

AC 2007-2275: IMPLEMENTING EC2000 – PERSPECTIVES FROM BOTH SIDES OF THE ASSESSMENT TRENCH

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Implementing EC2000 – Perspectives from Both Sides of the Assessment Trench

Abstract

As implementation of Engineering Criteria 2000 (EC2000) has matured so have the expectations of program assessment as viewed by many ABET - EAC program evaluators. Most engineering programs are preparing or have just completed a second visit under the new criteria and find that assessment practices considered acceptable for the first EC2000 visit no longer are. Surprises at this point are clearly not appreciated. ABET's current concern with the EC2000 accreditation process is to make program evaluations consistent, while programs are concerned with developing assessment programs that meet ABET's expectations but at the same time are sustainable. The process remains episodic for many programs while the intention of EC2000 is to make program assessment systematic. As both an ABET evaluator, and the individual with administrative responsibilities for accrediting five engineering programs at California State University, Chico, the author offers suggestions to help develop a clear framework for assessment activities and to help make the process sustainable. Examples of annual timelines for collection, evaluation, and overall reporting strategies based on the author's experience are offered.

Introduction

Assessment of student learning outcomes has become a fundamental part of the framework for American higher education in the 21st century. Regional accreditation agencies as well as the Accreditation Board for Engineering and Technology (ABET) are highlighting the importance of assessing student learning outcomes. Problems encountered with early EC2000 assessment programs were noted in a study initiated by the American Society of Mechanical Engineers (ASME) titled *Initial Assessment of the Impact of ABET/EC2000 Implementation Using Mechanical Engineering Programs as the Pilot Study Group*¹. That study lauded the extensive initial involvement of faculty in defining educational objectives, and the participation of program Advisory Boards to name a few. It also noted the shortcomings of certain assessment techniques, the failure of initial employer survey methods, and expressed concern regarding the strain that EC2000 appeared to place on program resources. In 2002 ABET commissioned a comprehensive study published in 2006, titled *Engineering Change: A Study of the Impact of EC2000*². Through careful evaluation of surveys of educators, employers, and engineering graduates, the study documents the overall positive impact that EC2000 implementation has had on engineering education. While the impact on engineering program graduates is clearly positive, it does not change the perspective of many faculty that on-going assessment programs represent a great deal of work that at times does not have an apparent connection with program improvement. In an early ABET newsletter, a column by Gloria Rogers titled "How Are We Doing?" summarized her expert opinion of our overall success in implementing EC2000³. In her evaluation, engineering programs overall earned a "D" grade for program assessment for a number of reasons, including a slow migration from indirect to direct methods, citing that many programs continue to rely heavily on student surveys instead of direct measures of student learning. Further, Rogers pointed out that many EC2000 implementers jump from a pre-defined set of outcomes, namely ABET (a)-(k), to collecting mounds of data, without a faculty consensus on what body of evidence constitutes achievement of a given outcome within a given program.

For this Rogers gives EC2000 implementers collective a grade of “F,” for failing to identify a limited number of performance indicators for each outcome. Based on personal observations from accreditation visits, the author shares this opinion. While this is likely the most difficult element in creating an effective assessment plan it is also the most important because it requires faculty to collectively decide what are appropriate measures of student learning.

Like most new undertakings, much can be learned from studying the success and failure of others -which approaches constitute best practices, and which assessment methods should be avoided. The good news is that it is up to faculty and administrators to develop and implement assessment plans that fit individual programs. While there is no clear “manual” for developing meaningful assessment programs that don’t consume an entire department’s time and energy, there are good examples of successful strategies that can serve as models for others. The following suggestions are based on the author’s personal experience as a faculty member, administrator, and mechanical engineering program evaluator.

Workload Recognition and The Right Stuff

Program assessment is clearly an endeavor that requires significant time and energy. To be successful, outcomes assessment needs a leader at the program level whose workload is formally recognized by the college administration. In larger institutions, there may be a central faculty or staff person charged with promoting assessment. Or, it may be the case that an administrator at the college level is given responsibility for coordinating ABET assessment activities. However, these individuals are positioned too far from program curricular decisions. Each program needs a faculty champion who is responsible for coordinating assessment activities among the faculty and staff, and has on-going release time to do so. Further, the assessment designee needs to have buy-in from both faculty and administration to have the process work. So who is the “right” faculty member to choose? The author has seen examples where this responsibility is assigned to a junior faculty member working his/her way toward tenure, or to a senior faculty member who is rich in experience but nearing retirement. Neither of these choices is a good one. The junior faculty should be focused on developing research and teaching pedagogy, as well as learning one’s way through the tenure and promotion gauntlet. While junior faculty might have the energy and enthusiasm for promoting assessment, they often lack influence with senior faculty. A mature faculty member, on the other hand, will often have the experience and insight to guide the process but may lack the drive to inspire innovation. A better choice is a mid-career faculty member with tenure and experience, who is both invested in the program and who will likely have to live with the results of the next ABET visit for some time.

Program Assessment Teamwork

Meaningful program assessment requires teamwork and cooperation among faculty not previously required to have successful engineering programs. Historically, engineering faculty are self-motivated individuals who often behave and work fairly independently. These faculty are experts in their field who have developed research programs and long-standing curriculum in their areas of expertise. This, however, is no longer an effective faculty model for EC2000. In the author’s experience, as faculty begin to focus more on program level student learning outcomes, the discussion shifts the focus away from the notion that a given course belongs to

professor “x,” and instead is part of a curriculum with collective ownership. Faculty must begin to cooperate and work as a team more than ever before. Successful programs will foster a team building environment for faculty, which is inclusive and without rank. In smaller programs, this can be the faculty as a whole. In larger programs, the dialog is more complicated by numbers and logistics, but it can be done effectively by an assessment committee with sufficient numbers and faculty diversity to have a significant impact on the program. To be most effective, this committee should be closely aligned with the curriculum committee. The author has observed the detrimental effects of a “disconnect” between the results and recommendations of an assessment committee and an independent minded curriculum committee.

Creating a Program Improvement Plan

During an early ABET EC2000 accreditation visit to the author’s institution, one of the program evaluators made the observation that the program assessment plan “appeared to exist only in the program self-study” and didn’t have a life outside of that context. As a result, the department chair created a working document titled the *Program Improvement Plan* whose purpose was to “outline the process for continuous assessment and improvement” of the program⁴. This document includes

- Summaries of the program mission and vision
- Summaries of the program educational objectives and program outcomes
- An outline of specific assessment measures and metrics used
- A timeline for periodic collection, evaluation, and dissemination of assessment results

The document does not include results, per se, but merely summarizes how, where, and when information on student learning and alumni achievement is collected and used. It is a clear, concise summary that serves as an assessment “handbook” for all program faculty. Because assessment goals and plans change continuously, the document is updated routinely. This model has been implemented by other programs within the college and serves as an excellent example of how to make the overall assessment scheme clear to all.

Timeline for Assessment

In the author’s experience, preparation for ABET accreditation visits in the past were always episodic. Every six years there was a flurry of activity among faculty and staff to collect student work, prepare course binders, clean laboratories and write a laborious self-study that was quickly forgotten after a successful visit. Unfortunately, some EC2000 efforts have followed the same pattern. The author observed numerous program assessment plans that were so elaborate and consuming that they were surely never executed after the ABET visit. Faculty are rightfully exhausted by the effort and quickly abandon the plan because of the inordinate time and energy required. These clearly did not meet the intention of EC2000 and could not be sustained.

It became clear to the author that programs needed a framework to help make the process periodic and accountable on an annual basis, not the six year period of an accreditation cycle. As a result, the author developed an annual timeline and reporting structure for programs within the College of Engineering, Computer Science, and Construction Management at California State University, Chico, included as Table 1. The timeline shows activities that include course

embedded assessment collection, evaluation, and dissemination as well as a timeframe for conducting surveys of graduating seniors, alumni and employers. In response to the Dean's expectation, this timeline has been adopted by all programs within the College.

Table 1 - Academic Year Assessment Cycle

The following are grouped logically by semesters and breaks but have overlapping timelines

Fall Semester	Activity
2 Weeks Before Classes Begin	Faculty submit course syllabi to Department Chairs and/or Assessment Coordinator for assessment review
1 Week Before Classes Begin	Department Chairs approve syllabi, return to faculty with assessment deliverables identified Faculty administer Senior Exit Surveys prior to end of semester
Winter Break	Activity
Fall Semester Grading Due Date	Faculty submit assessment materials to Department Chair and/or Assessment Coordinator Assessment Committee reviews assessment results
1 Week Before Classes Begin	Assessment Committee present assessment results to faculty, set actions if needed.*
Spring Semester	Activity
2 Weeks Before Classes	Faculty submit course syllabi to Department Chairs and/or Assessment Coordinator for assessment review
1 Week Before Class	Department Chairs approve syllabi, return to faculty with assessment deliverables identified Faculty administer Senior Exit Surveys prior to end of semester
Summer	Activity
Spring Semester Grading Due Date	Faculty submit assessment materials to Department Chair and/or Assessment Coordinator Assessment Committee reviews assessment results Dept. Chair and/or Assessment Committee conducts Alumni and Employer surveys Senior Exit Survey results analyzed - results reported to Department Chairs
1 Week Before Classes Begin	Assessment Committee present assessment results to faculty, set actions if needed.*
Fall Reporting	Activity
October	Annual Assessment Report from Department Chairs to College Deans summarizing assessment results, actions.*

* Department assessment results are to be shared, analyzed, and reflected with appropriate constituent groups including advisory boards or student groups at regularly scheduled meetings.

Annual Reporting of Results

The results from most of the assessment activities previously mentioned are summarized in an annual report to the college dean. Reporting these activities annually helps to assure that programs not only collect but also evaluate assessment results and report appropriate actions if needed in an on-going manner. Specifically the report summaries address the following areas (if applicable):

1. Assessment of Program Outcomes
 - 1.1. Summary of Program Outcomes
 - 1.2. Summary of Embedded Assessment Measures
 - 1.3. Summary Other Direct Measures (such as FE Exam results)
 - 1.4. Summary of Indirect Measures (such as student surveys)
 - 1.5. Analysis and Interpretation of Results
 - 1.6. Proposed Actions from Assessment of Outcomes
 - 1.7. Proposed Revision of Measures, Metrics, or Outcomes
2. Assessment of Educational Objectives
 - 2.1. Summary of Program Educational Objectives
 - 2.2. Alumni Survey Methodology and Results
 - 2.3. Employer Survey Methodology and Results
 - 2.4. Advisory Board Feedback
 - 2.5. Proposed Actions from Assessment of Educational Objectives
 - 2.6. Proposed Revision of Educational Objectives
3. Program Accreditation
 - 3.1. Summary of Accreditation Feedback
 - 3.2. Summary of Actions Taken to Address Accreditation Issues

These annual reports encourage on-going continuous improvement activities that are the foundation for a successful EC2000 assessment program.

Sustainable Embedded Assessment

Student outcomes assessment should be both meaningful and sustainable. In a recent edition of *Community Matters*, ABET's newer monthly newsletter, a column by Gloria Rogers titled "Assessment 101" outlines the different but valuable roles played by both indirect and direct assessment measures⁵. Many assessment experts agree that course embedded assessment techniques are among the most efficient direct measures of student performance and are the least taxing on faculty as a whole. While many courses may support the development of certain student outcomes, student work does not need to be evaluated in each for program assessment purposes. A simplified alignment of outcomes and courses where embedded measurements are made is provided in Table 2. By assessing key student work in upper level courses faculty are able to measure student learning when, in theory, they have attained subject mastery expected of undergraduates. Appropriate grading rubrics enable faculty to collectively use evaluation of specific assignments for program level outcomes assessment. By developing a lean "course

measurement matrix” there is little duplication of effort as each outcome is measured in a small number of courses.

Table 2 – Lean Learning Outcomes Course Measurement Matrix

<p style="text-align: center;">Student Learning Outcomes Course Measurement Matrix</p> <p style="text-align: center;">(Items 1-7 direct embedded measures)</p>	Student Learning Outcome A	Student Learning Outcome B	Student Learning Outcome C	Student Learning Outcome D	Student Learning Outcome E	Student Learning Outcome F	Student Learning Outcome G	Student Learning Outcome H
1. ENGR 200 - Engineering Graphics II								
2. ENGR 325 – Engineering Design								
3. ENGR 310 – Numerical Methods								
4. ME 238A –Design Project I								
5. ME 238B –Design Project II								
6. ENGR 420 – Thermal-Fluid Systems								
7. ENGR 495 – Lifelong Development for Engineers								
8. Fundamentals of Engineering Exam (EIT)								
9. Senior Exit Survey (Indirect Assessment)								
10. Alumni Survey (Indirect Assessment)								
11. Alumni Employer (Indirect Assessment)								

It is clear that EC2000 driven program assessment will not disappear from engineering accreditation criteria. Overall, comprehensive program improvement has been measured and documented since EC2000 has been initiated ¹. To make the process sustainable, however, there is a need to institutionalize it. This includes administrative support for assessment activities, allocation of adequate resources to support them, and faculty acceptance. For the later, the importance of faculty training cannot be overemphasized. All program faculty need some level of assessment training, either through in-house programs or preferably by professionals with significant assessment experience. In addition, college administrators need to provide incentives and funding to encourage faculty to attend ABET or other society sponsored training programs. When these support structures are in place, there is clear evidence that programs improve, and because of that, future generations of engineering graduates will be better prepared.

References

1. American Society of Mechanical Engineers, *Initial Assessment of the Impact of ABET/EC2000 Implementation Using Mechanical Engineering Programs as the Pilot Study Group*, Laurenson, Robert M., Editor, A Project of the ASME Committee on Engineering Accreditation, 2002.
2. Accreditation Board for Engineering and Technology, *Engineering Change: A Study of the Impact of EC2000*, Lattuca, Lisa R.; Terenzini, Patrick T.; Volkwein, J. Fredricks, The Center for the Study of Higher Education, The Pennsylvania State University, 2006.
3. Rogers, Gloria, "How Are We Doing?" *Communications Link*, Assessment Tip 8, ABET.
4. California State University, Chico, Department of Mechanical Engineering, Mechatronic Engineering, and Manufacturing Technology, *Mechatronic Engineering Program Improvement Plan*, Roth, Ron, June 2004.
5. Rogers, Gloria, "Assessment 101: Direct and Indirect Assessments: What Are They Good For?," *Community Matters*, ABET, August 2006.