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A Unified, Interactive Approach to Degree Programme Accreditation and Quality Assurance*

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In preparation for our accreditation visit in 2002 by the Accreditation Board for Engineering and Technology (ABET), faculty at the University of Arkansas Biological and Agricultural Engineering Department assembled a powerful, interactive electronic package designed to provide easy access to information needed. The self-study document, which is part of the package, includes our educational objectives, our assessment plans for programme outcomes, copies of all course syllabuses, links to examples of student work and documentation of our feedback loops in action. The package has been organized on a CD-ROM with hundreds of links to help the reader navigate through the material efficiently. Not only was the package useful for accreditation review, it has become an important tool used by the faculty for making changes in our programme. By routinely updating the package, we will facilitate steady and continuous quality improvement.

Keywords: accreditation methodology; ABET; curriculum matrix

INTRODUCTION

A PILOT PROGRAM in which the Accreditation Board for Engineering and Technology (ABET) began to apply a radically modified set of criteria for evaluation and accreditation of engineering programmes, was, in 1996, participated in by the Biological and Agricultural Engineering Programme at the University of Arkansas. The new criteria ask programmes to demonstrate that their graduates have certain abilities, including, as a minimum, the well-known specific outcomes listed by ABET as "a-k".

In addition to specifying desired outcomes, each programme must establish a system for assessing the abilities of their graduates with respect to the outcomes, and define a process for improvement. The self-study document prepared by the BAE department in 1996 was written in the form of a Continuous Quality Improvement (CQI) Programme. In preparation for our ABET visit in 2002, we organized our CQI and supporting data into a powerful electronic package.

INTERACTIVE PACKAGE

Our self-study document is an MS-Word file with hundreds of internal links, and many of them to external files included with the package. Among these are some to examples of student work, and the curriculum matrix described below. [1]

We began creating our electronic version of the self-study document by using the basic outline provided in ABET's criteria for accrediting engineering programmes. [2, 3, 4]

Using that basic outline, we created the table of contents illustrated in Figure 1. Most of the links, of course, are internal to our document and package. Many of the links in the table after the subheading "Other Resources" are to external documents in our package. In addition, at various places in our package, there are links to pages maintained on the University's web server, completely independent of our documents.

When hyperlinks are established in a Word document, the words from which the links originate are usually underlined and blue in colour. We have now included the word 'Link' with all of our hyperlinks so that those who are colour blind, or less experienced with such links can still navigate our package easily.

A reader of our self-study document might, for example, want to jump immediately to our curriculum matrix, using the link in our table of contents. She/he might then want to examine the syllabus for one of our courses, using the link to that syllabus on the spreadsheet containing our matrix. From the syllabus, the reader could navigate to the curriculum vita (CV) for the instructor of the course, using the appropriate link. The 'back arrow' could then be used to return one step at a time to the original document, or to any intermediate point.

Our self-study document was created so that it could be printed and used as a hard copy. The giant matrix was printed on poster-size paper and folded to be bound with the document. The loss of

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Fig. 1. Self-study table of contents with links

utility, however, in going from the dynamic electronic package to the static hard copy is dramatic.

Curriculum matrix

The foundation of our self-study package is an external document called the Curriculum Matrix, sometimes called the 'Giant Matrix'. Links to the external file occur within our self-study document. It is an Excel spreadsheet that uses the name of each of the courses in our curriculum as a column heading. For those courses taught within the department, each column heading serves as a link to the corresponding syllabus, contained in the Word document that comprises our self-study. Row headings are divided into the following categories:

1. Core Competencies in Biological Engineering;
2. Fundamental Engineering Topics;
3. Specialized Biological Engineering Topics;
4. ABET Outcomes.

Within the first three categories, each row heading is a topic area, such as 'Bio-Instrumentation' or 'Basic Sciences and Mathematics', among many others. Within the fourth category, the row headings are the specific outcomes we hope to achieve within our curriculum. Each of these 'ABET' row headings is a link to the more detailed description of the outcome, assessment strategies and feedback mechanisms contained within our self-study document.

Each interior cell in the spreadsheet, then, corresponds to a course column and a row topic/outcome. Within each cell there is a description indicating how that topic area (or programme outcome) is addressed within the course. We defined standard keyword descriptors for the cells as follows:

1. Introduction—Initial exposure to a topic area, with background, motivation, theory, some applications, and problems.
2. Bridging—Exposure to a topic within a broader experience, intended to develop understanding of the importance of the topic and its linkage to other engineering topics. Provides motivation and better understanding for students to grasp the topic later when it is formally covered.
3. Development—Further coverage of a topic, building upon earlier exposure, bringing in more advanced concepts appropriate to higher level student experience and academic background.

4. Comprehensive—Broad, complete coverage of the topic, including introduction, development and practice, with applications.
5. Practice—Additional experience in applying a concept in engineering practice.
6. Capstone Experience—Final presentation of topic, advanced theory, integrating topic with the comprehensive view and skills of a professional engineer.
7. Specialty—Non-core topics in a specialized area that further enhance engineering skills in the student's area of interest.
8. Cover—Fundamental topics covered in courses outside the department.

Many of the interior cells also contain comments, visible when one moves the mouse pointer over the cell, describing how the instructor addresses the particular topic within the course. In addition, cells with a grey background, indicate that the instructor of the course, in consultation with the other faculty, has made a commitment to ensure that the corresponding topic will be covered in the course to the extent indicated by the keyword in the cell, no matter what other changes may be made in the course. These 'benchmark' cells provide the basis for the design of an integrated curriculum, in which critical topics can be progressively covered across many courses. The faculty, as a whole, has designed this integrated curriculum. Individual instructors are expected to cover the benchmark items (that are shown as grey cells in the curriculum matrix). As a result, our programme covers many important fundamental topics/skills in an integrated way from first to senior year. This allows us to avoid speciality courses (for example, engineering economics) and provides a 'just-in-time' context for better student understanding and improved ability to apply.

Figure 2 is an image of part of the spreadsheet, illustrating the variety of information available:

You can see that the mouse pointer is over the cell in the column with the heading 'BENG 3712' and in the row with the heading 'Quantifying Biological Phenomena'. The cell has a grey background, so this is a 'benchmark' item that the instructor is committed to covering. The comment embedded in the cell shows some detail of the coverage of the topic (i.e. focused on basic biochemistry and cell structure). The keyword in the cell is 'Development', with all that is implied by the description given before.

USE OF THE CURRICULUM MATRIX

Individual faculty members who are planning to make changes to one of the courses taught in the department use the matrix to insure that the course will continue to meet commitments already made. In addition, if new material is to be added to the course, the matrix will provide information about the level of preparation that can be expected of the students coming to the course, based upon courses already completed.

The matrix also provides guidance in meetings of faculty groups. In the department, there are two types of faculty meetings in which curriculum issues are discussed formally. One is the annual faculty retreat, in which curriculum is the principal focus. The other is the weekly brown-bag lunch, in which curriculum issues are frequent topics of discussion. In both types of meetings, the curriculum matrix provides a comprehensive overview of the curriculum and the impact of any changes suggested.

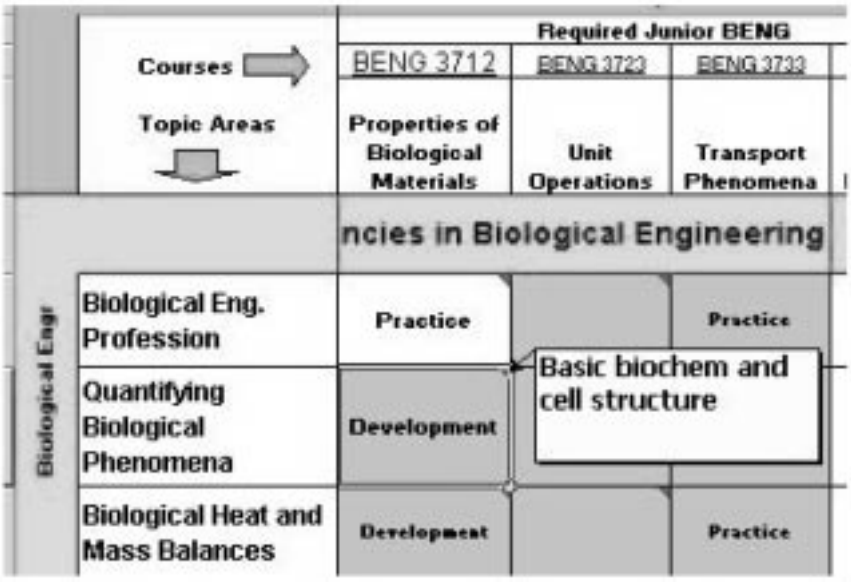

Fig. 2. Part of the curriculum matrix

Table 1. Entry in the closing-the-loops table

	Date	Subject of Discussion	Venue	Constituencies	Summary	Actions Taken	Impact
1	Mar 5, 1998	Curriculum	Faculty Meeting	Faculty	Proposal for new course, BAEG 2622, "Bio-Physical Systems II" See Memo, See Notes	Tom Costello developed the course, BAEG 2622	Students did projects involving life-support systems.

Closing-the-loops table

This table is another fundamental element of our self-study document. Each time there is an activity in the department that has an impact on our academic programmes, an entry is made in the table. Table 1 is an example of such an entry.

The act of making entries into the table allows us to focus on and document the impacts of any changes in our programme. Entries have internal links within the self-study document, and external links to supporting documents such as notes and minutes. Each entry has a line number which is the target of a hyperlink elsewhere in the self-study document. Thus, the reader can jump from a discussion of a particular outcome to a description of actions taken to assist in achieving it, and then jump back.

Examples of student work

Since most of our students now compose their assignments electronically, and all of them could be required to do so, it would be a simple matter to require that all assignments in all courses be submitted in this way. Many of our courses have this requirement now. A selection of student responses to these assignments is available in our package. Links within the self-study document, especially in the discussions of outcomes, are used to jump directly to examples of homework or exams in which our students demonstrate their abilities.

In addition, while we include only a selection of examples of student work in our package, in this electronic age, exhaustive collections of student work can be maintained on CDs, available for review by the faculty as we continue to improve our programme. We are currently creating such electronic collections for each course and each student.

SUMMARY

Our faculty members are sold on the use of the electronic self-study package, not only as a means of meeting the requirements for accreditation, but also as a tool for continuous quality improvement in the years between accreditation visits. The ease of creating a fully integrated electronic document can be compared to the tedious difficulty or impossibility of creating an equivalent document in hard copy. Moreover, the electronic package provides mechanisms for a programme reviewer to efficiently explore the massive detail included in the report. A copy of the digital package can be obtained by contacting Carl Griffis at 203 Engineering Hall, University of Arkansas, Fayetteville, AR 72701.

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Thomas A. Costello is Associate Professor of Biological and Agricultural Engineering at the University of Arkansas in Fayetteville, AR. He teaches and does research in the area of animal waste management and controlled interior environments for livestock and poultry. He is part of the team that has developed the university's new biological engineering curriculum and designed the packaging needed to effectively communicate the program details to ABET.

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