

Lessons Learned in the ABET Review of the Undergraduate BME Program at the University of Tennessee

**Jendrucko, R., Wasserman, J., Kasra, M., English, A., Schmidt, M. and Iannelli, J.
Biomedical Engineering Program, The University of Tennessee, Knoxville**

Background

The achievement of ABET accreditation of engineering programs is critical to the demonstration of program excellence and to the recruitment of high quality students. For these reasons, preparation for an ABET inspection is often met with trepidation and a deep concern about how to achieve accredited status. A successful ABET review has become more challenging with the establishment of highly specific ABET 2000 criteria. The latter require the establishment of a clear set of program objectives, identification and demonstration of the achievement of program outcomes, and the demonstrated success of a continuous improvement process based on customer input.

The University of Tennessee, Knoxville undergraduate biomedical engineering (BME) program was established in the fall of 2000 and had its first nine graduates in May 2002. ABET accreditation for this new program was sought during "mid-cycle" for our College of Engineering so that accreditation, if granted, would retroactively apply to the first graduating class.

The first step in preparing for the ABET program evaluation was to assign overall coordination to a lead faculty member. Often, this assignment is not viewed as career-enhancing and thus appointment is often made by the department head sometimes on a semi-voluntary basis. In any case, in order to be effective as an overall ABET review coordinator, the selected individual must be willing to devote a substantial portion of his or her time for several months and must be a "detail person" who can give attention to the many facets of the preparation process. The coordinator must also be thoroughly knowledgeable of ABET 2000 requirements in order to guide the activities of other program faculty. Additionally, the coordinator should anticipate motivating and encouraging the other faculty members to keep the project on schedule. In our case, the coordinator participated in a two-day ABET training course sponsored by ASEE during its annual conference in the year before ABET review preparations were begun. This formal training was very helpful in building confidence that the later preparations could be carried out in a manner leading to a successful ABET program review.

An important lesson learned during our biomedical engineering program ABET inspection was that the basic quality of the curriculum being evaluated sets the tone for much of the review. For our undergraduate BME program, curriculum content had to be consistent with College of Engineering requirements (e.g. a common freshman year) and had to meet the specific ABET program criteria for the BME specialization. A key challenge in the design of an undergraduate

BME program is to achieve an ideal balance between engineering and life science content. Ideally, these two fields are integrated in a number of specialty courses. Of prime importance is the need for the program to be a strong engineering program not substantially diluted in engineering content with life sciences coursework. In attempting to achieve this goal our 136 hour curriculum was designed to include 30 hours of basic engineering sciences including courses in engineering fundamentals (statics and dynamics), intermediate dynamics, engineering materials science, mechanics of materials, electric circuits, fluid mechanics and thermodynamics. In our experience, the design of our curriculum to be an obviously strong "engineering program" presented a favorable beginning point for the ABET review.

Preparation of the Self-Study

A well-known ABET priority is that all program faculty participate in all aspects of the ABET program model. It is of particular importance that all faculty are knowledgeable of and committed to all ABET requirements for program accreditation. Thus, preparation for the ABET program evaluation began with organizing the BME faculty into a focused, coordinated team. Each faculty member participated in the discussion of all centrally important ABET issues and the assembly of program materials. Of particular importance was the preparation of the program Self-Study document. Preparation of the Self-Study was a very demanding undertaking requiring the participation of all program faculty on a substantial time basis for several months. For this purpose, each faculty member was assigned tasks collecting data and composing draft text for the several Self-Study document chapters. As the Self-Study text was generated in blocks, it was reviewed and edited by the team coordinator followed by a review and editing by an Associate Dean of Engineering assigned to oversee ABET preparations for all programs being reviewed.

The exercise of preparing the Self-Study revealed a small number of areas where procedural improvements needed to be made to the program to assure satisfaction of ABET criteria. For example, a review of procedures for dealing with student exceptions to the satisfaction of prerequisite and corequisite course requirements revealed that on occasion, a form to document reasons for the lack of completion of pre- and co-requisite courses had not been completed and included in student's files. To solve this discovered problem, a new procedure was established immediately: copies of the first day attendance sheet for each BME course whereon each student indicated which pre- and co-requisite courses had been completed was to be provided to the BME Program Head. The Head would then call a brief conference with each student not having completed a waiver form. In these meetings students are instructed to complete the form so as not to be dropped from the course in question. In this manner, a problem identified during the preparation of the Self-Study was solved before completion of the latter document and well before the ABET program inspection site visit.

Among the many issues that were brought to light during the process of preparing the Self-Study was the issue of putting in place a system for assuring sufficient regular input from program customers (including program graduates and employers) to guide continuous improvement of the curriculum. When it was realized that employer input had been obtained heavily on an intermittent, somewhat random basis, it was decided to "firm-up" this process by establishing an industrial advisory board which will meet at least annually to provide the needed "outside input"

needed as a part of a recurring program assessment. Clearly, any and all problems known a priori or discovered during preparation for an ABET program evaluation should be remedied decisively before the ABET team visit to campus.

As may be common, in our case following submission and review of the Self-Study a set of questions was raised by the ABET team BME program examiner. One question related to apparent inconsistencies in first-year common curriculum courses taken by several of first BME program graduates. This question was addressed and answered quickly with the assistance of the Associate Dean of Engineering who was most familiar with a recent change in the common freshman curriculum which explained why some students had taken different courses than others. A rapid response to such inquiries was deemed essential to maintaining the image of a "tight program" with a well-informed faculty ABET review coordinator.

Preparation for and Conduction of the Site Inspection

Thorough planning and extensive preparation was done for the ABET team site inspection visit. As indicated above, questions about the program, particularly any potential areas of concern were anticipated, discussed among program faculty and appropriate actions were initiated immediately to correct the small number of potential problems identified. The BME program office and laboratory facilities were cleaned and organized as needed. A BME laboratory under renovation was selected to be showcased as a prime example of continuous program updating and a high level of commitment of College of Engineering to the funding of the BME program. Additional recent improvements to the teaching classrooms including the installation of "Smart Board" computer-operated interactive display monitors were selected to be exhibited. The ABET team site visitation schedule was designed to include observing a course lecture, sessions with a selection of high quality, motivated students, and sessions with several strong outside supporters of the program. Finally, the program faculty was briefed on final preparations and their individual roles in the site inspection schedule. The importance of their familiarity with the details of the curriculum and student advising procedures was emphasized. Finally, the advantages of maintaining a "positive outlook" during conversations with the ABET team was discussed. Based the described planning, our October 2002 BME program site visit inspection was conducted without incident and the inspection team seemed pleased overall with their experience.

Summary Observations

Based on many prior discussions with professional colleagues at several institutions having undergone ABET inspections of undergraduate BME programs, it seems clear that the outcome of a given ABET program evaluation depends upon several factors. Among these are the underlying level of university support, the basic content of the curriculum being examined, the effectiveness of the preparations for the program evaluation and the make-up and orientation of the ABET evaluation team. In this case we were operating in the context of a large state-supported university and we could not, for example, order changes to the content and manner of mathematics or life science course instruction. In addition, we could not predict in advance the particular interests, experiences and professional preferences of the ABET inspection team members. However, we had full control of and responsibility for the BME curriculum content

and the level and quality of effort we dedicated to preparing for the ABET evaluation of our program. It was in the latter two areas that we focused our attention in our preparatory work.

Based on our experience outlined above in preparing for an ABET inspection of our new undergraduate BME program, the following are noted as the primary and most important "lessons learned":

- The ABET accreditation approval process in effect begins with the design of the specific content of the curriculum. In our experience in the design of an undergraduate BME program, the inclusion of a substantial number of traditional engineering science courses was important in having a sound "engineering program" not lacking or diluted with life science and other non-engineering course content. There was specific mention made of the strength of our program in this regard during our program evaluation.
- The careful preparation of the required Self Study document will elucidate any areas of potential program concern in time to modify ongoing procedures before the beginning of the formal ABET program evaluation. Thus, the Self-Study preparation exercise should be viewed as an important component in the required ABET 2000 program updating process.
- The selection and motivation level of the faculty ABET coordinator is of paramount importance. The individual selected must be highly organized, knowledgeable of ABET 2000 criteria, and have substantial time availability for leading the preparations for the ABET program evaluation. This faculty "team leader" must be able to effectively motivate and guide the activities of the other program faculty through the entire preparation process.
- All of the "program personnel" who are to interact with the ABET inspection team members, including faculty, students and outside program advisors and evaluators should be informed of program operational details. Additionally, these individuals should be encouraged to represent the program under review in a distinctly positive light as if an already-ABET accredited program were being showcased.

In summary, in spite of initial concerns, our recent preparation for an ABET 2000 BME program evaluation yielded a set of positive results. Program faculty learned more about program details and learned to work better as a team. Potential problems with the program were readily identified and effectively solved under the umbrella of ABET 2000 requirements. The preparation process itself was found to benefit substantially from an inherently strong curriculum, the selection of an effective faculty team leader, and the motivation and integral involvement of all program faculty. It is hoped that our positive experience might provide useful insight and guidance to others preparing for an upcoming ABET 2000 program evaluation.