

feature story

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What Should Be the First Professional Degree in Engineering?

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We'd like your opinion. Should the first professional degree in engineering be at the Bachelor or Master level?

The IEEE is considering whether to follow the recommendations of several other professional bodies and declare that a Master of Science or Master of Engineering (rather than Bachelor-level degrees) should be an engineer's first professional degree. While electrical and computer engineers make up the IEEE's single largest group of engineers (with mechanical engineers forming the next largest contingent) the policy being worked on—in collaboration with other professional associations—will address all branches of engineering. To help guide the IEEE's position, we are soliciting our members' opinions.

THE BASICS Let us start with some background. The first professional degree in engineering is the customary degree needed for the practice of engineering. Practice is understood to be carried out in an industrial setting, and does not require much additional training.

However, it is widely accepted that in a field as large and diverse as engineering, some specialties require more training. For example, researchers and academics often need advanced degrees. Individuals who branch into sales and marketing often seek additional degrees in business administration. Still, the concept of the first professional degree is useful, since it informs the public (and licensing bodies) about the minimum requirements that qualify an aspiring professional for practice.

MORE SCHOOLING In many countries, the first professional degree in engineering is the Bachelor of Science or Bachelor of Engineering. In the last decade, some educational programs that required more schooling or practice (and awarded a title such as Diplom-engineer) have reduced their requirements to conform to the B.Sc./B.Eng. "standard." Nevertheless, the increasing complexity of engineering tasks motivated educators to add new topics and subdisciplines to the curriculum, increasing significantly the amount of study required. One of the consequences is that students take longer to complete their studies (in the United States the average is 4.8 years for a four-year program).

Although other professions such as medicine and law have organized their academic programs to require longer studies, and mandated a graduate degree as the first professional degree, most engineers still hold a Bachelor-level degree that required only four years of study.

Over the years, many advocates have encouraged the engineering profession to emulate the longer training of other professions, but their advice went unheeded. When the Bologna Process for higher education was proposed in 1999 by the European Commission, it called for engineering programs to have a "3+2+2" structure. The first three years are to be devoted to studies toward a Bachelor of Science degree, which would become a pre-engineering degree. The next two years are to be devoted to attaining the first professional degree, namely a Master of Science. A doctorate would normally require two additional years of study and a dissertation.

In the United States, the National Academy of Engineering and the American Society of Civil Engineers have advocated that the Master of Science be declared the first professional degree in engineering. The U.S. National Council of Examiners for Engineering and Surveying recently discussed changes to its Model Law requiring a Bachelor of Science degree plus 30 semester credits as a prerequisite for candidacy for licensure.

The tables presented here [see "[The Main Arguments](#)" and "[The First Professional Degree in Engineering](#)"] summarize the issues and provide reasons for and against a change. Weigh in on the matter by answering this month's [Marketplace of Ideas question](#).

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FOR MORE INFORMATION on the European Commission's Bologna Process, see http://ec.europa.eu/education/policies/educ/bologna/bologna_en.html. For the American Society of Civil Engineers's view on academic prerequisites, visit http://www.asce.org/pressroom/news/policy_details.cfm?hdlid=15.

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The Main Arguments

...for making a change

- The business demands placed on today's engineers have made the standard 120 semester-credit programs insufficient for an adequate education. Like physicians, lawyers, and other professionals, engineers have to develop specializations and undergo longer professional training before beginning their practice.
- The undergraduate engineering curriculum continues to expand, due to changes in technology and society. There is not enough time in the current system to cover all subjects that engineers must master. Most engineering students already take a longer time to get their Bachelor degrees compared with the time advertised by schools.
- The threshold for entry into engineering is significantly lower than that for medicine, dentistry, and law. This results in entry-level engineers of lower quality and lower status compared with these other professionals.
- Many companies overcome educational deficiencies by paying for on-the-job training and long apprenticeships. That creates engineers trained to be successful only in a specific environment, rather than being trained for a wide spectrum of tasks. Society would be better off if resources were invested in academic training focused on a wider range of job-related skills.
- Advancements in computing and information

...for the status quo

- Traditions of engineering practice are not only well established but also time-tested and successful.
- Significant dislocation would occur (with new regulations and grandfathering clauses) and added expenses would be incurred (the first professional degree would cost 20 percent to 30 percent more than it does today). There will be little or no benefit.
- The current system works well. Although some associations of engineers and educators favor longer study, the primary clients of engineering education, namely industry and the public, are unconcerned about alleged shortcomings of entry-level engineers. There are enough regulations and checks and balances to guarantee the public's health, welfare, and safety. "If it ain't broke don't fix it."
- Many parts of the world have already observed a decline in the propensity of young people who choose engineering as a career. What is the logic in making entry requirements even more difficult and costly?
- A new set of requirements is not likely to be adopted everywhere. Thus engineers in one jurisdiction might not be recognized in another. The question "Who is a real engineer?" would damage our community. It would confuse the public, and it would fragment the profession and reduce its stature.

technology have transformed many traditional engineering disciplines. Meanwhile, the increasing complexity of support software and the dependency on computing tools have not yet affected the curricula as they should. Adequate engineering education programs require more pertinent coursework, which cannot be crammed into the existing four-year time frame.

• It is not clear that the additional education needed beyond the Bachelor degree should be in engineering disciplines (or in a university's engineering department). Perhaps engineers should be encouraged to acquire graduate-level knowledge in other areas, such as business. The proposal to "add 30 credits or another degree" shows that the matter has not been thought through. Proponents have not defined the benefits of the additional education.

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The First Professional Degree in Engineering

Question	Current Practice	Proposed
What should be the minimum requirement?	A Bachelor of Science in engineering (or equivalent)	A Master of Science in engineering or a Bachelor of Science in engineering plus 30 additional semester credits
What additional training would be required?	None	Holders of a B.Sc. or B.Eng. would have to acquire additional educational credentials such as a M.Sc. or M.Eng.
What changes in engineering education would be needed?	None	New accreditation procedures for graduate programs; development of new graduate curricula; changes in licensure procedures and laws
Who supports each position?	Inside the IEEE, several sections, including the Alaska Section. In the United States, several representatives of state licensing boards that do not intend to adopt new guidelines.	Several engineering associations including the American Society of Civil Engineers. In the United States, the National Academy of Engineering and National Council of Examiners for Engineering and Surveying. In Europe, the developers of the Bologna Process.

