

NEW CHALLENGES, SAME EDUCATION?

Today's students want to change the world. Let's help them.

For about as long as most college engineering programs have existed, the profession of engineering has been, true to its Latin root *ingeniare*, about invention. In 2000, when a National Academy of Engineering committee named the most important engineering achievements of the previous century, the list was dominated by devices: planes and spacecraft, cars and agricultural machines, lasers and PET scanners. Asked to project to the next century, another committee speculated on humanoid robots, smart appliances, and advanced materials – again, more devices.

A decade later, a new NAE committee re-examined the engineering grand challenges of the 21st century. This time, the panel reframed the discussion. Its list includes making solar energy economical, preventing nuclear terrorism, ensuring health informatics and clean water, and reverse-engineering the human brain. None of these are devices. Nearly all address complex social issues that use technology but cannot be solved by technology alone. Most require engineers to work with policymakers, business professionals, social scientists, and humanists. And most are inherently global.

As these large social problems enter the engineering profession's portfolio, the world faces a severe economic slump, if not a depression. Many see a connection between these two developments. Author Tom Friedman has argued that green technology can drive the next economic expansion. At a recent World Economic Forum in Dubai, participants called for entrepreneurship in the global public interest. The world is counting on engineers' ability to innovate out of this mess. Will the next generation be prepared

to face the challenge? Not if we teach it in the traditional manner of past decades.

By a fortunate coincidence, today's young engineering students are less motivated than we were to solve puzzles and more by a desire to change the world. The challenge for educators is to tap into that energy and give what it needs to succeed. Engineering fundamentals will be a part of that. But so, too, will be the analytic, creative, and business skills needed for global grand-challenge innovation.

What's the difference between this type of education and the traditional curricula associated with social and for-profit entrepreneurship? Social entrepreneurship is laudable but doesn't scale. Traditional for-profit entrepreneurship scales but usually accepts existing market conditions. Grand-challenge entrepreneurship sits in between. It can be for-profit – and generally needs to be, to have a broad impact on society. Yet, like the grand challenges noted above, it involves the interplay of technology with public policy and business and human behavior in ways not typical of most for-profit ventures.

Consider the challenges of solar energy and carbon sequestration, for example. They can be for-profit ventures, but not without support from policies that stabilize fluctuating energy costs and negotiate appropriate tradeoffs for the social and environmental cost of hydrocarbon combustion. Electric cars may be viable for 80 percent of commuters but will require a change of human behavior stimulated by more than market forces.

Several engineering programs have begun to address the need for a new type of engineering education. Working with Engineers

Without Borders, Duke University students recently completed a project to bring Internet connectivity to an isolated village in Uganda. The students quickly learned that the project was not merely about solar-powered laptops and wireless access points but also about establishing access to an Internet service provider where none existed. In establishing an Internet café, Uganda-style, they had to study micro-finance, local culture, public policies, and law. In short, theirs was a micro-scale engineering grand challenge.

COMPLEX GLOBAL PROBLEMS CAN'T BE SOLVED BY TECHNOLOGY ALONE.

The pieces of the puzzle for future engineering education are already here; we just have to put them together. The NAE has charted a course for our profession to move from devices to global social challenges, and has identified a number of exciting ones. We have also learned that this generation of students wants to get involved. To capitalize on this coincidence, we must create programs that engage students in society's global grand challenges and prepare them to be the generation that solves them.

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