and post-tenure reviews

- regular assessments of facilities

12. Continuation of the process log (Item 8), recording all assessment activities related to Criterion 2.

Documents Related to the Program Educational Objectives to be Provided to ABET Visitors

The ABET materials are relatively explicit in their treatment of what programs should do to prepare for the ABET evaluation of Criterion 2. In the Program Self-Study Instructions, programs are directed to "Discuss in detail the educational objectives, the process by which these objectives are determined and evaluated, how the program ensures these objectives are achieved, and the system of ongoing evaluation that leads to continuous improvement of the program, as required by Criterion 2".³ At a minimum they should:

- provide a list of Program Educational Objectives
- show how the PEO are consistent with the mission of the institution
- identify significant constituencies of the program
- describe the processes used to establish and review PEO and the extent to which various constituencies have been involved in these processes
- produce documentation that demonstrates that the processes are working and producing the desired results and that the results are being used to improve the effectiveness of the program
- describe how the program curriculum and processes ensure achievement of the PEO. Provide data that shows the processes are working and producing the desired results and that the results are being used to improve the effectiveness of the program.⁴

The process outlined above enables each program to produce the necessary elements for providing the detailed discussion required by ABET, but we thought that it would also be helpful to provide an annotated list of documents programs should prepare for the ABET visitors. The list is shown in Appendix 2.

Online Management

Thus far in this paper we have offer detailed procedures for guiding programs as they consider Criterion 2. However, another issue is the logistics of managing these procedures in a large college of engineering with many programs. At NC State we have created a website containing the above information about Criterion 2 and more. This website has three main functions: (1) to provide guidelines for programs to follow as they are engaged in the various aspects of the ABET process; (2) to provide a central location for programs to post their work in draft form so that other programs may get the benefit of their work; and (3) to provide a virtual portfolio for programs to use for their ABET reviews. (See <http://www.engr.ncsu.edu/abet>)

Conclusion

The primary purpose of this paper is to offer a procedure for operationally defining the tasks and documents associated with EC2000 Criterion 2, a procedure necessary because of its relatively indefinite description in the ABET materials. This procedure consists of two parts, first the interpretation of various ABET documents related to Criterion 2 and second the development of heuristics or guidelines based on the interpretations. We then described some of the guidelines that we have generated from this procedure at North Carolina State University.

But there is a larger purpose as well, which is to refocus our collective attention on Criterion 2. This criterion is central to the effectiveness of the EC2000 process because it embodies the broad purposes of the new accreditation procedure: to create a system for the continuous improvement of engineering

programs and to allow programs to define success for themselves, thus avoiding cookie-cutter engineering curricula. Because PEO play such a critical role in attaining these purposes, it's important that program ABET committees do a good job of defining and assessing their PEO. However, the disproportionately small amount of discussion of Criterion 2 in our literature suggests that we may not be giving this criterion its due, focusing our efforts instead on the criteria that are more definite and more familiar.

This paper attempts to rectify that oversight. The process of defining and assessing the PEO has the power to change our perspective of engineering programs. When we invite the participation of stakeholders in this process, we come to see what we do in light of the needs of those stakeholders. When we look at our programs in terms of the mission of the institutions in which we work, we come to understand what we do as contributing to a larger complex of goals. And when we view our programs as integrated systems, we come to appreciate the dynamics of how the different components of those systems interact with each other to create a whole. This change of perspective is what EC2000 is trying to encourage.

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Bibliography

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URL: <http://www.abet.org/downloads/2000_01_Engineering_Criteria.pdf>
2. These standards were compiled from the key ABET documents: "Criteria for Accrediting Engineering Programs"; "Engineering Criteria 2000: Program Self-Study Instructions, 1998-99 EC2000 Visits (Engineering Accreditation Commission of The Accreditation Board for Engineering and Technology); "Engineering Criteria 2000: Manual of Evaluation Process, 1998-99 Visits" (Engineering Accreditation Commission of The Accreditation Board for Engineering and Technology).
3. URL: <<http://www.engr.ncsu.edu/abet/departments/ce/ce-criterion-2/ce-peo-2.html>>.
4. "Engineering Criteria 2000: Program Self-Study Instructions, 1998-99 EC2000 Visits," p. 4.

Appendix 1

Program Educational Objectives Department of Civil Engineering North Carolina State University

The Department of Civil Engineering at NC State is home to educational programs in the professions of Civil Engineering, Construction Engineering and Management, and Environmental Engineering. A single department head and management structure direct the educational mission of these three closely related specialties. In a cooperative effort, the faculty of this department in collaboration with students, recent graduates, employers, and other constituencies developed the following objectives for Civil Engineering undergraduate education.

1. To prepare students for entry into successful careers in Civil Engineering emphasizing the mastery of engineering fundamentals, the ability to solve engineering problems, and the importance of engineering judgment, engineering experimentation, and the creative process of engineering design.
2. To instill in students the sense of pride and confidence that comes from applying their knowledge of engineering principles and procedures to the economic and social benefit of society.
3. To encourage in students an understanding of the professional and ethical obligations of the engineer, to conduct themselves as professionals, recognizing their responsibility to protect the health and welfare of the public, and to be accountable for the social and environmental impact of their engineering practice.
4. To establish an educational environment in which students participate in cross-disciplinary, team-oriented, open-ended activities that prepare them to work in integrated engineering teams.
5. To offer a curriculum that encourages students to become broadly educated engineers and life-long learners, with a solid background in the basic sciences and mathematics, an understanding and appreciation of the arts, humanities, and social sciences, an ability to communicate effectively for various audiences and purposes, and a desire to seek out further educational opportunities.
6. To expose students to advances in engineering practice and research as preparation for opportunities in professional practice and graduate education.
7. To obtain resources necessary to recruit, develop, and retain faculty who are committed to the educational mission of the department and to acquire, maintain, and operate facilities and laboratory equipment appropriate to our engineering program, and to incorporate traditional and state-of-the-art educational technology and methods.³

Appendix 2

Documents to be Provided to ABET Evaluators: Criterion 2

1. **"Program Educational Objectives"** The purpose of this document is to state the objectives and then to explain them. It should include:
 - (a) a list of the PEO;
 - (b) a detailed discussion of the objectives, showing how each one is consistent, where appropriate, with the mission of the institution, the needs of key constituencies, and with the spirit of continual improvement represented in the EC2000 criteria;
 - (c) a description of the relationship between the objectives and the program's curriculum (Criterion 3) and other relevant EC2000 criteria.

2. **"Establishing Program Educational Objectives"** The purpose of this document is to describe the process the program created for establishing the PEO. It should emphasize the degree of involvement of the key constituencies and the role of the institutional mission in the process. The document may include appropriate portions of the process log as an appendix. This document should include:
 - (a) a list of the key program constituencies,
 - (b) a discussion of how and why those constituencies were identified as key to the process of establishing objectives,
 - (c) a delineation of how and why individuals or groups were chosen to represent the key constituencies,
 - (d) a description of the initial plan for establishing the objectives and how the program arrived at that plan, and
 - (e) a detailed outline of the process the program actually followed, including any explanations necessary for deviations from the original plan.

3. **"Process for Periodic Review of Educational Program Objectives"** The purpose of this document is to show that the program has in place a thorough and realistic procedure that allows it to assess, in consultation with key constituencies, the extent to which the program is achieving the objectives and also to review the objectives themselves, all of which leads to a more effective and responsive program. This document should include:
 - (a) an outline of the assessment plan: including assessment cycles, kinds of information to be used for evaluation, how key constituencies are involved in the review, and how the results of the review will be used to improve the effectiveness of the program and/or revise the objectives;
 - (b) reports for each of the review cycles detailing the particular process undertaken (including any explanations necessary for deviations from the original plan), the results of the review, evidence that the program is achieving its objectives, opportunities for improvement revealed by the assessment, specific recommendations for changes in the program or changes in the PEO, and a description of the process of implementing those changes.

4. **"System for Continual Improvement"** The purpose of this document is to demonstrate that the various parts of the program contribute to the goal of continual improvement of the whole program. The document should describe the whole system, the parts of it that influence the PEO, the parts that work together to attain those objectives, and the processes by which various reviews and assessments drive the system toward continual improvement.

This document should include:

- (a) a description of the program as a system. Using the PEO as the core of the description, show how all the parts of the system are related to them. Some parts, such as the institutional

mission and the needs of the key constituents, serve to influence the creation of the objectives. Other parts, such as the curricular outcomes and the faculty and the facilities, serve as the instruments by which the objectives will be achieved. What's important to note, though, is that the objectives provide the crucial link between, say, the mission of the institution and the faculty. The description, then, will consist of a graphical and verbal rendering of this system, showing how its parts are strategically and integrally related to its whole.

- (b) a description of the system as a means of leading toward continual improvement of the program. This part will focus on the way the various reports and assessments have been used to unite all the parts of the system in the general improvement of the whole. It will summarize the reviews in place, the results of these reviews, and the role that the results have played in making the program better, particularly in terms of the PEO.