

Developing a Sustainable ABET Continuous Improvement Plan

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Abstract

A sustainable continuous improvement process was required for use in the ABET-ASAC and ABET-ETAC accreditation process for our Operations Management, Construction Management, and Electronics Engineering Technology programs. Considering the state of assessment requirements in higher education, ABET accreditation standards, and the tools of quality and continuous improvement, our Department of Construction & Operations Management developed a three-intersecting-loop graphic that helped us to clarify the assessment, evaluation, and student learning improvement processes we will need to continue over time.

Keywords

Assessment, Continuous Improvement, Accreditation

Introduction

Our Operations Management (OM), Construction Management (CM), and Electronics Engineering Technology (EET) programs program are on track to have an accreditation visit in 2016. These three Department of Construction & Operations Management (COM) programs assesses student progress on the outcomes all through the curriculum, generally gathering data on three or four ABET¹ Criterion 3 Student Outcomes (SO) per course. We are also periodically re-evaluating the Criterion 2 Program Educational Objectives (PEO) and how graduates show that they are meeting them using the SO assessment process. From past experience in ABET-ETAC only accreditation, we believed that we had a good balance of data collection practices in place. What we did need, in 2012 as the programs were in the planning stage for the 2016 visit, was a more consistent and defined review process, for both PEOs and SOs. This paper explains what went into the process of developing the plans.

The State of Higher Education Assessment

Assessment can be defined as “the systematic collection, review, and use of information about educational programs undertaken for the purpose of improving students learning and development”². New importance is being placed on standards that require institutions to provide evidence of student academic achievement³. The ultimate purpose of engineering education assessment (or any type of evaluation) should be to improve student learning, which begins with setting objectives and renews itself with each assessment activity⁴.

Ewell, a leader in higher education assessment, states⁵ that there are four guiding principles for responding to calls for external accountability that also preserve and develop institutional capacity for evidence-based continuous improvement:

- Respond visibly to domains of legitimate external concern.
- Show action on the results of assessment.
- Emphasize assessment at the major transition points in a college career.
- Embed assessment in the regular curriculum.

Responding to external concern falls under the umbrella of the phrase *Culture of Evidence*, which is currently popular among policy and assessment experts. It captures the belief that higher education can enhance student learning and success if they systematically collect and examine data⁶. Ewell⁵ calls this the *Improvement Paradigm*, which can embrace many kinds of evidence-gathering, including standardized and faculty-designed examinations, capstone projects, demonstrations, portfolios, and specially designed assignments embedded in regular courses. As Baehr⁷ says, “Simply put, assessment is a process used for improving quality.” Measurement of student achievement of outcomes is the base for improvement, but an efficient, sustainable continuous improvement process must be in place before improvements can be made.

Quality and Continuous Improvement Definitions

There are several definitions from the world of quality that can be applied to the higher education assessment process. The American Society for Quality (ASQ) is a leading force for setting standards, and for providing education on how quality can be implemented and maintained in a variety of different situations. ASQ defines quality⁹ as:

1. the characteristics of a product or service that bear on its ability to satisfy stated or implied needs; 2. a product or service free of deficiencies. According to Joseph Juran, quality means “fitness for use;” and according to Philip Crosby, it means “conformance to requirements.”

ASQ defines continuous improvement¹⁰ as an ongoing effort to improve products, services or processes. The ISO 9001-2008¹¹ standard is used to assess whether manufacturers are following a good continuous improvement process. Figure 1 shows a graphic from the ISO 9001-2008 Standards document illustrating the continuous improvement process.

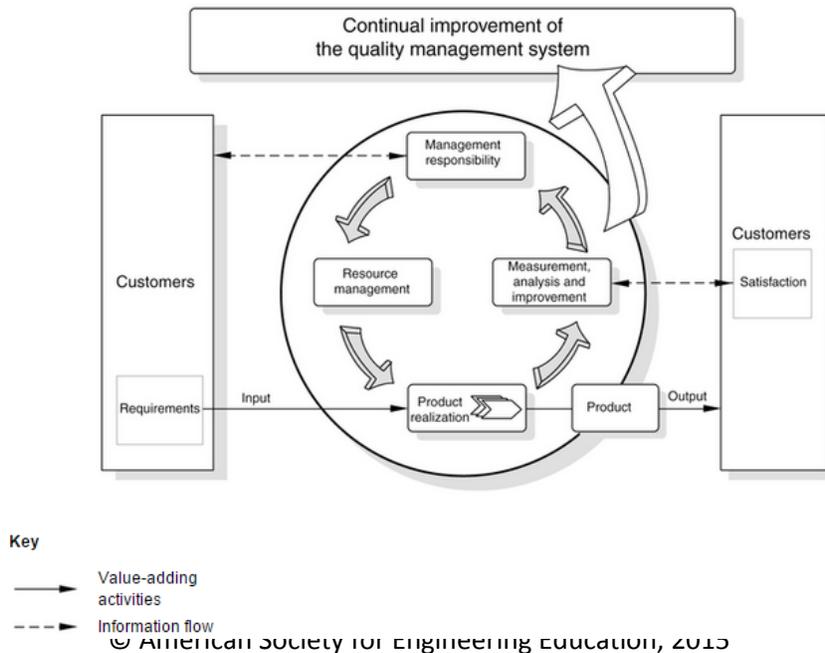


Figure 1. ISO 9001-2008 Continuous Improvement Process¹¹

As a specific process for continuous improvement, the Shewart Cycle, also known as *Plan-Do-Check-Act* (PDCA) can be applied to all processes. PDCA¹⁰ can be described as follows.

Plan: establish the objectives and processes necessary to deliver results in accordance with customer requirements and the organization's policies.

Do: implement the processes.

Check: monitor and measure processes and product against policies, objectives and requirements for the product and report the results.

Act: take actions to continually improve process performance.

For use by our COM Department¹¹, we have developed and use this definition: Quality Control (QC) is an in-process or embedded technique:

- In manufacturing, processes are monitored, to identify problems that could lead to non-conforming products
- Corrective action can be taken quickly in assessing a course, after each semester.
- Can also be used to test new materials, equipment, and methods. If a test did not work well, then fixing it can happen the next time the test is given.

In our COM Departments program's continuous improvement process, we use mostly embedded assessments, that is, we use the assignments, quizzes, tests, labs, reports and projects that are a part of the grading of the course as the assessment tool. A specific rubric is developed to apply to each assessment instrument to assure that we look at the specific SO we are assessing.

One of Deming's 14 Points on Total Quality Management¹² is especially relevant to continuous improvement in an educational environment: Cease dependence on mass inspection. In a manufacturing process "mass inspection" is used to find and remove defects in products before they are sent to the customers. In the educational process, we use exams in a similar fashion to weed out "defective" students¹³. Instead of mass inspection, assessment should use sampling. ASQ defines sampling¹⁴ as "the selection of a set of elements from a population or product lot". Sampling lets you draw conclusions or make inferences about the population from which the sample is drawn. In the COM Department continuous improvement process, as a part of QC, we sample student work to use as measurements of SOs, that is, we do not assess every assignment in every course (mass inspection).

Another quality idea that needs to be applied to the world of assessment is cost. Quality cost¹⁵ are the total of the cost incurred by:

- Investing in the prevention of nonconformance to requirements.
- Appraising a product or service for conformance to requirements.
- Failing to meet requirements.

Most faculty involved in the process of assessment and evaluation, seeing the costs of their time and effort (appraising for nonconformance), and approach the quality process as a necessary evil to satisfy the requirements of their institution. However, using assessment and evaluation of data to improve the quality of student learning (reducing the cost of failing to meet requirements), can

greatly benefit programs, although they may be difficult to measure. Those measurements would be the topic of more research.

Accreditation and Assessment using Continuous Improvement Terminology

The ABET 2015-16 Criterion 4 Continuous Improvement¹ states:

The program must regularly use appropriate, documented processes for assessing and evaluating the extent to which the student outcomes are being attained. The results of these evaluations must be systematically utilized as input for the continuous improvement of the program. Other available information may also be used to assist in the continuous improvement of the program.

The practice of continuous improvement applies not only to measuring student outcome performance, but also monitoring the assessment systems that are used to assess programs. Assessment systems that are efficient and current are less time consuming to employ and are more likely to yield reliable data. It is crucial to review assessment systems with the goal of continuously improving the process, that is, making them more sustainable.¹⁶

Spurlin, Rajala and Lavelle¹⁷ illustrated the overlapping and inter-twined aspect of both assessing how well students are learning, and also assessing the assessment system. The graphic they produced, shown in Figure 2, helps to clarify who is responsible for what actions, and then shows who should use the results of those actions in the next step of a process.

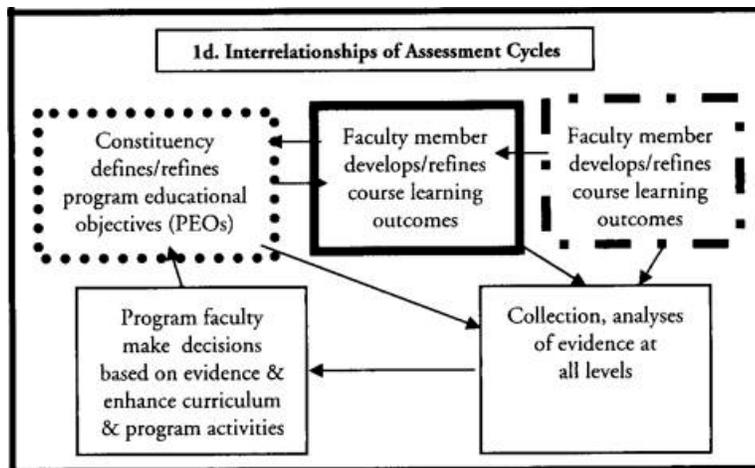


Figure 2. Interrelationships of Assessment Cycles¹⁷

The figure, though illustrative of what has to happen in a good continuous improvement process, does not provide a clear, operational, process to emulate. In our COM Department continuous improvement process, we chose to use the idea of interlinking cycles, but created more detailed and separated loops.

Using the COM Department Continuous Improvement Process

Considering the state of assessment requirements in higher education, ABET accreditation standards, and the tools of quality and continuous improvement in mind, our COM Department developed a three-intersecting-loop graphic¹⁸ that helped us to clarify in our minds the assessment, evaluation, and student learning improvement processes we had been doing for several years. Each loop is a complete PDCA process, carried on at different repetition rates, with different goals and quality targets in mind, as shown in Figure 3. For purposes of this paper, Figure 3 is shown too small to properly read, and each loop is broken out, in a larger scale, following.

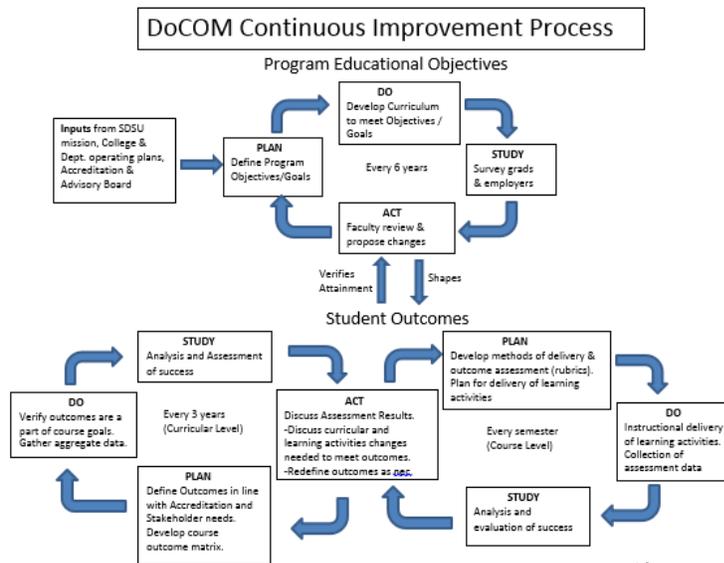


Figure 3. Complete Three-Loop Continuous Improvement Process¹⁸

The top loop, shown in Figure 4, at a larger scale to allow detail to be read, applies to the ABET Criterion 2 PEOs only. The figure illustrates that we are using input from our constituents, developing the objectives statements, setting a curriculum to meet the objectives, conducting surveys to check if the objectives were met, and then using the data to propose changes for the next iteration of the loop. This loop is repeated, ideally, every 6 years, as the overall, big picture, PEOs should be fairly constant over time.



Figure 4: Program Educational Objectives Loop¹⁸

The lower-left loop, as shown in Figure 5, dealing with the definition of Criterion 3 SOs, and making significant changes to the Department of COM program’s curriculum, should occur every three years. In this loop we maintain our course outcome matrix, that is, deciding in which course we will assess which SO. The data gathered each semester is summarized over time. The purpose of this loop is to decide if bigger, curriculum-level changes need to be made, for example if there is a need to switch program content from one course to another, or to add or drop courses to the curriculum, if we determine that is needed for students to learn what is needed by a Department of COM graduate.

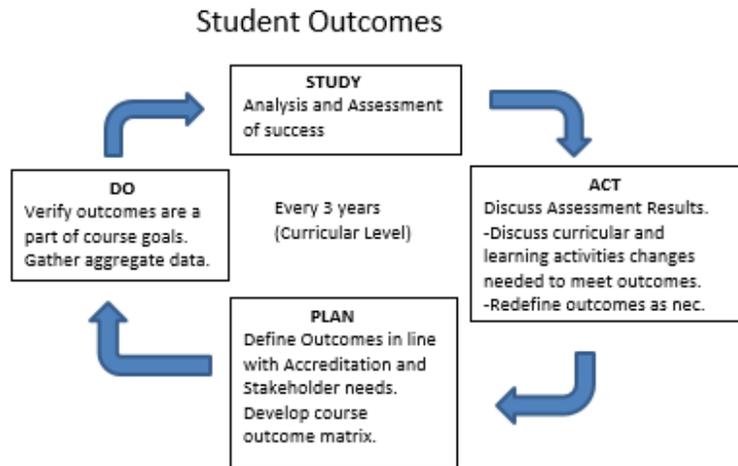


Figure 5: Considering the Student Outcome Statements Loop¹⁸

The lower-right loop, shown in Figure 6, deals with the assessment and evaluation of student outcomes data that we gather each semester. Again, using a PDCA process we let each faculty member decide on the tools (exams, labs, projects, etc.) they will use to assess the outcomes chosen for that course, decide on a rubric to use, gather student data throughout the semester and apply the rubric, and evaluate results to see if students met the goals we have set.

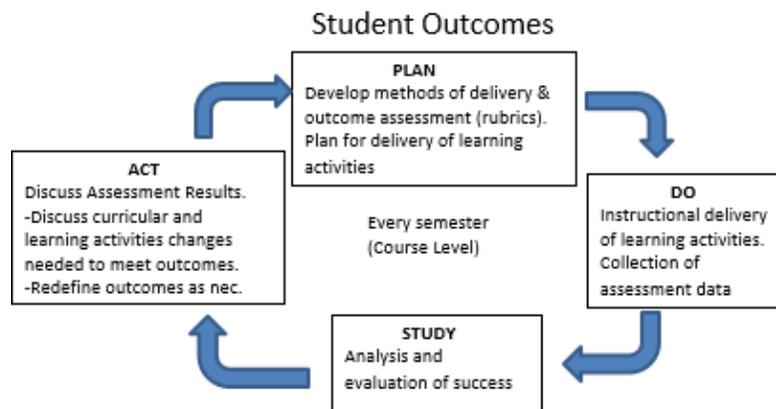


Figure 6. Review whether students meet selected SO goals every semester¹⁸

If it is determined that students in that class, as a group, do not meet the goal, then faculty make small changes in course sequence, the tests and/or projects that are assessed, or when

assessments will be made. This loop overlaps with Figure 5 loop, in that if the faculty as a whole decide that small changes will not be enough to improve student learning, then bigger curriculum changes are proposed and approved.

Conclusion

A sustainable continuous improvement plan is the goal of any ABET accredited program. We have created a graphic that helps us to keep separate, and be more efficient with, the process of assessment data collection, evaluation of the data, and improvement of student learning using the data. It is a process we feel comfortable with for now, and plan to use it in the years to come. We know, however, that the process itself is subject to review and assessment for how well it is working, and so is subject to change over time.

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