BUILDING THE EC 2000 ENVIRONMENT

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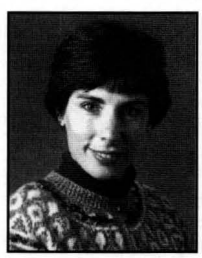
By now, most engineering faculty have accepted the fact that accreditation of engineering programs according to ABET EC 2000 is inevitable. No further introduction or justification of the new criteria is required; it is simply time to "just do it."

Over the past several years, EC 2000 has been the topic of discussion at ASEE and FIE conferences, at assessment workshops, and among engineering faculty nationwide. It has been quite common to hear comments similar to those we hear from students who are reluctant to begin a tough assignment: "When is this due?" "Will this material be on the final?" "What do I do to get a 'C'?" As Dr. Gloria Rogers, Dean for Institutional Research and Assessment at Rose-Hulman Institute of Technology, stated at the 1998 Annual ASEE conference,[1] the hope is for engineering programs to get more than a "C" as we proceed into implementation of successful assessment and improvement processes. But as George Peterson, Executive Director of ABET, confirms, no one expects this to be easy.[2]

THE TIDE IS TURNING

There has been a noticeable turning of the tide. Among these same reluctant faculty, there can be seen, at a minimum, resignation to the fact that accreditation according to EC 2000 will happen. Even more commonly observed is an approach to assessment and program improvement as a scholarly activity that will yield positive outcomes; engineering faculty across the country are rolling up their collective sleeves to begin the task set before them.



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I consider myself fortunate in having been able to serve as a program evaluator on an EC 2000 visit while in the midst of my own department's preparations for an EC 2000 accreditation visit (in the fall of 1998), and thus observing from both sides of the fence. There has been no better EC 2000 "crash course" than these combined experiences.

In writing this paper, I do not represent ABET's Engineering and Accreditation Commission (EAC), since ABET is deliberately not prescriptive about the nature of quality improvement processes adapted by individual programs. The spirit of EC 2000 is, in fact, to encourage programs to establish their own customized objectives and improvement processes that are tailored to that particular institution's and program's mission and are responsive to the needs of their constituencies. Rather than proposing a set of instructions, this article simply relates experiences and lessons learned. Two topics that frequently surface in discussions about EC 2000 are examined: constituency "buy-in" and closing of the improvement loop. How these issues affect evaluation and institutionalization of a program-improvement process will be addressed.

A COMMON CAUSE

Several institutions already have well-established program improvement processes in place. These institutions have been motivated by various factors, including the desire to achieve a vision, improvement of teaching, competition with other institutions, state mandates, industrial linkages, or other factors.[3,4] In most of these institutions, assessment and program improvement are the *modus operandi*. For most of the rest of us, this goal is yet to be achieved.

This is not to say that prior to EC 2000 engineering institutions have been operating in an improvement vacuum; for many years, program improvement has been integral to course evaluations, curricular revisions, training and mentoring new faculty, and interactions with employers and industrial advisors. But we have been anecdotal about these methods. ABET

criteria now ask us to become more structured, more focused, and much more quantitative regarding program improvement. Furthermore, we are directed to improve in the direction of measurable goals—our program educational objectives—and our student (graduate) outcomes must demonstrate how well we are doing in this endeavor. This additional formalism and documentation is what most faculty find intrusive, in that such up-front planning, careful documentation, measurement against performance standards, and analysis of improvement trajectories all take time and represent a departure from old habits.

BUY-IN FOR THE LONG HAUL

Time *is* a factor. Preparation for an EC 2000 visit, much less the design and implementation of a sustainable program-improvement process, cannot be done overnight. Moreover, not all faculty and students can be expected to contribute willingly or to be 100% committed to the effort. A foundational principle of EC 2000 is that program improvement must be permanently integrated into how engineering programs conduct business. Therefore, as Covey says, we should plan "with the end in mind"[5] in order to develop a sustainable process that the academic staff, faculty, and students will be comfortable with for the long haul.

One way in which the level of sustained commitment to these processes can be significantly impacted is by involving program constituencies in the early planning and preparations. Leonard, *et al.*,[6] describe two such approaches. Hopes for permanent implementation and constituency "buy-in" appear to be maximized if we draw upon current assessment activities, leverage what has already been done, and involve as broad a constituency support base as possible.

BUILDING THE EC 2000 ENVIRONMENT

Since in most institutions the faculty have ultimate responsibility for evolution of academic programs, development of an improvement process may work best and impel faculty most if the effort *proceeds from* faculty. Rather than a process being dictated from outside or from above, faculty must assume some ownership of the planning and implementation steps. Many institutions have set forth in this mode.

Review the Old; Share the New At Michigan State University (MSU), a college-level ABET task force was established in early 1997 to determine the feasibility of an EC 2000 accreditation visit for the 1998-99 cycle. No one assumed *a priori* that a request would be made to ABET for evaluation under the new criteria (this will no longer be an option for accreditation beginning in 2001-02).

Comprised of a faculty representative from each program (some of whom are ABET evaluators) and selected administrators, the group first endeavored to understand EC 2000 and how improvement processes might support the mission of our institution. The task force was also careful to accept and use common definitions for EC 2000 terminology (see Sando and Rogers[7] and the NSF *User-Friendly Handbook to Project Evaluation*[8]). While the ABET two-loop model is useful in understanding steps in the processes for setting objectives and for assessing outcomes, the task force worked with a more traditional feedback model to visualize how EC 2000 fit into academic programs.[9] The model provided reference points on which to peg the focus of our discussions and the results of our efforts.

The task force next began a thorough analysis of the assessment status quo in the college. We inventoried the existing assessment practices, both at the college level and within programs. A complete review of the program self-studies (Volume II) from the previous ABET visit was conducted in order to identify items that overlapped with material being requested for the new criteria. (Since then, Sarin has published an inventory of this type of information.[10]) Because of our lack of expertise in assessment, we sometimes called on industrial and academic experts in this field for advice. In addition, several task-force members attended meetings and workshops to learn as much as possible about best practices in assessment and program improvement. Current literature on these topics was reviewed regularly. Most importantly, information was freely shared among programs, and reports of task-force progress were regularly transmitted to the departmental faculty. Requests for input from departmental faculty were equally frequent. Thus, while faculty had not yet "bought into" the ideas, they were kept apprised of the process from its inception.

Retrofitting With input and support from the college faculty, in April of 1997, the task force voted to recommend a request for evaluation according to EC 2000. Most of the work from this point forward was carried out in the programs, but the task force maintained its role of facilitation and oversight. The task force continued to edit existing college-level assessment instruments for EC 2000 compatibility by fine-tuning for assessment of the skills and attributes represented in the Criterion 3 outcomes. The individual programs were free to choose whether or not to include these college-level assessments in their own toolbox of methods. We did not suggest the adoption of a single assessment and evaluation model for the entire college (as proposed by Aldridge and Benefield[11]). With full knowledge of what was available at the college level, however, the individual programs could streamline their own assessment efforts.

Self-Evaluation The task force members took advantage of two additional ABET documents relevant to the visit preparations, both found in the Manual of Evaluation Process. We regularly scored our own programs on the "Level of Implementation" (Manual of Evaluation Process, Appen-

dix A[12]), which is completed by the program evaluator to assess the extent to which programs have implemented several aspects of EC 2000. Another calibration exercise was to perform the Program Deficiency Audit (PDA). It is used by the visit team as a "roadmap" to criteria deficiencies and their resolution through the entire accreditation process. In our planning efforts, the PDA helped several programs focus their process development efforts in the areas perceived to be weakest.

Lessons Learned This type of college-level approach clearly demonstrated four important points:

- *Sharing and review of information is a valuable practice. It is not necessary that each program reinvent assessment instruments already proven to be effective. In fact, a somewhat unified approach for the entire college is easier to manage and may present a stronger case for sustainability to the ABET program-evaluation team.*
- *It proved time-efficient to retrofit current, in-house assessment and evaluation practices for EC 2000 compatibility. More important than the savings in time and effort was the fact that these were already part of the existing environment.*
- *It was helpful to view our efforts through the eyes of an ABET evaluator. Using the same documents as those used by program evaluators was useful in focusing our planning and implementation efforts.*
- *Even though buy-in from the entire faculty is desired, it was critical to have one individual in each program serve as champion and coordinator of that program's improvement efforts. In fact, as institutions look beyond EC 2000 visits, it is clear that someone or some group must assume responsibility for maintaining the assessment and evaluation processes. Evaluators will undoubtedly be looking for this confirmation.*

At MSU, development of the EC 2000 environment was accorded enough importance that task-force members were compensated in various ways for their efforts. This typically amounted to a fraction of the academic year's release time, a portion of a summer's salary, payment for student help, or some combination of these. In the EC 2000 pilot visits that have occurred, many programs have had "EC 2000 coordinators" who are individuals other than the program administrator. Preparation for an EC 2000 visit and the institutionalization of continuous program improvement processes are significant responsibilities that, if done well, consume more time than any program administrator is able to provide. But support from the program administrator, the college administration, and ideally, the institutional administration is vital to the long-term success of these efforts. While an ABET evaluator may not worry too much about whether or not the EC 2000 coordinator was adequately compensated, financial support does attest to administrative commitment to this effort.

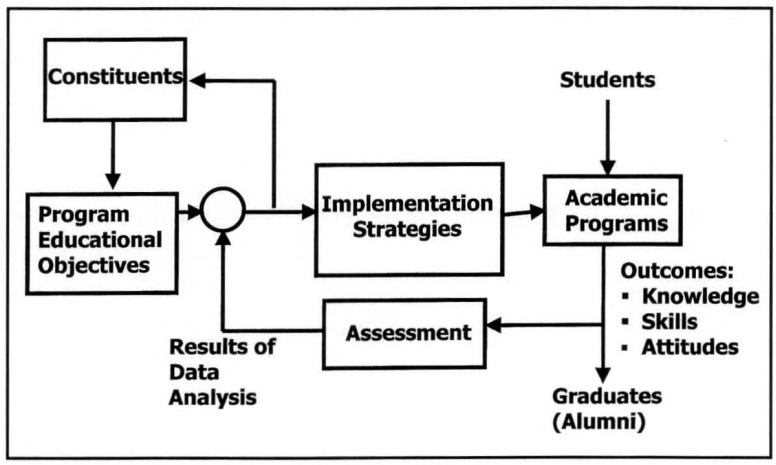

Figure 1. *Program Improvement Process Model.*

PROGRAM-LEVEL ACTIVITIES

Task-force efforts paved the way for work that needed to be done at the program level, where curriculum committees frequently assumed responsibility for the bulk of the work. Students also became more intimately involved in the processes by virtue of their membership on these committees and in related assessment-development activities.

Modeling We found the use of a process model (see Figures 1, 2, and 3) to be an effective framework for our planning strategies. The model (Figure 1), first used by the task force, was expanded to include a more detailed representation of the relationships among the assessment instruments, implementation strategies, constituencies, and the academic program (Figures 2 and 3). Current assessment literature addresses the various types and hierarchal levels of assessment.[13,14] The process diagram helped us visualize how various levels of assessment would

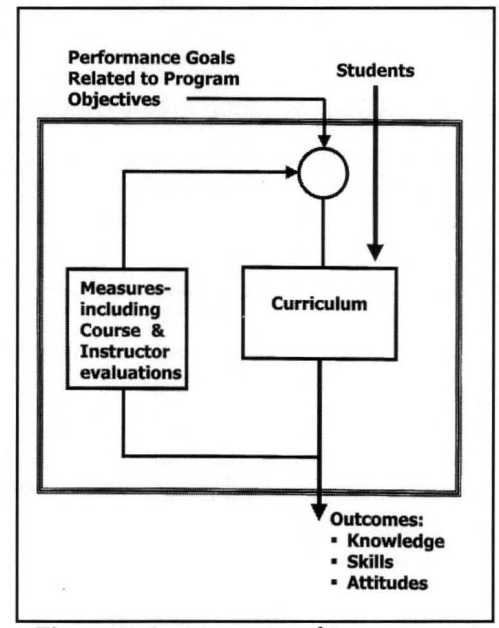

Figure 2. *Assessment and Improvement Process at the curricular level. Detail of the "Academic Programs" block in Figure 1.*

integrate into the overall program improvement process.

Objectives and Outcomes Our department's educational objectives and program outcomes had already been developed through routine departmental and advisory meetings involving faculty, students, industrial advisors, and alumni. Even though we had not cemented a formal process at this point, we had involved the major constituencies of our program and had a starting point in hand. Our focus turned to implementation.

As discussed by Ewell,[3] the major point of contact through which any program achieves its educational objectives is the curriculum, and therefore, we identified how each individual course contributes to achieving our program objectives. A discretized approach was not intended. No one course contributes in achieving all objectives, and some contribute more strongly for some objectives than others. Interestingly, even this preliminary analysis helped us identify program weaknesses where objectives were not supported and outcomes were not realized.

Assessment—Just Do It Early on in our planning, we realized that we could never become assessment experts. Reaching somewhat beyond the "comfort zone" of the faculty, we plunged into "doing" the assessment without having read all of the literature and with the knowledge that the assessment tools we had developed were not "perfect" or even tested. We borrowed some ideas from colleagues and developed strategies of our own. This strategy resembled the typical approach to open-ended design problems—an initial design is completed, the preliminary results are evaluated, and the process is repeated for an improved design.

Our curriculum committee determined that, to assess all program outcomes and to give validating evidence (triangulation) whenever possible, the chemical engineering program would supplement the college-level surveys with several program-level instruments. After initial trials of these surveys, several problems became obvious. First, we had over-assessed. We therefore reduced the scope of some of the surveys and decided to use others less frequently. Second, it took little more than almost useless responses from the first version of a survey to result very quickly in a second, more streamlined and effective instrument. Third, these initial trials quickly established that surveys alone are not enough to demonstrate student outcomes, as required by Criterion 3.

A better testimony of outcomes—the knowledge, skills, and attributes acquired by our students—is student work. Our department faculty chose student portfolios as the major means to demonstrate *and* assess course and program outcomes. Initially, a student task force was established to assist in development of the portfolio approach. It established a reasonable set of guidelines for the contents of portfolios, basing its decisions on group discussions and information from the literature.[15] These students gained an understanding of the philosophy of quality improvement and became familiar with ABET EC 2000, thereby becoming a supportive constituency.

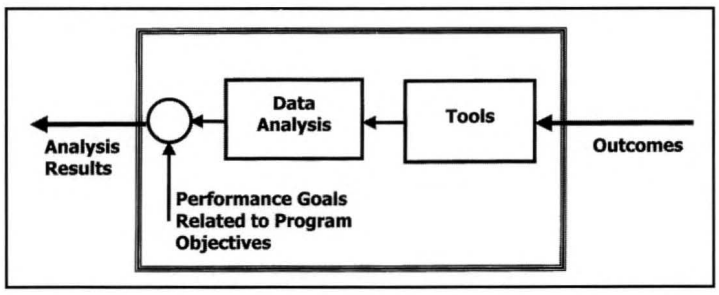

Figure 3. *Assessment and Analysis. Detail of the "Assessment" block in Figure 1.*

Performance Goals An important element of assessment analysis is establishment of performance goals, or performance criteria—specific measures by which to determine if objectives have been met. Programs should have evidence confirming that students and program graduates have achieved the desired level of performance. Performance goals may include such measures as 1) a certain percentage of satisfactory responses on a survey, 2) a target hiring rate for new graduates, 3) specific skills or attributes demonstrated by students, 4) a minimum "score" on student portfolios, or 5) a minimum grade point average. Such performance goals are not only measures of acceptable achievement of objectives, but are also an indication of the relative importance of the objectives to the constituencies—the higher the achievement standard, the higher the implied priority.

Closing the Loop In all of the preparation for the new criteria, it seems that more attention has been paid to assessment rather than what is done with the results of the assessment evaluation. "Closing the loop" is possibly the *key* to EC 2000; many evaluators have found this to be the weakest link in the implementation of program improvement processes. This step can be facilitated if programs use the mechanisms already in place to complete this step.

The academic governance and accountability systems in most engineering colleges are fairly traditional. All academic programs have regular meetings of the entire faculty and of specific subcommittees of the whole. Faculty performance is typically reviewed annually by the head or chairperson. Faculty and staff retreats are common, and advisory board meetings occur periodically. These regular deliberations provide a venue for discussion, review, and action on items related to EC 2000. Using the existing structure enhances the sustainability of the processes and demonstrates to an ABET evaluator that they are "ongoing." If a program has a person or subcommittee responsible for the continued oversight of program-improvement efforts, it is not an onerous task to include regularly in these meetings discussion or action items on program improvement.

A flowchart of our program improvement process is shown in Figure 4. Included is a list of typical departmental activities as well as a timeline for administration of assessment tools. The only new element is the Program Review Meeting. The objectives of this meeting are to review the results of the assessment analyses, to recommend improvement strategies based on the results, and to prioritize the recommendations. The Program Review Meeting involves at least one representative from each of our major constituent groups. The outcomes of the meeting are forwarded to department faculty and to the industrial advisory board for recommendations and implementation.

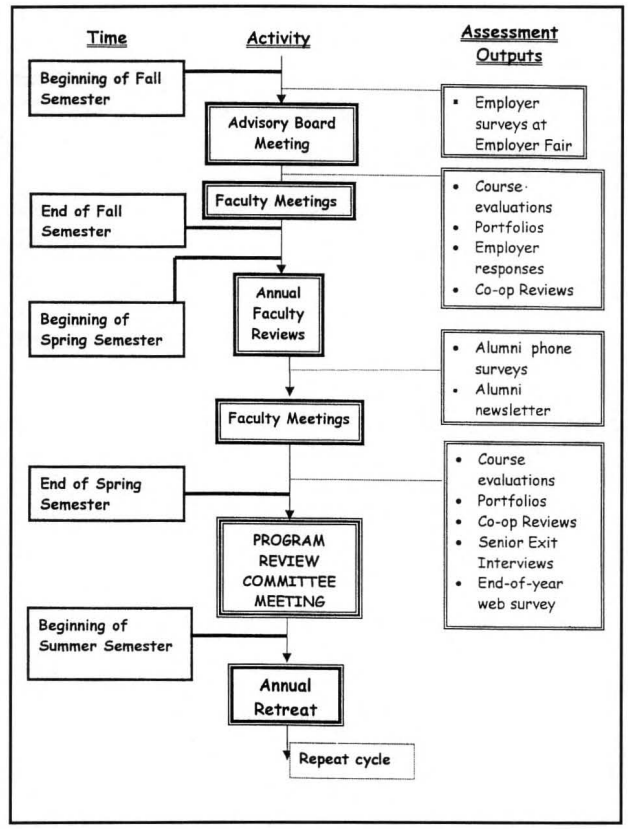

Figure 4. *Program improvement process and assessment timeline.*

Increasing Participation During our program's planning process, the sphere of constituency involvement gradually expanded. Individual faculty were given the responsibility for describing the strategies by which program objectives were achieved and outcomes demonstrated in his or her course. This naturally led to the development of course learning objectives as a set of benchmarks toward the achievement of program objectives.

Later in the process, the chairperson and faculty contributed to writing the self-study report; several faculty members were directly involved in the design and implementation of survey instruments. This involvement encouraged faculty to become more knowledgeable not only about the contents of the self-study, but also about the practical aspects of executing the processes required by EC 2000.

Members of the industrial advisory board (employers, alumni, and advisors) were involved in development of the program-improvement process through the regularly scheduled meetings of this body where the program's educational objectives were discussed and approved. Board members gave recommendations on best practices for surveying and assessment. Regular reports to the board from the chairperson and the ABET coordinator kept the group apprised of EC 2000 activities in the department.

Students were familiarized with our program's educational objectives and with course learning objectives and expected outcomes. More than just being mentioned at the beginning of the course, learning objectives and expected outcomes were integrated into the classroom culture. Learning objectives were used to chart progression of the course material; student portfolios required student self-assessment in achievement of outcomes. We also involved our students in administration of the phone survey and in analysis of the survey results. Other institutions have involved students directly in survey design. ABET program evaluators will undoubtedly find that interviews with students will give a strong indication of their involvement in program improvement.

At some point, the assessment results may suggest changes that require involvement of supporting departments (*e.g.*, chemistry, physics, mathematics). Whether this interaction occurs at the college or program level may be decided by the extent of the needed change and whether one or more engineering programs are involved. At MSU, an inter-college committee was established to address the relevance of the statistics course taken by most engineering students—this served to benefit the entire college. On the other hand, a few chemical engineering faculty collaborated with their counterparts in chemistry to discuss the restructuring of a physical chemistry sequence. Both approaches can be effective.

Who To Tell? Olds and Miller[16] emphasize the importance of reporting back to constituencies. Not only should constituencies be involved in the program-improvement processes, but they should also be made aware of the results of which they have been a part. Positive results catalyze "buy-in."

As is evident above, students are one of the major constituencies in our department. Without positive feedback, all that most of them see of the assessment process is the portfolios they must organize, the surveys that must be completed, and an occasional reference to something called an "abet"! It is gratifying to be able to come to students and say, "We are emphasizing this material in class this year because last year's graduates felt that it was a weakness in our curriculum," or "This course is being offered to help you develop more of the skills that your future employers think are vital."

Positive results of improvement efforts are also a good motivator for faculty commitment. Our initial use of student portfolios yielded good feedback to faculty. Although ini-

tially viewed as burdensome, portfolios were adopted by the faculty as a major means of outcomes assessment.

Off-campus constituencies should also be informed of the results of their feedback through existing channels such as reports to alumni through newsletters, meetings with advisory board members, and regular communication with employers. Keeping alumni and industrial representatives informed as to how their feedback is being used for program improvement can help encourage continued involvement and can engender a sense of "connectedness" to the program.

THE SITE VISIT

Having presented an example scenario for developing the EC 2000 environment and preparing for a visit, let's briefly look at the other side of the fence.

Questions and Answers Even though EC 2000 evaluators are all trained with similar materials, they will approach a site visit with different predispositions. This is one thing that has not changed from evaluation under the present ("old") criteria. But for EC 2000, all evaluators and team chairs will be looking for answers to several questions:

- What are the program objectives?
- Are program objectives linked to appropriate outcomes?
- Are the program outcomes (and therefore objectives) being met?
- Are the ABET EC 2000 defined outcomes (Criterion 3, a-k) being achieved within the context of program outcomes? Is there evidence to support this?
- What processes are in place for enhancing the program? Is the process improvement loop working and ongoing?
- Are the constituencies involved? Is there evidence to support this?

How much do members of the constituency groups know about these topics? Faculty should be familiar with these elements and should have taken some part in their realization. Students should also be familiar with objectives both at the program and the course levels, and they should know that certain outcomes are expected of a graduate of the program. Both faculty and students should be able to describe their participation in the processes and actions that have been taken to improve the program. The evaluator will most likely conduct interviews with faculty and students (and possibly with other constituencies as well) that will provide a clear indication of the level of implementation and the level of commitment to the program improvement processes.

Self-Study "Must-Have's" The self-study report is still the first contact that an evaluator has with a program. Based on the experiences of the five EC 2000 pilot schools and their evaluation teams, a better perspective has been gained on how self-studies can be most informative. The Self-Study Instructions are now considerably more prescriptive to allow for more consistent evaluation among programs. The topics they delineate are also a useful guideline for preparation for an EC 2000 visit.

It is no longer the responsibility of the evaluator to pore over course material to sift out evidence in support of a program's claims. Evidence of ongoing processes and documentation of outcomes should be clearly laid out in the self-study and in materials presented at the time of visit. It is the responsibility of the program to provide documentation of the capabilities of their students and graduates. Programs must be able to identify both the strategies used to achieve outcomes and the evidence that substantiates the success of these efforts.

In conclusion, effective use of a combination of existing assessment practices and involvement of a broad base of constituencies are the key elements in building an effective EC 2000 environment in engineering colleges. While implementation of program-improvement processes requires significant resources, the resulting program improvements are evident in a surprisingly short term and, in the long term, hold promise for keeping pace with the demands of the engineering profession.

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