Continuous Improvement in an MET Program

Christine L. Corum, Mark A. Pagano
Purdue University

Abstract
In 1995, the Technology Accreditation Commission of the Accreditation board for Engineering and Technology (TAC of ABET) approved a new criteria which places direct responsibility on each engineering technology program to plan and implement continuous improvement and furthermore, they must demonstrate achievements. The criteria (V.A.3.) and (V.A.4.) appeared in draft form in the 1996-97 criteria release; and since there have been no serious objections to date, this criteria will most likely appear in binding form in the 1997-98 release. The Mechanical Engineering Technology (MET) Department at Purdue University anticipated this requirement and first began to prepare for it during the spring of 1994. Several of the resulting initiatives have been accomplished and others are in various stages of progress. Since, the requirement is for “continuous improvement,” most of the initiatives will never be finalized but will be ongoing in nature.

In the following paper, the authors present the background and environment which seem to contribute to the criteria change. Then, perceived justifications for the new criteria will be presented. Thirdly, the various initiatives that have been launched in the MET Department at Purdue will be outlined and briefly described. Some of the positive outcomes which have already been realized as a result of the continuous improvement efforts are described and conclusions are drawn in the final section.

Background
There was considerable propagation in the length of the TAC of ABET criteria in the early years while they were in the formative stage. The criteria expanded in scope from a few pages to the format of approximately 25 pages as they appear today. However, during the past decade the criteria have matured and changes have been less frequent. In a 1992 panel discussion on TAC of ABET Criteria and Accreditation, Dr. Fred Emshousen carefully tracked the evolution of the criteria from inception to the then present time. He concluded “The number of changes per year has decreased indicating a stabilization of expectations and furthermore a sign that TAC operations have matured and stabilized regarding process and operations as well.” [1]

Conversely, in the past few years since 1992, renewed interest in change has been initiated in academic accreditation and assessment. There has been a strong movement in professional organizations and accreditation bodies towards “outcome-based” accreditation standards. Regional academic accreditation organizations have made a rapid transition to this type of standard. Typical regional accreditations now focus on student learning and achievement (outcome-based standards) rather than on faculty, courses and facilities (input standards). This in turn has caused substantial movement in specialized accreditation agencies to also
contemplate this trend. This is certainly true with ABET. Recently the Engineering Accreditation Commission (EAC) of ABET has proposed new out-come based criteria for engineering programs. These criteria known as “Criteria 2000” [2] are currently being utilized in pilot accreditation visits with plans for full implementation on or before the year 2000.

In conjunction with the national movement towards outcome-based assessment, there has also been a great deal of interest in applying Continuous Quality Improvement (CQI) principles that have been so successful in industry to academic institutions and programs. It is the combination of these two movements, that prompted TAC to closely examine its current accreditation criteria and practices. Some of the advantages and disadvantages of current TAC of ABET practices and proposed ideas for the future are presented in an earlier paper by Pagano [3]. For the present, TAC has chosen to maintain its course, and has resisted wide-scale adoption of the outcome-based philosophy. Conversely, TAC has fully supported the integration of continuing improvement expectations into the criteria. To examine and possibly implement some of these changes, TAC convened a mid-year working session in February 1995. Some of the actions that were considered at this meeting resulted in the TAC criteria revisions which are the subject of this paper and are given below [4].

“V.A.3. Programs must have written goals which are consistent with overall institutional goals. These goals must, as a minimum, focus on the student body served, resource allocation, and other factors directly affecting the program. Articulation of goals should be accomplished through specification of objectives by which achievement toward goals can be measured. Programs must demonstrate achievements through various methods, e.g., student outcome assessments, graduate career performance and employer feedback measures.

V.A.4. Programs must have plans for continuous improvement. The visiting team will be looking for evidence which demonstrates implementation of continuous improvement processes and procedures for each program.

Several individuals in the School of Technology (SOT) at Purdue University are involved in TAC of ABET activities and were aware of the changes being contemplated. In anticipation of these changes and due to the fact that the university as a whole was beginning to plan a CQI initiative, it was decided to go ahead and launch a continuous improvement program in the MET Department. It was felt that the department was due for a major review and could substantially benefit from a formal continuous improvement program. The next ABET visit to the MET Department at Purdue is scheduled for Fall 1998. Because the planning and documentation for such a visit normally span at least an entire academic year, it was felt that prompt action was necessary. Therefore, after some preliminary planning, continuous improvement activities were launched in the Summer of 1994. The progress to date is described below.

**MET Department Initiatives**

**Formation of the Continuous Improvement Committee (CIC)**
In a university setting, one of the first things that happens when new ideas or initiatives are launched is the formation of a committee. This was also true in the case of CQI. Even though it
was realized that CQI must involve every individual in the department including faculty, staff, and administration, it was determined that a focused group would serve as the hub of activities initiated. This group would be responsible to record and maintain the documentation of efforts for later inspections by TAC of ABET or other assessment teams. It is important to note that the new TAC of ABET criteria (V.A.4.) include a requirement for evidence which demonstrates continuous improvement results. The committee would also be responsible to monitor all accreditation agency requirements and CQI expectations of the university and to disseminate this information to faculty and staff. The committee was appointed in May 1994. It originally consisted of a chair and three members; one for curriculum, one for facilities, and one for processes. Later, a fourth member, representing student activities, was added. The committee has met almost monthly since its formation and has served as a true catalyst to move the department’s CQI program into a proactive stance. Meeting minutes are kept as well as other documentation of committee efforts so that specific improvements can be gauged.

**University Wide North Central Assessment Effort**

The university’s next accreditation visit by the North Central Association (NCA) takes place in the year 2000 and, as a result, there has been a university level effort to establish a plan meeting the NCA requirements. To this end, representatives from each school were selected to form a task force with the job of guiding this effort. The School of Technology representative also facilitates a school level committee made up of representatives from each department of the school. The North Central Assessment Committee, as the school level committee is known, has met regularly throughout the school year.

An important ongoing effort of this committee has been to facilitate communication between departments and share information about assessment or other improvement projects being developed. For example, the MET representative has provided the school committee with a copy of a planning calendar and an example of a learning outcome model (see Specific Department Efforts below). Each department should be able to learn from the success or failures of the other departments. This committee serves as a vehicle for this exchange of information. One additional project that the committee has undertaken is to revise a school wide survey to use in assessing our success in education as viewed by employers, alumni, and faculty.

**Purdue University’s Excellence-21 Campaign**

During the Fall 1995 semester, the Purdue University president assembled 140 representatives of every Purdue School, administrative unit, and campus to launch **Excellence-21**, an initiative to apply continuous improvement techniques throughout the university.

The two-day leadership conference featured seminars on how to apply CQI tools and techniques in a university setting. The conference also featured success stories of several examples of how Purdue units had improved performance in the past through customer attention and overall redesigning of processes.

Principles of customer-centered thinking were the focus of the two-day event. These principles, applied since the 1950’s in industry, were presented by Motorola Inc. Motorola is internationally known for CQI and they have joined Purdue as a partner in the Excellence-21 campaign. The
two-day conference was followed by a year long implementation phase, where the principles were disseminated and applied to all facets of the university’s operation. Each unit on campus was responsible to define, implement, and report on at least two CQI initiatives during the 1996 calendar year. For academic units, at least one of the projects had to focus on improvement in teaching effectiveness or student learning. The MET Department’s contribution to this effort involved a project that focused on a restructuring of the credit hour count in the existing plan of study with an emphasis on overall reduction of hours required. Outcomes for this project have been summarized in another paper by Hutzel, et.al [5]. A second project involves planning and implementation of a more comprehensive recruitment/enrollment development plan. The technical staff is working on a third project aimed at standardizing and documenting laboratory procedures to allow smoother transitions when laboratory courses are taught by different faculty or with different technical support personnel.

In general, the university community has responded very well to the Excellence-21 concept. More information is available on its success on Purdue University’s web site at http://thorplus.lib.purdue.edu/xl21. It is anticipated that this effort will definitely enhance the positive outcomes of the MET Department’s CQI initiative. The Excellence-21 campaign has added foundational university support for the department’s CQI program.

Participation in School of Technology CQI Efforts
The School of Technology as a whole has also initiated several CQI projects. At least two of them were in direct response to the Excellence-21 campaign. MET is an active contributor to these projects as well. An initial project involved centralizing all student service functions from the eight technology departments under the leadership of a single School of Technology Student Services Director. This move has already improved the services that our students receive while at the same time making the operations more efficient and less costly. Pooling of resources has provided gains in the school’s recruiting and enrollment management efforts as well. The second school initiative is to strengthen and then expand the graduate program in the school. The action items that are underway include; increased training and mentoring for graduate students who serve as teaching assistants, and preparations of brochures that define each departments contribution to the SOT Graduate Program. The MET Department has completed its brochure and has placed a faculty mentor in charge of each graduate student connected to MET. This initiative has also prompted the MET Department to prepare 1-year and 5-year plans for how it will support and augment the school’s graduate program.

Specific Department Efforts

Curriculum Review Effort. During the Spring semester 1994, the MET Department began an extensive review of each of the undergraduate curricula in the department. Even though progress was impeded by the lack of an overall department strategic plan, the review proceeded. To overcome some of the obstacles created by a lack of a formal strategic plan, the department’s most recent Mission Statement” (1992 ABET review) was supplemented with several review philosophies. These philosophies and mission statement then became the focal point for driving the review. These statements are presented in Appendix 1.
As the curriculum review project neared completion and formal recommendations began to be formulated, it was decided that the department should engage in some form of strategic planning as the preliminary curriculum changes were implemented. This would provide a period of relatively stable curriculum so that the faculty could focus on more comprehensive planning efforts, which would include all phases of the MET Department’s operation. Then after preliminary long range plans were formulated, the normal continuous curriculum review activity would commence.

To initiate the planning effort, a two-day retreat was set up just before the Fall 1995 semester began. The entire MET Department, including both West Lafayette and off campus Purdue Statewide Technology (PST) sites, were involved and several other MET colleagues from other autonomous Purdue sites around the state were invited to attend as guests. The format and scope of the retreat sessions are described below.

**Strategic planning retreat format and scope.** The retreat was formatted so that work sessions alternated between small focus group interactive settings and large group discussion meetings. Approximately one month prior to the retreat, department faculty were polled to determine what they believed were the most important issues facing the department currently and over the next several years. They were asked to prioritize which of these issues they would be most interested in discussing in a planning meeting. Results were consolidated, and the top seven issues were adopted as topics for discussion at the Fall retreat. Seven “focus-group” leaders were then chosen to act as facilitators for two sets of interactive sessions at the retreat. The seven major topics which received the most request for discussion were:

1. Student recruitment
2. Assessment - how students learn
3. Modernizing equipment, facilities, and instructional technology
4. Distance learning and Purdue Statewide Technology (PST) development
5. Faculty professional development
6. Assessing teaching performance
7. At-risk students/remediation

For the first interactive session of the retreat, seven “focus-groups” were formed, each consisting of five or six persons randomly selected from the retreat participants. For this session each focus-group had the same task. All of the seven major topic areas were to be addressed. The goal was to brainstorm on each topic and formulate a list of either concerns that our department faces in this area, or issues that could arise in this area due to changing external forces. The results were summarized on flip chart sheets or overhead transparencies. Each group leader then presented the results to the entire retreat group during the afternoon larger group discussion session.

After each focus-group had the opportunity to share their findings with the entire group, new focus-groups were formed for the second interactive session. For the second session, each focus-group was assigned one of the seven major topics. Participants were placed into these topic areas based on their response to the earlier poll. The group was given the results on their topic from each of the seven morning focus-groups. The first task was to summarize these results and get a clear assessment of what the majority saw as the primary factors that need attention under this area. The
The next task was to define specific departmental actions that could be formulated to address the majority concerns. The proposal needed to clearly define the specific actions, the person(s) responsible, and a projected time frame for implementation. These proposals were then presented to the entire retreat group as motions for discussion and vote.

After the retreat, the outcomes were used as a stimulus for developing a department strategic plan. The results of the curriculum review have been combined with the department’s 1995 committee charges and the retreat actions to formulate a Draft MET Department - Plan of Action. It is currently labeled a draft because it was agreed that the department would reconvene each Spring to review and possibly revise the plan’s initiatives. The strategic plan is currently being used as a blueprint to guide MET’s CQI efforts.

Establishing a time line for Continuous Improvement Initiatives. The continuous improvement committee spent the Fall 1995 semester researching sources for assessment practices, reviewing CQI initiatives at other institutions, discussing possibilities for tracking progress, and developing a model of course learning outcomes. At the beginning of the following semester, the committee put together a planning calendar of continuous improvement projects. The reason for establishing the calendar was three-fold: 1) identify each individual project and its expected completion date to guide the committee’s focus and assist it in planning project activities to meet completion dates, 2) distribute the calendar to department faculty to keep them informed of the status of both “committee” projects and “faculty responsibility” projects, 3) use this calendar to serve as a measure of how successful the committee and faculty were at meeting or accomplishing established goals (projects).

The initial time line extended to fall 1998 (eventually this will be expanded further into the future) and included the upcoming ABET visit. Each project was identified as was each incremental step needed to complete the project. Since this was a continuous improvement effort, some “projects” were ongoing and so appropriate periodic reviews where noted on the time line.

Learning objectives project. An early project of the continuous improvement committee was to develop a learning objective model to communicate to MET faculty as a working example. This model was presented during the Spring 1996 semester and was used by faculty in developing their own learning objectives in the Fall 1996 semester. During the Spring 1997 semester, these objectives will be reviewed and edited with input solicited from industry and interested/affected faculty members. These objectives are to be given to students along with the course syllabus. The objectives identify course goals and prerequisite structure concurrent with department curriculum and serve as a course content outline throughout faculty transitions. These objectives are designed differently than most of the current course objectives in that they are written to be measurable. In this way, they can be used to assess student learning.

Graduate exit survey. In order to measure how students perceive the MET department, a graduate exit survey was created. Rather than beginning from scratch, a survey from another department was revised to fit MET needs. The survey directs students to rate and comment on faculty, staff, course, equipment and facility effectiveness and/or success. Students are also
asked to comment on the value of their education, co-op employment experience, and the strengths and weaknesses of the MET department. The first survey was issued during the last weeks of the Spring 1996 semester. The survey is scheduled for periodic review each semester.

Individual faculty teaching improvements. Individual improvements have been and will continue to be encouraged. The continuous improvement committee has recommended and provided faculty with resources to use in their continuous improvement endeavors. Besides the work being done on learning objective development, which is somewhat an individual effort, several copies of “Classroom Assessment Techniques,” by Angelo and Cross [6], have been provided by the department for faculty use at both the main campus and statewide sites. At the MET spring retreats, faculty members share their continuous improvement experiences with other faculty to help individuals identify assessment methods that work for their course material and teaching environment.

Positive Outcomes Realized
The CQI activities have already begun to bring improvements to the department. Now there is a clear understanding of who is responsible for what and when it should be accomplished. This has given the department a concrete sense of at least short-term direction and an understanding of where priorities lie. The intense interaction and discussions during meetings and retreats has resulted in increased openness with individual improvement goals and efforts. Communications and networking have also increased. Overall, CQI has brought a renewed sense of community and teamwork to the department as well as the benefits gained by the specific improvement projects.

Conclusion
It is important to reflect on the initiatives that have been implemented and attempt to glean which have been most productive relative to the effort expended. Criticism of the CQI program, is that faculty and staff often feel overwhelmed. It is important to carefully prioritize goals and to not over extend participants or divert their efforts completely away from their existing responsibilities. This is where the strategic plan becomes invaluable. It is believed that the planning retreat, and resulting planning document are the most critical steps in the overall CQI effort.

It should also be noted that CQI really needs to become a part of the department’s culture. The Department Leaders must initiate and support the activities, but the “whats” and “how-tos” must come from the faculty and staff. The Department Head’s responsibility is to guide the effort and reward those who stimulate progress toward the goals.

It is also believed that documentation is critical. In an academic setting where many facets of performance are subjective, it is important to have concrete evidence that participants can see when gains are accomplished. This observation demonstrates the adage that an attribute must be measurable, if you are going to work at continuously improving it. Therefore it is advisable to select the more objective facets of the department’s operation to work towards improving first. This will allow confidence to build as documented gains are achieved.
In conclusion, it is important to note that the criteria for continuous improvement is indeed a reality. With the strong support behind it, it is almost certain to pass and become part of the 1997-98 criteria. Therefore, all engineering technology programs interested in TAC of ABET accreditation must begin to plan and implement their strategies for compliance. Since the process will be required but not defined, it is hoped that this initial overview of one department’s beginning efforts are useful to those who have not yet begun to address this issue.

Appendix 1
The mission of the Department of Mechanical Engineering Technology is to provide educational opportunities (2 and 4 year programs) for technical career development to those students whose interest and aptitudes are applied technology oriented. Specifically, the goal of the faculty is to educate technicians and technologists who are well grounded in the fundamentals of science and engineering, and oriented to the practical applications of these fundamentals in industrial applications. In achieving this mission the department serves to help citizens achieve proficiency as technicians and technologists while at the same time it serves society by providing defined technical manpower needs, primarily for Indiana business, industry, and service agencies. In addition, the following philosophies were adopted for the curricula review effort:

1. Our Associate of Science and Bachelor of Science curricula must prepare our mechanical engineering technicians and technologist for current industry practice, and for lifelong learning opportunities.

2. Technical depth and breadth are necessary components of the MET student’s education. Depth prepares the student for immediate employment in his/her area of interest, while breadth provides the foundation for lifelong learning.
   a. The AS graduate will have some limited amount of depth in the areas of mechanics and design, with breadth in other areas of MET.
   b. The only upper division course requirements will be foundation courses, which provide breadth (and some overall depth). Technical depth will result from elective course, which typically deal with specific types of applications or other topics beyond the scope of required knowledge for all MET graduates.
   c. Flexibility at both levels is desirable so that the student can impact his/her own plan of study.

3. The MET program must remain a TAC of ABET accreditable MET program. Accreditation must be possible at the associate’s level for the Purdue Statewide Technology sites and at both the associate and baccalaureate levels (within the “2 plus 2” format) at West Lafayette and Purdue North-Central.

References


CHRISTINE L. CORUM is an Assistant Professor of Mechanical Engineering Technology at Purdue University, where she teaches courses related to materials and manufacturing quality control. She received a B.S. in Metallurgical Engineering from the University of Missouri-Rolla and an M.S. in Industrial Engineering from Purdue University.

MARK A. PAGANO received his BS and MS degrees in Thermal and Environmental Engineering and his doctorate in Engineering Science from the Department of Mechanical Engineering and Energy Process from Southern Illinois University - Carbondale. Currently he serves as Professor and Head of Mechanical Engineering Technology and part time Assistant Dean of the School of Technology for Purdue Statewide Technology Development at Purdue University.