

Editor's Note



George Bugliarello is President Emeritus and University Professor at Polytechnic University in Brooklyn, New York, and foreign secretary of NAE.

Globalization and Engineering

Globalization is not a new phenomenon. Carthage, Rome, the Ottomans, several European powers, and mercantile city-states had multicontinental trading networks made possible by a combination of economic power, military power, and the latest technology. At certain stages in their history, they all outsourced elements of production, education, and even armies. Eventually,

however, these globalizations collapsed, often because of the political and economic consequences of war.

The globalization we are experiencing today is unprecedented in its magnitude and reach. The whole world has become a market for the economies of many countries, and globalization is transforming not only the location and organization of production and services, but also social and economic patterns. The long-term consequences are still unfathomable, and the debate rages on, not only in the United States, but also in Europe and elsewhere. In our country, there are growing concerns about the impact of globalization on our technological prowess, the long-term maintenance of our manufacturing capability as critical technological skills migrate abroad, our energy supplies, our research capacity, and our ability to stay on the cutting edge of engineering and science, which is essential to preserving our strength and freedom.

These concerns are aggravated by the anemic production of engineers in the United States, where enrollments in engineering colleges have remained practically static for the past 20 years. The 70,000 or so engineers we graduate each year, including foreign students, represent a decreasing percentage of the worldwide total. Even if 70,000 seems to be in balance with job opportunities at this moment, it is worrisome that less than 5 percent of U.S. college students go into engineering, far fewer than the 12 percent in Europe and the 40 percent in China. While other countries are setting very

high targets for the number of engineering Ph.D.'s as a key to future success, the number in the United States has increased very little. Combined with similar declines in the sciences, the United States is becoming less technologically literate, although the country is bound to depend more and more on science and technology for its future security, prosperity, and health.

Clearly, for the United States to hold its own in technology and prosper in a globalized world, we must rethink engineering education and make it more attractive to young Americans. We must also develop a farsighted science and technology policy and rethink our funding priorities for R&D in the physical sciences and engineering. Dissipating the fog and uncertainties of globalization and taking advantage of the opportunities created by globalization will require cool heads and realistic assessments, rather than knee-jerk reactions. We are moving into uncharted territory, and time is not on our side. But we *are* becoming aware of what needs to be done.

The NAE Engineer of 2020 Project, which has produced two studies on the skills U.S. engineers will need in 2020, is an important first step. A new National Research Council (NRC) report, *Globalization of Materials R&D: Time for a National Strategy*, which will be available shortly after this issue of *The Bridge* goes to press, explores these and many other issues. An upcoming report by the Committee on Science, Engineering, and Public Policy (COSEPUP) of the National Academies, *Storm Clouds on the Horizon: Setting the Right Course for America's Economic Leadership*, also focuses on what needs to be done for the United States to prosper in the global economy.

In short, globalization can weaken us, or it can offer us, and the world, hope that we can find ways to avoid global conflicts and improve human welfare. But we must act now to ensure that the United States continues to prosper and has the strength and talent to contribute to improvements in the security and quality of life for people everywhere.

The papers in this issue address some of these issues and concerns. Martin Kenney and Rafiq Dossani describe the very rapid increase in offshoring of R&D and engineering design jobs. American companies, they point out, are looking to hire individuals with advanced

degrees and workplace experience in India, the Philippines, and elsewhere. To illustrate the challenges of globalization, the authors focus on changes in civil engineering and electronic and computer engineering.

Senator Lamar Alexander addresses broader concerns about our scientific and technological strengths. He also suggests directions for public policies to mitigate the consequences of a looming crisis.

The article by **Peter Bridenbaugh**, chair of the NRC Committee on the Globalization of Materials R&D, and Mike Moloney, senior program officer of the National Materials Advisory Board, provides a summary of the conclusions and recommendations of the new NRC report, which focuses on the consequences of offshoring of materials R&D for U.S. engineering and technological leadership.

Ron Hira's article identifies trends and impacts of offshoring engineering and describes the "adjustments"

required of U.S. workers in a globalized marketplace. Hira notes the urgent need for good data and enlightened public policies to help U.S. workers meet the challenges ahead.

NAE president **Wm. A. Wulf** pieces together a mosaic of disturbing trends that must be reversed. (A statement recommending changes in visa policies, signed by President Wulf and the heads of dozens of major academic and professional organizations, is reprinted on p. 36.)

We hope the articles in this issue and upcoming Academies reports will encourage a discussion—and inspire action—not only in the engineering community, but also among decision makers and concerned citizens.

A handwritten signature in black ink that reads "George Fugliese". The signature is written in a cursive style and is underlined with a single horizontal line.