Chapter 7
The Role of Standards in Engineering Education

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ABSTRACT
The role of standards is increasing, and as a result the role of education about standards should also increase. At the same time, there are a set of requirements—accreditation criteria—toward engineering programs. The close relationships between the accreditation criteria and standards education is not fully recognized, even by accreditation bodies and educators. The goal of this paper is to uncover these relationships. Furthermore, the paper establishes connections between other components of engineering education such as ethics, engineering design, labs, and integrated courses, on one hand and standards education on another. The conclusion from these relationships is that standards education is more important than previously realized. The paper also discusses how standards education can be incorporated in engineering and technical curricula.

INTRODUCTION
There is little doubt that various technical standards are the foundation of much of every part of the high-tech industry. A large part of the world trade today involves products that comply with at least one, and typically a much higher number of standards. For example, the US Congress has estimated that standards and government technical regulations affect at least $7 trillion of world trade (U.S. House of Representatives, 2005). A study estimates the annual contribution of standards to the British economy at 3.6 billion euros (National Standardization Strategic Framework, 2008).

At the level of a single company, standards are a significant factor for business success in the long
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term (De Vries, 2005). Some of the benefits from participation in standards-developing organization are higher market share, reduced cost and shorter time-to-market, higher visibility in the industry, and better opportunities to license intellectual property. Some companies do not sell products, but sell intellectual property. Intellectual property required for the implementation of a successful standard is generally very valuable and highly sought after by companies and businesses (Krechmer, 2007).

To remain competitive a growing number of nations have developed national standards strategies. These national standards strategies have recognized for a long time now the need to develop comprehensive standards education programs. More recently these national standards strategies have called for expanded and strengthened efforts to assist university and college programs in their efforts to educate students on standards. For example, the British National Standardization Strategic Framework specifically calls for embedding knowledge of standards into formal education curricula. The need for education about standards is discussed in several publications (De Vries, 2005; Krechmer, 2007).

Standards education has traditionally been done on the job using information on the web sites of national standards bodies and other courses and seminars generally in area of continuing education. While continuing education activities are and will remain important, in this paper the focus is on regular education. All engineering, computing, and technology programs in the United States undergo a periodic accreditation review by the Accreditation Board for Engineering and Technology (ABET).

In the General Criteria (ABET, 2006), Criterion 5 regarding the Curriculum requires that

“Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints.” As a result of these initiatives, the American National Standards Institute (ANSI) and the IEEE established committees on standards education with one of their charges to support and assist engineering and technology programs in standards education (Kelly, Bickart, & Forselius, 2006).

The accreditation criteria toward technology programs include “competence in the use of standard design practices, tools, techniques, and computer hardware and software” and “technical expertise in industry standards”.

It should be noted that the accreditation requirements towards computing programs are somewhat different. ABET requires students of information technology programs to have “understanding of best practices and standards and their applications”, but there is no similar explicit requirement towards students in computer science and information systems programs.

It should be noted that the above-mentioned Criterion 5 appears somewhat ambiguous: ‘appropriate engineering standards’ does not mean following proper engineering practices, but it actually means ‘appropriate technical standards’. Furthermore the criterion does not fully describe to what extent should standards be incorporated, and more importantly does not describe how can the accreditation requirements be satisfied. The Institute of Electrical and Electronic Engineers (IEEE) is a major international standards developer and has been playing an important role in electrical and computer engineering education. In an attempt to complement the ABET requirements, the IEEE Standards Education Committee (SEC), has been trying to determine what should electrical and computer engineering students know about standards (IEEE Standards in Education Committee, 2008).

Although ABET criteria are specifically for the United States, global expectations with respect to culminating capstone projects in engineering,
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