READY OR NOT?
Entrepreneurship has become an essential professional skill. It should be embedded in engineering.

As the director of engineering entrepreneurship at Villanova University, I frequently rub shoulders with alumni. Whether returning to campus for reunions, sporting events, or other functions, without exception they wish their undergraduate years had included the business fundamentals instruction we offer now. A common refrain: "It would have helped me tremendously and saved me lots of time in my career."

Engineers didn't always need entrepreneurship skills. When I was an undergrad studying electrical engineering, employers didn't care about the course I took in effective communication skills or that I aced an elective in the business school on project management. Nor did interviewers ever ask about my interest in the creative arts or the course in Peace and Justice on my transcript. Focusing instead on my technical GPA and how well I performed on their on-the-spot quizzes to design an amplifier using NPN transistors. My first job after graduation was at a large automobile manufacturer. Day after day I was given specifications for circuits to design and algorithms to create. I never knew what others on the project were doing, who the customer was, or the budget. Since I love technology, I was perfectly happy cranking out solutions—and that's all the company wanted.

Today, however, sophisticated design tools, highly integrated circuits, and a global low-wage workforce of skilled technologists have freed up U.S.-based engineers to concentrate on more sophisticated areas, such as systems design, creativity, opportunity identification, and innovation. The National Academy of Engineering saw this emerging trend, predicting that the Engineer of 2020 will need to be dynamic, agile, and resilient, with good communication and management skills as well as leadership abilities. Indeed, high-tech employers like Lockheed Martin list mentoring, passion, and organizational skills among the qualifications it seeks in engineers. Lifelong learning is another prized attribute—and a glance at today's new job titles shows why: user-experience engineer, sustainability manager, and cloud-computing architect.

We must do more to meet the needs of employers and society. A number of engineering schools, including Penn State and other pioneers, now offer entrepreneurship minors. Broadening mind-sets, however, requires immersion. At Villanova, "entrepreneurially minded learning" (EML) infuses classes from the freshman engineering core to upper-level courses. Rather than focusing on start-ups, students learn how to identify, evaluate, and act upon opportunities and to explain their technical ideas in economic terms. They still study thermodynamics, of course, but in a way that stresses the value of that knowledge within the context of business and customer needs.

All first-year engineering students, for example, compete in a video pitch exercise against business school students. Many engineering professors also have developed EML-related classroom exercises, semester projects, case studies, readings, videos, and contests in their core and elective classes. Students in a soils class, say, might be challenged to find opportunities inspired by recent news events. Headlines about mudslides, infrastructure repairs, drug smugglers' tunnels, and Elon Musk's Hyperloop provide plenty of inspiration! In addition, about 15 percent of engineering majors pursue a 15-credit minor in Engineering Entrepreneurship that covers concepts from market research and technical analysis to leadership, culminating in a prototype product and well-honed pitch. Most of the seniors also will have submitted provisional patents to protect their intellectual property.

A number of entrepreneurship-related extracurricular opportunities supplement EML in the classroom. In the 24-Hour Imagination Quest, a fast-paced team competition mash-up of the Amazing Race and Shark Tank, students must move from idea to trade show booth, complete with logos and prototypes, in a weekend. Hands-on 3-D printing and other workshops help hone students' ability to turn ideas into working prototypes—a plus over back-of-the-envelope calculations when pitching new ideas to investors and customers.

But what about those scores of graduates who missed this entrepreneurial induction? Their technological acumen will always be widely needed. But to make the most of their careers, and to make an impact on their companies and society, these engineers must continue their education through online courses, certificate programs, and graduate degrees.

For our part, universities need to listen to their own marketplace and offer postgraduate programs that include training in entrepreneurial skills. Let's help working engineers learn how to design and develop innovative products and services to meet the needs of the marketplace. Let's train them to identify and assess the viability of potential business opportunities, understand intellectual property issues, and raise finances for companies of any size, start-up to blue chip. By providing the business context in which engineers operate—from supply chain issues to public perceptions—we will enable technologists of all ages to remain productive in today's rapidly changing global economy.

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