The Raise the Bar initiative for engineers has built upon decades of study, discussion, and activity within ASCE and other organizations. And its focus points in one direction: to the future of the profession so that engineers can continue to be adequately prepared to ensure the safety, health, and welfare of the public. 

By Robert L. Reid

A long process—a marathon, not a sprint,” explains Thomas W. Smith III, ENV SP, P.E., M.ASCE, the vice-president for lifelong learning and the dean of the Division of Continuing Studies at the University of Wisconsin’s Madison campus. And it took until nearly 1980 to secure licensure laws in U.S. territories and the District of Columbia. In similar fashion, in 1979 Iowa became the first state to mandate continuing education for professional engineers; today, 41 states have this requirement, according to a January 2013 state-by-state summary compiled by the National Society of Professional Engineers, of Alexandria, Virginia (www.msp.org/sites/default/files/resources/ pdfs/education/state_ce_requirements.pdf).

Thus, the adoption of the Raise the Bar goals will entail looking forward at the kinds of changes that will be happening for the engineers who will practice in 2030 and 2040 and 2070,” Leonard explains. “And they’re also failing to recognize the changes in education that have occurred” in recent decades, he notes.

These changes in what engineers are expected to know and to do and in how they are to be trained to meet their professional responsibilities are at the heart of the Raise the Bar initiative. It is an effort that engineering leaders knew at the outset would require decades, not just months or years, to achieve. As with the efforts by engineers during the first half of the 20th century to enact professional licensure laws in every state, the goal of requiring a master’s degree or 30 additional credits must be adopted on a state-by-state basis. That in itself is a daunting task—no state has yet adopted the master’s degree or an equivalent as a requirement for professional engineers; today, 41 states have this requirement, according to a January 2013 state-by-state summary compiled by the National Society of Professional Engineers, of Alexandria, Virginia (www.msp.org/sites/default/files/resources/pdfs/education/state_ce_requirements.pdf).

NOW IN ITS 20TH YEAR, the Raise the Bar effort essentially began in 1995, when “key educational and professional leaders of the civil engineering community in the United States began working to reform civil engineering education,” according to the 2012 paper “The Raise the Bar Initiative: Charting the Future by Understanding the Path to the Present—An Overview,” written by Russell and Thomas A. Lenox, Ph.D., Dist.M.ASCE, then an ASCE executive director. (Now retired, Lenox was a professor at the United States Military Academy before joining ASCE’s staff.) The paper was published in the Proceedings of the 2012 Annual Conference of the American Society for Engineering Education and can be accessed at www.asee.org/public/conferences/8/papers/3048/view. (Also see “Policy Statement 465: Why We Must Raise the Bar,” Civil Engineering, April 2002, pages 60–65 and 94–95, and “Preparing the Civil Engineer of Tomorrow by ‘Raising the Bar,’” Civil Engineering, September 2007, pages 64–71.)
Preventing the Civil Engineer for the Future (a second edition appearing in 2008), in ASCE’s The Vision for Civil Engineering in 2025, and in the National Academy of Engineering’s 2005 report Educating the Engineer of 2020: Adapting Engineering Education to the New Century. As outlined in these publications, the additional educational requirements would not take effect for at least eight years after being passed by a state so that new editions of engineering curricula would not have the rules changed in midstream. Furthermore, engineers already licensed at the future effective date would not be subject to the new requirements.

The National Academy of Engineering report urged. If such areas are neglected, even in favor of technical subjects, it will not be “in the best interest” of future engineers, who must be trained to be lifelong learners so that they will be “able to communicate the public” and “engage in a global engineering marketplace,” the report concluded.

Leonard notes that “it’s not enough to just treat the water we have so we can drink it…. We have to do a better job of understanding how to use it more effectively.” That involves conservation, which in turn requires an understanding of public policy and regulatory issues. “It may have been enough in the past for us as engineers to simply say, ‘When you’re ready to build a water treatment plant, call me and I will do that,’” he explains. “But to really be effective in protecting the public health, safety, and welfare, we need to be in the conversation, saying, ‘OK, how do we deal with this?’ How do we deal with it? How do we conserve it? Are there alternatives other than how we have always been doing this?’”

Engineers need to be part of the entire conversation, Leonard says. They need to be familiar with the science, with how communities work, and with how laws are made and regulations established. “We need to be able to walk into the city council when we’re asked to talk about a project and understand the bigger picture,” he stresses. Unfortunately, many engineers have not been taught in most undergraduate engineering programs, only a combination of an undergraduate and a master’s degree program—or the equivalent 30-credit path in addition to the baccalaureate degree—will make for the professional skills and this contextual background, Leonard explains.

As Russell explains, people think that engineers should “simply meet the minimum code requirements and that’s our only obligation as a profession, that’s one view. But if we view it from a different perspective, one in which we continue to integrate across many of these different social concerns and issues, in addition to meeting the code requirements, that view will take a different breadth and depth in terms of the formal and practical experience that one attains before becoming licensed. And that is where the master’s degree or equivalent becomes very important.”

Ethically, engineers are obligated “first and foremost and paramount to uphold public safety, health, and welfare,” Russell adds. But while the question of public safety is straightforward—preventing injuries and fatalities—public health and public welfare are broader concepts and are more difficult to quantify, he contends. Consider a new building. If you meet the code requirements in terms of foundations, structural systems, and electrical and mechanical systems you will probably be a “safe” building. But will it be a building designed to optimize the health of occupants and foster productivity? Will it promote the high-end creativity of modern knowledge workers? These are more difficult aspects to quantify, Russell explains.

Or suppose a road is washed out in a flood and people must drive considerably farther to reach their jobs or a building is shut down by high water. Even if no one is injured, “the impact of an extreme water event in terms of the use of the facility, what it takes to get the facility back online, has significant implications for health and welfare, even if they’re very nuanced,” Russell says. In such cases, the greater breadth and depth of knowledge an engineer would acquire during his or her graduate work could prove essential to meeting those health and welfare obligations. “It’s a question of being able to integrate the broad context,” Russell explains, “of being able to think through from a risk point of view what some of these scenarios might be. For example, water is a sustain-ability issue, and sustainability issues can be linked to weather patterns, so the engineer with a master’s degree might start thinking about risks and different scenarios with a range of possible outcomes, all of which could lead him or her to ask, ‘What kinds of extreme events could impact or influence my design?’”

Russell explains another critical point in favor of raising formal educational requirements is that even as the demands on engineers are increasing, the number of credit hours required in many typical four-year undergraduate engineering programs has been decreasing.

And even when the required number of credit hours remains above 120, the figure is often still far below what it used to be. When he earned a bachelor’s degree in engineering from New York City’s Manhattan College in 1961, Charles H. Thornton, Ph.D., P.E., Hon.M.ASCE, the chair- man of Charles H. Thornton & Company LLC and a cofounder of the international engineering firm Thornton Tomasetti, had to complete roughly 160 credit hours. But today, a similar engineering degree at Manhattan College requires only 115 credit hours.

The reasons for reducing the credit hours vary but often involve a desire to reduce the costs of college by enabling students to earn a degree in four years. This is particularly
true of state institutions, notes Kenneth J. Fridley, Ph.D., F.ASCE, the senior associate dean for administration in the University of Alabama’s College of Engineering. “If it’s advertised and promoted as a four-year degree, then students should be able to graduate in four years,” Fridley says, calling this a question of accountability and responsibility for state-funded schools.

Between 2005 and 2012, Alabama’s engineering curriculum was reduced from 132 credit hours to 125. Although Fridley notes that modern technology helps the university “put more technical content into a credit hour today than we were able to do years ago,” he concedes that the changes have reduced some of the earlier program’s fundamental breadth.

“Where before we required all students to take thermodynamics and circuits, today it’s a choice of either or,” Fridley says. Likewise, the former requirement of a laboratory class in both the sciences of chemistry and physics now just a “civil engineering materials lab,” which “covers some aspects of mechanics materials that we felt were important, so the students are still getting some of the critical information—but not the broad coverage of a hands-on lab experience with both mechanics and materials,” Fridley explains.

The work that ASCE has done in defining the civil engineering body of knowledge also helped guide some of these changes, Fridley adds. Originally, he explains, the university required students to take two years of chemistry, two of physics, and one of an additional science, typically geology. Initially, this was reduced by eliminating that additional science semester. But in part because of the body of knowledge recommendations, the curriculum was readjusted again to require one semester of chemistry and physics, a second semester of either chemistry or physics, and one semester of an additional science, typically geology. “This would then enable the universities to ‘bring back some of the fundamental breadth of topics that we’ve had to take out to meet the credit hour reductions,’” he says. The result would be a more comprehensive undergraduate program combined with a “master’s program that’s a much more professional track focusing on the technical depth and specialization the students’ interests,” Fridley explains.

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Moreover, far from increasing the number of credits, ABET would not even agree to a request contained in a resolution is- sued in 2007 by the National Council of Examiners for Engineering and Surveying (NCEES), of Seneca, South Carolina—which develops, administers, and scores the engineering and surveying licensure exams—in the United States—to place a lower limit on the number of credit hours, notes Jon D. Nelson, P.E., Dist.M.ASCE, a senior vice president in the Tulsa, Oklahoma, office of Tetra Tech and a former NCEES president. Although some engineers mistakenly believe that ABET does set a lower limit, its refusal to do so raises concern that someday the number of credits might even fall below 120, Nelson adds.

What engineers are trying to accomplish through the Raise the Bar initiative is just what other learned professions have already discovered. Medicine and law began requiring additional education during the first half of the 20th century, pharmacists in the 1970s, and the formal educational requirements of some professions today range from five to eight years. Other major professions, has remained static since then at just the four-year baccalaureate degree, Lenox says.

Leonard echoes that thought, noting that a graduate degree is currently required to be a licensed clinical social worker, a physical therapist, a school principal. “It’s just sort of under- stood” that you’ll need an advanced degree in those fields, he explains. “But it shocks me that engineers don’t understand this. We are in a very technically oriented profession and haven’t figured out what everybody else has figured out—that to practice competently in the future we just can’t do it without a bachelor’s degree anymore. It just doesn’t fit.”

Of course, some engineering and architecture firms have already reached that conclusion. A graduate degree is already practically the baseline requirement for becoming a structural or geotechnical engineer across the industry, notes ASCE’s Smith. “But most of our members are for instance, it is almost impossible to be hired without a master’s degree, explains Thornton, who believes that the stature and confidence of an engineer are increased by earning a graduate degree. Thornton jokes that he “knew everything” about engineering when he received his bachelor’s degree and that it took a master’s degree to make him realize how much he still needed to learn.

Looking to the future, many engineers see themselves needing, eventually heading in the direction of a team concept analogous to a medical practice. Lenox recalls a recent operation he underwent that involved, obviously, a surgeon but also a team of licensed practical nurses, registered nurses, nurse practitioners, physicians’ assistants, and others, each of whom had his or her own specialized training or education—and, in some cases, licensure or certification. “The sur- geon didn’t come in and take my blood every hour. That was done by a [licensed] practical nurse,” Lenox says, and someone else monitored his blood pressure or prescribed his medication—both required licenses in that state. Engineers believe that teams consisting of licensed professional engineers holding a master’s degree with various other specialists, for example, engineering technologies and engineering technicians, taking responsibility for the supporting work, Lenox explains.

As the Raise the Bar initiative moves into its third decade, certain aspects have changed. Last year, the NCEES removed Raise the Bar provisions from its model law and asked a committee to put them in a position statement instead. The model law was to be a guide by state engineering and licensure boards, and some boards were concerned that it set too rigid a deadline for the master’s degree or equivalent requirement. That deadline, January 1, 2020, was seen as too near to meet, explains Terri Tech, Nelson, who at present is serving on the NCEES committee that was asked to move the Raise the Bar provisions into the council’s new position statement.

For the University of Alabama’s Fridley, the young civil engineering students he encounters give him an insight into the future. Although some opponents of Raise the Bar worry that adding a master’s degree or equivalent will turn large numbers of qualified students away from the profession, Fridley finds the opposite to be true. “This isn’t a big issue” for the students, many of whom already expect to need a master’s degree “for their own professional growth and marketability,” Fridley explains. “It’s an expectation matched by the reality of data from a report recently issued by the Center on Education and the Workforce, part of Georgetown University’s McCourt School of Public Policy, that compared students with science, technology, engineering, or mathematics (STEM) degrees with non-STEM majors (read ‘STEM College Majors Earn the Most at All Points in Careers,’ on Civil Engineering online). According to the report, an estimated 56.5 percent of civil engineering ma- jors currently go on to graduate school, which boosts their average annual earnings to $101,000, well above the $83,000 average for all civil engineering graduates.

Moreover, Fridley has often solicited the views of freshmen about the provisions of the Raise the Bar initiative as part of an introductory civil engineering course. Over the past five years, roughly two-thirds of the students responded positively to the idea of requiring a master’s degree for professional practice. “To me, if we’re talking about raising the standards of entrance into what is a top state university who aren’t fazed by it whatsoever, then really I don’t think there’s an issue or a concern,” Fridley concludes.