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**COVER** A surface fire, near Crown King, Arizona. Low-intensity surface fires have burned repeatedly through ponderosa pine forests of the southwestern United States. Chronologies of fire scars in the tree rings reveal an association between wildfire occurrence in this region and the El Niño–Southern Oscillation during the past three centuries, demonstrating that global-scale climatic patterns affect the frequency of fires and their effects on the ecosystem. See page 1017. [Photograph by John H. Dieterich]

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## Accreditation and Diversity in Engineering Education

For more than a century and a half, engineering schools in the United States have pursued a variety of educational philosophies, offering programs built around their local comparative advantages. The resulting diversity has been an important source of national technological strength. Today, faced with the challenges induced by rapid global political, economic, and environmental change, we need diversity and innovation in our new engineering graduates more than ever before. We need young engineers who can solve the problems of U.S. manufacturing; make substantial improvements in environmental quality, energy efficiency, and safety; and respond in innovative ways to the dramatic changes accompanying the end of the cold war. But, in contrast to the flexibility of undergraduate science education, heterogeneity and innovation in U.S. engineering education are threatened by the creeping demands of our system for accrediting undergraduate engineering curricula.

Accreditation of engineering curricula is coordinated in the United States by the Accreditation Board for Engineering and Technology (ABET). General requirements include one year of math and basic science, one year of engineering science, half a year in engineering design, and half a year of humanities and social science. Also required are laboratory experience, computer-based experience, education in written communication, and coverage of ethical, social, economic, and safety issues in engineering practice. Beyond these general criteria, each professional engineering society maintains affiliated committees that work out more detailed requirements for specific fields. When a school's most basic educational objectives and the ABET constraints have both been met, there is often little or no flexibility left. It is not unusual for an engineering undergraduate to have no opportunity to select a completely free elective course.

In principle the ABET system allows flexibility and diversity for both traditional and "nontraditional" curricula. In practice the ABET rules, which are often implemented by "bean-counting" accrediting teams, can present a formidable disincentive to innovation.

The simple way to remove this disincentive without compromising ABET's intended function of quality assurance is to reduce by 20% the total portion of time in an engineering undergraduate curriculum that ABET can specify for technical units of all kinds. The individual professional society committees in the different engineering disciplines should then be given considerable freedom to decide how they wish to allocate this smaller budget of units across the material that they consider to be important to their fields. The new flexible space created in the curriculum by the 20% rollback in technical requirements would be used in very different ways by different engineering schools. Following their tradition of diversity, some might focus on advanced specialized technical training; some might use the time to provide general international or country-specific education, including a focus on developing foreign language skills; some might devote the time to general education or the liberal arts; some might emphasize manufacturing or the special needs of high technology service industries; some might experiment with radical departures from conventional curricula such as "just in time learning." Whatever the local details, the result nationwide would be a surge of innovation, experimentation, and diversity in engineering education that could enormously strengthen our future ability to respond to the problems of an unpredictable, changing world.

The most likely criticism of a 20% rollback on ABET's technical requirements is that it might allow some weak schools, with limited numbers of course offerings, to get accredited. If this is a legitimate concern, the response should be to upgrade the quality of ABET's visiting teams and refocus them on evaluating course and curricular quality, de-emphasizing the current focus on quantity.

Many engineering educators have long recognized the problem of restricted flexibility caused by accreditation, but have felt helpless as individuals or as single schools to do much about it. The ABET system was built by the engineering profession. Working together, with encouragement from others, the profession can change it. It is time to free up American engineering education and stimulate a new wave of innovation and diversity in our undergraduate engineering curricula.—M. GRANGER MORGAN, *Head of the Department of Engineering and Public Policy and Professor of Electrical and Computer Engineering, Carnegie Mellon University, Pittsburgh, PA 15213*

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