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Engineering Accreditation and Educational Objectives

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As ABET Coordinator for the Division of Engineering, I have spent part of the past four years enmeshed in an effort to respond to the latest jeremiad emanating from the federation of professional and technical societies that represents the fields of applied science, computing, engineering, and technology. Here I briefly tell the tale of EC2000 (the name given to the outcomes-based reform effort in engineering accreditation) and what Brown engineering faculty are doing differently as a result of this process. The Division of Engineering has had ABET accreditation for its Sc.B. programs in electrical, civil, and mechanical engineering since 1936, in materials engineering since 1967, and in chemical engineering since 1985. The Accreditation Board for Engineering and Technology (ABET) responds primarily to pressure from employers applied via the professional societies, and passes along those forces to educational institutions that seek accreditation. Brown values the ABET imprimatur both as a drawing card for prospective undergraduates and as a necessary credential for some small fraction of its engineering graduates who will go on to become licensed professional engineers.

Under EC2000, Criterion 2 requires each accredited program to publish detailed educational objectives, develop a process based on the needs of its various constituencies whereby the objectives are periodically determined and evaluated, develop a curriculum and processes to ensure achievement of the objectives, evaluate the achievement of objectives, and improve the effectiveness of the program. Further, Criterion 3 requires that programs demonstrate that their graduates "have" a set of outcomes, labeled (a)-(k), that include both technical skills, such as "an ability to design a system, component, or process to meet desired needs," as well as more

nebulous capabilities, such as "a knowledge of contemporary issues." The outcomes must be assessed and the results of assessment must be applied to the improvement of the program. Since these two criteria sowed mostly confusion among educators, the ABET chieftains also promulgated these informal interpretations — *educational objectives* refer to the expected accomplishments of graduates in the first few years after graduation, whereas *program outcomes* are the things your students know and can do upon completion of their coursework. Some other key terms and their special ABET meanings: *constituencies* are any stakeholders in the educational process but *not* current students and faculty; *assessment* does *not* include grades on course work.

The Division of Engineering's process, developed over several years of discussion and introduced during the 2001/2002 academic year, requires some new activities and record keeping at the course level, the concentration level, and the Division level. The individual faculty member publishes a brief set of goals for each course and relates those goals to the ABET-mandated outcomes. For example, one of the goals in EN51 is that students shall "develop the ability to visualize, comprehend, and manipulate vector fields." Like a great many of our course goals, this one relates to two of the ABET mandates concerning the ability to apply knowledge of math and to use the skills of science in problem solving. Progress towards such goals is gauged towards the end of the course. Usually at the same time that students complete the university-required evaluation of teaching form, they now also complete an outcomes-assessment form that checks their view of their progress towards the course goals, and which components of the course helped most for which goals. Note that these questions do not grade the instructor's presentation of the material so much as the design of the course itself, in terms of content and format. Graduating seniors are also asked to rate their overall concentration program against the ABET outcomes, and to identify which courses contributed most to which outcomes. This survey may be conducted over pizza, with the concentration advisor also providing some context and perspective on why the assessment process matters to us.

In contrast to assessment, which focuses mostly within the undergraduate course-taking experience, the process of evaluation of objectives reaches outside the university. The primary groups that we have identified as constituents are alumni of our programs, current and prospective employers, and graduate and professional schools. Each of the programs has formed and convened an Advisory Board consisting of several voluble individuals from these groups. The boards, which meet once each year, are charged with formulating and revising the program educational

objectives, reviewing the results of evaluations and assessments, and providing a report to the faculty. Evaluations of the educational objectives are also solicited from alumni in an e-mail survey. When the engineering faculty meet as a group each January, they hear from the concentration advisors a set of program reviews that include the feedback from these assessment and evaluation activities. Recommendations for change to the curriculum or the process are ultimately acted upon by the Engineering Executive Committee, and (we hope) reflected in subsequent cycles of assessment and evaluation.

Informal feedback from the ABET examiners suggests that although our process is similar to what other institutions have established, assessment ideally should involve multiple faculty plus non-campus colleagues giving written feedback to students on how their major design projects measure up to the "(a) through (k)" outcomes. Furthermore, the program objectives ideally should be generated by our constituencies, not by the faculty themselves. These demands are viewed with some skepticism, although faculty frequently do value (and arrange for) the participation of colleagues from professional practice. The process that the Division has implemented means that there exist now several new formal channels for soliciting feedback aimed at program improvement. Whether and how those channels get used effectively will depend, as most things do, on the inspiration and hard work of students and faculty who for their own reasons become committed to change and who are fortunate enough to find resources to support their efforts.