Model for Outcomes-Based Assessment of Undergraduate Engineering Programs

1. Introduction

The purpose of this model is to guide the continuous improvement of undergraduate engineering programs at The Ohio State University. It is intended to be a source of guidance without constraining experimentation or alternative approaches that may be developed by individual programs. The focus of the model is on the eight criterion listed in General Criteria for Basic Level Programs [1];

- Criterion 1. Students
- Criterion 2. Program Educational Objectives
- Criterion 3. Program Outcomes and Assessment
- Criterion 4. Professional Component
- Criterion 5. Faculty
- Criterion 6. Facilities
- Criterion 7. Institutional Support and Financial Resources
- Criterion 8. Program Criteria

The eight criterion can be subdivided into 1) Process Perspective and 2) Resource and Content Perspective. Criterion 2 and Criterion 3 deal almost exclusively with process. Criterion 1 and 4-8 deal primarily with resources and with specific content needed for a program.

The following three sections are intended to:
- further define each perspective,
- suggest the general process by which each program, in collaboration with the college, establishes, and maintains program objectives and outcomes, and assesses progress, and
- describe the role and operation of the College Committee on Outcomes Assessment.

2. Process Perspective for Evaluation and Improvement

The ABET Basic Level Accreditation Criteria can be viewed as requiring two different major feedback systems, Educational Objectives and Program Outcomes, as shown in Figure 1. The arrows that link the elements of the model can be viewed as feedback loops. This feedback is essential for continuous improvement, and most often incremental in nature.

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1 Adopted by Outcomes Assessment Committee, 1998; Revised October 2002; Revised October 2004; Revised March 2005, Revised February 2006
Figure 1. Defining and Evaluating Attainment for Educational Objectives and Program Outcomes

The *Educational Objectives* (EO’s) for a program are “broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.”[1] Development and maintenance of EO’s interfaces with external constituencies and deals with long-term issues.

The *Program Outcomes* (PO’s) describe “what the student’s are expected to know or be able to do by the time of graduation. These relate to skills, knowledge, and behaviors that students acquire in their matriculation through the program.”[1] PO’s focuses on shorter-term issues faced by the faculty and administration and interfaces with students.

EO’s and PO’s should be informed by and remain consistent with the most recent version of the General Criteria for Basic Level Programs and the Program Criteria. Current EO’s for each program must be clearly stated in literature of the College, Department and Program and available to current and prospective students. For example, current EO’s for each program are to be published for future students on the College of Engineering website [http://www.eng.ohio-state.edu/prospective/future_students.html](http://www.eng.ohio-state.edu/prospective/future_students.html) and the University website, “major series”, [http://undergrad.osu.edu/academics/majors.asp](http://undergrad.osu.edu/academics/majors.asp).

### 2.1 Educational Objectives (EO’s)

In relation to outcomes assessment, Criterion 2 requires

“(b) a process based on the needs of the program’s various constituencies in which the objectives are determined and periodically evaluated”, and

“(d) a process of ongoing evaluation of the extent to which these objectives are attained, the results of which shall be used to develop and improve the program outcomes so that graduates are better prepared to attain the objectives.” [1]

EO’s are identified and refined by the program in consultation with outside constituencies and current students. This is a cyclical process. The goal is to keep the EO’s current by having a process which identifies the needs of the program’s various constituencies, critically assess the attainment of graduates and periodically reassesses and updates of the objectives. Although elements of this process are continuous in nature and will vary among programs, each program has responsibility to assure a documented cycle of activity such that EO’s, as well as their linkage to PO’s, are re-evaluated *at least every three years*. Recognizing that different constituents may have competing needs and expectations, each program will have a process in
place to resolve potential conflicts while fulfilling as many of the needs as practically as possible.

Recent graduates are deemed to be in an important position to observe whether the EO’s of their program have been met or exceeded. For the first six years (1999-2005) of outcomes assessment by the College under this system, senior exit, 2nd, 6th and 15th year alumni were surveyed. After careful review of the data collected, the college decided to modify its approach. The college is now committed to conducting a bi-annual alumni survey of 2nd and 3rd year alumni (See Appendix 1). The survey will contain two main sections: 1) statements / questions common to all programs in the college and 2) statements / questions that are program specific. Data gathered through such surveys will be accumulated and used as one key input to the EO’s and PO’s.

Within this process loop, external constituents can be divided into two major groups: 1) recent alumni of the college's programs, and 2) employers and/or supervisors of engineers. It is expected that this will give a balance of the perspectives of engineering managers and the recent experiences of our graduates.

Each program has the responsibility of working with and documenting the specific needs of its constituency. Multiple processes to identify and define these needs and expectations can be used. This may involve a range of possible mechanisms from the use of standing Departmental or Program Advisory committee to ad hoc groups selected to address a specific need or issue. However, it must be demonstrated that this type of needs analysis is being done on a regular basis and is documented as being effectively integrated into the assessment system.

2.2 Program Outcomes (PO’s)

Each program must formulate and periodically evaluate PO’s that foster attainment of the educational objectives and are inclusive of those noted by ABET [1] as (a) – (k). Establishing and monitoring progress towards PO’s is an iterative process taking place at two primary levels: Curriculum and Course. Although success of students in accomplishing the EO’s is an indicator of success in achieving the PO’s, progress towards PO’s can be most directly evaluated during and at or near the time of completion of the formal instructional process. Results may imply needed change in courses, curriculum or the PO’s. Figure 2 shows suggestions for inputs.
2.2.1 Curriculum Level Assessment Process

On-going curriculum level assessment, with a balance of both direct and indirect assessment techniques, will be the responsibility of the programs. The following inputs are suggested:

**General and Targeted Alumni Surveys** – As outlined in Appendix 1, alumni survey will be done every two years.

**Senior Exit Surveys** – This is a survey of engineering seniors at or near their point of graduation from the program. The objective is to assess the degree to which the students think their program met its objectives and to solicit their input regarding potential improvements to the program. Each program is responsible for implementing a process for their program.

**Co-op/Intern Performance Evaluation** – Surveys are to be requested to be completed by the direct supervisor each student upon completion of the co-op or intern experience. Each of these surveys is reviewed by staff of the Career Services unit. Results of each survey will be made available to the respective program of the student. Career Services will work in collaboration with the OAC on continuing to develop its surveys in a way that facilitates collection of direct assessment data for the programs.

**Monitoring of Professional Exam Results** – The college will annually report results of professional exams to the relevant programs.

**Monitoring of Student Progress** – Each program must have a system in place to monitor the progress of all students towards a degree, and to report any related problems.

**Monitoring Placement** – The Career Services office makes a report of placement of students available to all programs annually.

**Faculty’s Evaluation** – Periodically, the program will seek input from the faculty on their perceptions of the role of each course (or course sequence) in the curriculum; on how well the course or specific elements of the course is contributing to the desired PO’s.
Core Curriculum Committee – this committee has responsibility for the on-going development of the engineering core curriculum, the engineering general education curriculum, college listed courses and undergraduate student services within the college.

2.2.2 Course Level Evaluation Process

On-going course level assessment, with a balance of direct and indirect assessment techniques, will be the responsibility of the departments and programs. It is the responsibility of the instructor for each course to maintain a detailed course syllabus which carefully delineates both the content and PO’s addressed by the course. The syllabus should also contain course objectives, clearly indicate the selected teaching materials, instructional techniques and evaluation methods. The following inputs are suggested:

*Student’s Evaluation* – Each program should have a system for collection of student evaluation of courses which may include the Universities SEI form.

*Instructor’s Evaluation* – Each program should have a program for instructors to make evaluation input regarding courses.

*Student Performance* – Each program should have in place a system of evaluation of the student performance measured against program outcomes.

3. Resource and Content Perspectives

Resources and content can be generally defined as any input to an educational program that is necessary for the program to succeed (Figure 3.) Criterion 1 and Criterion 5-7 [1] bear directly on resources, while criterion 4 and 8 bear directly on content. Adequate resources must be available to the program at all times to have on-going accreditation. The following subsections highlight the major resource and content categories and the means by which the program will monitor progress in each category.

Figure 3. Resource and Content Perspective

3.1 Students (Criterion 1)

The college will retain responsibility to ensure that students admitted to the college meet the qualifications needed and that these qualifications correspond to the expected achievement level. The college and the program evaluates, advises, and monitors students to determine success in meeting EO’s and PO’s. Further, each program will have evaluation and improvement mechanisms in place to monitor the progress of students. The College, in cooperation with each program, will maintain a system for assuring that each student has met all curriculum requirements prior to graduation. Each program will also monitor the progress of its alumni and solicit their input for program improvement.
3.2 Professional Component (Criterion 4)

Although each program establishes its uniqueness through its EO’s and curriculum design, the College assumes responsibility to ensure that all programs operate within a certain envelope and that all graduates matriculate with specific qualifications. Towards this end, the College Committee on Academic Affairs (CCAA) is charged with the responsibility “for making recommendations to the Faculty of the College concerning the educational and academic policies of the College. This shall include, but shall not be limited to, the responsibility to make recommendations concerning the establishment, alteration, and abolition of all curricula and courses offered by the College or any division thereof, of all degrees and certificates supervised by the College, and of all departments, schools, and bureaus of the College.” [Rules of the College of Engineering, paragraph 5.7, November 21, 2005] In addition, the committee is to “Certify at the end of each quarter lists of students who have fulfilled the requirements for a degree or for whom special recommendation is made...” [same source]. Thus, CCAA plays the critical role of quality curriculum control within the college.

3.3 Faculty (Criterion 5)

“The faculty must be sufficient number; and must have competencies to cover all of the curricular areas of the program…” [1] It is the responsibility of the departments to assure that no program of study is offered or continued unless requirements for faculty are met or exceeded.

3.4 Facilities (Criterion 6)

“Classrooms, laboratories, and associated equipment must be adequate to accomplish the program objectives and provide an atmosphere conducive to learning.” [1] Each program assumes the responsibility to periodically assess priorities for equipment purchase and replacement, and to plan for the maintenance of adequate laboratory facilities. The college will coordinate distribution of student computing funding based on the student computer fee and matching funds.

3.5 Institutional Support and Financial Resources (Criterion 7)

“Institutional support, financial resources, and constructive leadership must be adequate to assure the quality and continuity of the engineering program.”[1] To assure that this criterion is monitored, the department chairs will report to their faculty regarding resources and expenditures of the department in all categories. Where it is feasible, the chairs will use both internal and external benchmarks.

3.6 Program Criteria (Criterion 8)

“Requirements stipulated in Program Criteria are limited to the areas of curricular topics and faculty qualifications” for a specific program [1]. It is the responsibility of each program to assure that it is satisfying the applicable Program Criteria (if any).
4. **Outcomes Assessment Committee for Undergraduate Engineering Programs**

   **4.1 Goal**

   The goal of the Outcomes Assessment Committee for Undergraduate Engineering Programs (OAC) is to facilitate the achievement of excellence in undergraduate engineering education through rigorous use of appropriate assessment processes and continuous quality improvement.

   **4.2 Duties and Responsibilities**

   The OAC for undergraduate engineering programs will exercise its duties and responsibilities in support of the committee’s goal and the overall vision of the College. The OAC is advisory to the Associate Dean for Undergraduate Education and Student Services. Committee duties and responsibilities include:

   a) Oversee the development and implementation of the College’s Outcome Assessment Model for Undergraduate Engineering Programs, with particular attention to ABET's Engineering Criteria.
   b) Oversees the development and implementation of general and targeted alumni survey’s.
   c) Serve as a vehicle for programs to exchange experience and coordinate activities directed towards continuous program improvement.
   d) Recommend activities and support innovations in curriculum assessment.
   e) Work in concert with other committees of the College, in particular the Core Curriculum and College Services Committee and College Committee on Academic Affairs
   f) Coordinate Program Self-Studies in preparation for ABET reviews.

   **4.3 Membership and Terms of Membership**

   a) One member from each undergraduate engineering program of the college – selected by each program for terms specified by the program.
   b) Associate Dean for Undergraduate Education and Student Services – permanent member, Chair of Committee.
   c) One staff member of AA & SS – appointed by Associate Dean UE&SS, secretary for the committee.
   d) One undergraduate student – appointed annual.
   e) One department advisor – three-year term, selected by the college advisors.
   f) Other individuals appointed by the Associate Dean UEAA&SS as needed.

5. **References**

APPENDIX 1 – General and Targeted Alumni Survey

This is a bi-annual survey of alumni. The survey population will be 2\textsuperscript{nd} and 3\textsuperscript{th} year alumni (based on calendar year) for whom addresses are available through the OSU Alumni Association. The objective of the general survey is to 1) assess the degree to which recent alumni think their program prepared them for engineering practice 2) to solicit their input regarding potential improvements to the program and 3) collect relevant demographic information. The objective of the targeted survey is to explore one or more issues in greater depth. Targeted surveys are generally only done one time.

Responsibilities and Timing – Alternate Year Cycle

The college Committee on Outcomes Assessment will be responsible for continuous improvement of the common portion of the survey. Similarly, each program will be responsible for the program specific element.

The Associate Dean for Undergraduate Education and Student Services and staff are responsible for maintaining a file of forms used for current and previous surveys at the college and program level. The college will maintain a database of the college level segment of the survey and make this available to program and the OAC. Each program is responsible for summarizing program specific elements and archiving the results.

- **Autumn Quarter Survey Year**
  - The OAC reviews/updates the college level segment of the survey.
  - Programs update program specific element of the survey.

- **Winter and Spring Quarter**
  - College staff procures alumni lists and prepares surveys for distribution under cover letter of department chair.
  - Survey distributed by March 1\textsuperscript{st} with requested completion by May 1\textsuperscript{st}.

- **Summer Quarter**
  - College staff prepares a summary of the data.

- **Autumn Quarter of Non-Survey Year**
  - OAC reviews the summarized data and prepares recommendations, as needed.
  - Program’s committee reviews summary data.