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Quality Assurance of Engineering Education

The goals of this paper were (1) to provide historical context for current issues facing U.S. engineering education and its quality control through accreditation, (2) to report on the progress of a multi-year study of the impact of new engineering accreditation criteria on educational practice and student learning, and (3) to describe current accreditation-based processes that facilitate the global professional mobility of engineers. The work is based on review of papers and monographs from the engineering education literature, on records of the Accreditation Board for Engineering and Technology (ABET), on the results of surveys of engineering faculty and department chairs, and on the personal experience of two of the authors (Prados and Peterson) as ABET officers and Executive Director.

Accreditation of engineering educational programs is based on professional judgment as to whether or not a given program meets specified standards of educational quality. U.S. this is a voluntary, peer-review process conducted by ABET, an association of professional societies. Founded in 1932 as the Engineers' Council for Professional Development (ECPD), ABET now accredits programs in engineering, engineering technology, computer science, information systems, and other engineering-related programs through four Commissions representing its member societies.

In the years following World War II, most U.S. engineering education programs became more heavily oriented toward mathematics and science and gave little attention to practice and the non-technical issues that strongly influence engineering decisions. Also, as time passed, the accreditation process became increasingly prescriptive, allowing little flexibility for innovation. Responding to strong criticism by engineering employers and far-sighted educators, ABET embarked on major reform efforts catalyzed by series of stakeholder workshops, and in 1995 adopted a new set of outcomes-based accreditation criteria – Engineering Criteria 2000 (EC2000) – that emphasize student learning and continuous improvement, rather than detailed specification of program characteristics. Following pilot tests and a 3-year phase-in period, the use of EC2000 has been required for all engineering accreditation evaluations since the fall of 2001.

ABET has continued to monitor the impact of EC2000, with special emphasis on the effectiveness of continuous improvement processes and the training of accreditation visitors (program evaluators) and team chairs. To provide a data-based evaluation of the impact of its reforms, ABET engaged the Center for the Study of Higher Education at the Pennsylvania State University to conduct a multi-year study of the preparation of graduates of programs accredited under EC2000 in comparison with those who graduated under the previous criteria. The study evaluates program characteristics and student learning in 203 programs in seven disciplines – aerospace, chemical, civil, computer, electrical, industrial, and mechanical engineering – at 40 institutions, chosen to provide a representative sample of U.S. engineering schools. Data are collected through five survey instruments targeted at program chairs, faculty, graduating seniors, alumni, and employers, along with an interview protocol for engineering deans. Results from the program chair and faculty surveys suggest that EC2000 is having a significant, positive impact on engineering education, but results from the graduating senior, alumni, and employer surveys, which are still in progress, are needed to validate this conclusion.

Because EC2000 focuses on the learning outcomes of graduates rather than on the structure of educational programs, it provides a useful framework for evaluating the equivalence of preparation of engineering graduates from diverse educational systems and thus supports processes for international recognition of engineering educational credentials. ABET has been a leader in development of such processes, including agreements for mutual recognition of national accreditation systems, assistance in the development of accreditation systems in other countries, and in the absence of such systems, evaluating engineering programs for substantial equivalency to U.S. programs accredited by ABET.

To enhance the future impact and effectiveness of accreditation as a means of educational quality control, several questions still need to be addressed.

- What does the engineering profession believe are the significant skills, knowledge, and capabilities of graduates needed to satisfy the future needs of the profession?
- How well are the educational outcomes specified in EC2000 aligned with these needs?
- What kinds of learning experiences maximize achievement of the intellectual outcomes specified in EC2000?
- Under what conditions do continuous improvement concepts and practices become part of faculty culture?
- How transferable are accreditation criteria and processes across national borders?

Finally, ABET's own continuous improvement will require periodic repetition of some version of the EC2000 Study.

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Author 1: John W. Prados email: jprados@utk.edu

Author 2: Lisa R. Lattuca email: lattuca@psu.edu

Author 3: George D. Peterson email: gpeterson@abet.org

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