MY JOB LIES OVER THE OCEAN

By Dan McGraw

ASEE Prism, Dec. 2003, 13(4)

Trying to assess the role of higher education within the national economy is always tricky business. The obvious connection is that technological innovation drives economic growth, and science and engineering schools are responsible for developing the minds that drive the innovation. Virtually every job on the economic ladder, every morsel eaten in the economic food chain, is dependent in some way upon new ideas incubated in classrooms and labs around the country.

But the danger is in trying to quantify the relationship between economic growth and engineering education. If engineering schools pay too close attention to national economic interests, they become little more than technical job-training schools. Economic growth is a byproduct of a great educational system, but educational institutions cannot be great by merely serving national economic interests.

This is a much discussed point of contention between science and engineering educators and economists. Should engineering schools merely funnel grads into the job market, taking heed of what the private sector needs to help its bottom line? Or should engineering educators focus on creating an environment where their students discover the next big thing, whatever that might be?

The answer is not easy, nor is it an either/or proposition. And the issue is becoming more pressing everyday as globalization moves hundreds of thousands of engineering jobs offshore to countries like India, Russia, and China. The question for engineering schools is what role they face in stemming the tide of jobs being lost. Should they retool curricula to allow engineering graduates to better compete in the ever connected worldwide economy? Or should educators do what they have always done: provide the substantive education that will ensure that the next leap in technological innovation—be it in biotech, nanotech, or wireless technology—occurs in this country.

The numbers are grim. Gartner Inc., a high-tech forecasting firm, estimates that 10 percent of computer services and software jobs will be moved overseas by the end of 2004. Deloitte Research surveyed 100 of the world's largest financial services companies and found they expect to move 2 million jobs and $356 billion in operations to low-wage, developing countries within the next five years. Forrester Research, a marketing research firm, predicts that 3.3 million high-tech and service-industry jobs will move overseas by 2015, jobs that will provide $136 billion in wages.

The first jobs moving offshore are lower-level ones in computer programming and at call centers for financial institutions. But there is now an indication that higher-level engineering jobs—architectural services, research and development for computer chip makers, aerospace engineering jobs—are beginning to make their way out of the country as well.

“When manufacturing jobs started moving offshore, we were told not to worry, that the U.S. comparative advantage was in services and high technology,” Paul Almeida, president of the department of professional employees for the AFL-CIO, testified before Congress in the summer of 2003. “We were assured that the new global division of labor was both natural and benign: We would keep the high-paying, high-skilled jobs while developing countries would do the actual work of making things. Now, engineers with Ph.D.s and recent college graduates alike are hearing that they are too expensive, that their job can be done more cheaply abroad.”

The trend is complex and full of many moving parts, from the valuation of the dollar overseas to the ability of telecommunication to allow a computer engineer in Bangalore, India, to do the same work as someone in Silicon Valley. But what is at play here is central to the question of a global economy and “commoditization” of engineering work. If a computer programmer in India or China can do the work for $10,000 a year, and a U.S. computer programmer makes $60,000 a year, it is not difficult to see which country the work will gravitate toward.

How should engineering educators respond to the globalization of jobs? Some predict that as lower-level jobs migrate overseas, followed by R&D work, the best and brightest will shun engineering studies for business or law or medicine. That will lead to a decrease in real innovation, and the advantage in technology that the United States has held in the world will slowly be eroded.

Richard Tapia, professor of computational and applied mathematics, sees the situation as “a bigger threat than most people realize.” In science and engineering, Tapia says, “the job market certainly drives the educational component. Our job is to sell science and engineering education as an excellent opportunity. It drives the incentive for students. What is happening now threatens a traditional strength in this country. As job opportunities go away, a certain creativity goes with it.”

Tapia sees the move of even low-level tech jobs as having a “subtle long-term impact” on developing new technologies and the economic impact that goes along with that. “How many companies started over a cup of coffee?” Tapia asks. “People sit there and start brainstorming. It’s all part of the creative process. We can’t tell companies they have a certain quota for domestic workers, but we can give them the incentive to keep work here in this country. We must do that which strengthens our country long term.”

On the other hand, the globalization of the U.S. economy may be just another trend in the free-trade world. Under this theory, countries do what they do best competitively, the work is done cheaper, and consumers benefit in the long term. If computer chips can be made more cheaply in China, then that’s where the chips will be made. It is more important to remain on the higher rungs on the global economic ladder, designing the machines that use the chips, or creating new technology that makes old chip configuration obsolete. And from that innovation comes the real economic growth.

“In the United States, especially in the educational community, we often get spooked by economic trends,” says Anita K. Jones, a computer science professor at the University of Virginia and member of the National Science Board. “There are a lot of different kinds of

information technology jobs moving offshore right now. Many of them are not sophisticated jobs. But we as educators cannot change what we do in reaction to every economic change.

“The challenge for the educational community is to educate people for more sophisticated, knowledge-based jobs,” Jones continues. “What an engineer does is use knowledge to find new ways of doing things. That hasn’t changed. We need to educate for the future and, as always, we need to continue to educate our students better. Competition for jobs overseas doesn’t change our mission.”

Economic Evolution

The term “perfect storm” has almost become a cliché, but the term certainly applies to the factors that have caused so many white-collar jobs to be shipped abroad. Just a decade ago, the high-tech industry was rolling along with no end in sight. But the current move of science and engineering jobs overseas predates the Internet revolution of the 1990s. In the 1970s—and more so in the 1980s—basic manufacturing jobs were moved to Mexico and the Pacific Rim. Still, as the AFL-CIO’s Almeida testified, the high-tech innovation kept the economy humming.

But the economy soured around 2000, and the terrorist attacks in 2001 put the economy further in the tank. Adding to the current economic problems was the amount of funds private companies paid to upgrade for the anticipated Y2K problems, and subsequent lack of spending on IT in the ensuing years. The pressure during the economic recession forced companies to look more closely at their bottom line.

But there was also an inevitable economic evolution taking place. Much of the work being done in information technology and other engineering jobs became simple “rote” work. Software applications and writing computer code became more standardized and, therefore, more commoditized. And as this trend was going on, universities in countries like China, Russia, Ireland, India, and Malaysia were awarding science and engineering degrees in numbers approaching their U.S. counterparts. As more engineering graduates were being put into the engineering economy worldwide, there was a downward pressure on wages.

Ron Hira, an assistant professor of economic policy at Rochester Institute of Technology, studied the wage requirements for recent engineering graduates around the world. U.S. engineers make about $70,000 a year. The drop off for other countries is precipitous: Hungary, $25,690 annually; China, $15,120; Russia, $14,420; India, $13,580. The disparity in wages is exacerbated by the high value of the dollar in recent years. Because of the high value of the dollar, foreign engineers can live middle-class lives in their home countries. The savings in wages boost private companies’ bottom lines.

But the savings for companies are more than just wages. Because work can be done on one continent, and then passed off to another engineer in a different time zone, there are huge efficiencies to be achieved. A programmer in Ireland, for example, can begin work on a project and then pass the work off to an engineer in India. The same can be done for engineering work for architectural planning, designing new airplanes, improving industrial machinery, or basic biotech studies. And the cost for private companies in moving these jobs offshore is usually very cheap. In the past, when blue-collar manufacturing jobs moved to foreign countries, the cost of

building a new factory had to be figured into the equation. With back-office engineering jobs, the only costs are a desk, a computer hookup, and wages.

There is also the issue of the number of foreign workers who came to the United States during the heady high-tech days to work under temporary H1-B and L-1 visa programs. While huge numbers of foreign workers were needed to bridge the technology gap during the 1990s, many foreign workers, particularly from India, returned home with knowledge of how U.S. companies worked and connections to gain contract work from them.

A. Aneesh, professor of science and technology studies at Stanford University, studied 150 foreign workers in the United States, mostly from India. “There has always been a misconception that these workers came here under these visa programs with the intention of staying here forever,” Aneesh says. “People came here because the attrition rate of Indian companies was high in the 1990s, and they came here because the work and pay were the best. The prime motivation was to earn high dollars here, exchange them into rupees, and eventually go home. Since the Indian high-tech economy has improved so much, many foreign workers are going back and, unfortunately, taking jobs with them.”

The moves involve thousands of high paying jobs. According to Business Week, Intel plans to move 3,000 chip design jobs to India by 2006; Microsoft will move 500 software design jobs to India and China in 2003; Oracle will move 4,000 software design jobs to India during the next five years; and Phillips will move 700 consumer electronic design jobs to China in the next few years.

Smaller World

It is not hard then to see why U.S. companies are moving some of their basic operations to other countries. Actually, it is hard to see why they wouldn’t. But another factor for private companies is the international component of their businesses. Gail Dundas, a spokesperson for Intel, says 70 percent of computer chip maker’s revenues are generated overseas, and it makes sense for the company to have a strong international presence.

“We intend to maintain a steady level of employment in the United States, but we will also have new job growth in markets outside the United States,” Dundas says. “You have to look at all of the factors. There are times when cost-effectiveness is a part of it, but it is not the stand-alone reason. We have growing markets, good talented people in those markets, and people who are more educated than ever before. But we’ve been in foreign markets for 34 years. This is not something that just started happening for Intel in the past few years.”

But is this move of jobs offshore any different than globalization trends in the past? Is what is happening now any different than 1930s-era protectionism or the move of auto manufacturing jobs during the 1980s or the movement of electronics work to Asia and Mexico throughout the 1990s? Ron Hira believes there may be a fundamental difference now. With more than 2.6 million manufacturing jobs having been lost since 2000, there is a “spillover” effect, which is already decimating the IT industry, and a trend that may move to other engineering jobs. Hira thinks the unprecedented loss in manufacturing jobs and the movement of white-collar back-office jobs are related.

“The trend has always been to put research and development closer to production,” Hira says. “Location matters when it comes to the innovation process because it generates enormous spillover benefits and feeds on itself. An obvious example is Silicon Valley. If production is moved out of the country, other jobs follow, and the wages and benefits of our innovation are lost.”

Hira points to the unemployment levels for engineers. According to the U.S. Department of Labor Statistics, unemployment among electrical and electronic engineers reached 7 percent during 2003; 6.5 percent of all computer hardware engineers were unemployed; and 7.5 percent of all computer software engineers were similarly out of work. “The recession had a lot to do with these unprecedented levels, but the movement of work offshore is adding to the problem,” Hira says.

“The problem with Washington policy is that they ignore engineering education, and they basically ignore why talented people make decisions as students,” Hira continues. “If you agree that people are rational when they make decisions, it follows that the best and brightest students will look at the job market. Without jobs for all engineering students, from the low levels to the highest, we have the danger of slowly losing our competitive advantage.”

The issue is fast becoming a hot-button topic in Washington, D.C., and may become an even bigger issue in the 2004 presidential race. Sen. Joe Liebermann (D-Conn.), a candidate for the Democratic Party presidential nomination, is particularly concerned with computer-chip manufacturing, along with research and development in the industry, moving to China. Liebermann believes the movement of the semiconductor industry to China will have national-security implications for the defense and intelligence community.

“The loss goes beyond economics and security,” Liebermann wrote to Defense Secretary Donald H. Rumsfeld in June 2003. “What is at stake here is our ability to be pre-eminent in the world of ideas on which the semiconductor industry is based. Much of applied physical science—optics, materials science, computer science, to name a few—will be practiced at foreign centers of excellence. This stunning loss of intellectual capability will impede our efforts in all areas of society.”

Liebermann encourages active enforcement of free-trade rules, especially in computer-chip manufacturing, where China rebates 14 percent added tax on chip sales. He also encourages the Department of Defense and other government agencies to have some threshold of domestic content on high-tech purchases. He suggests increased government funding for R&D, cooperative research programs within universities, and tax incentives for U.S. investments.

Rep. Don Manzullo (R-Ill.), chairman of the House Subcommittee on Small Business, calls the movement of jobs offshore, “not a trend but an avalanche. You have to have engineers to do manufacturing. You have to have engineers to find innovation. You need engineers to create new industries. If the innovation process in manufacturing shifts to other global centers, a decline in the U.S. standard of living is assured.”

The Bush administration is increasingly seeing the problem as a serious one, both economic and political. “It’s a complex situation,” says Bruce P. Mehlman, Assistant Secretary of Technology

Policy for the Department of Commerce. “We’re seeing companies offering a variety of reasons as to why they are moving work offshore, but we continue to need to work to support job creation and retention in the United States.

“The real question is whether we’re reaping a bitter harvest in the post-Internet bubble, post-Worldcom, post-9/11, and post-Iraq world, or whether a fundamental shift took place during this same period of economic challenge that won’t allow an information technology workforce recovery as the broader economy recovers over the next few years,” Mehlman says.

With a problem so complex and so rooted in international economics, foreign trade agreements, currency valuations, and engineering education, there are no simple solutions. Globalization forces lower-level jobs to get exported, increases the standard of living worldwide, and provides for cheaper goods and services. But globalization also increases domestic unemployment in some industries, decreases the U.S pre-eminence in technology, and makes science and engineering a less attractive career choice.

For engineering educators, the offshore job issue is becoming paramount. From an increase in public/private partnerships, to new programs to retrain older workers, to more of a focus on international marketing and economics, educators are realizing that they are a vital cog in the national economy and this issue of jobs moving out of the country. But there are no easy solutions. Companies need certain workers at a certain cost structure. But engineering schools must also have the flexibility and the depth to create the minds that develop “the next big thing.”

“The short term is that we didn’t produce the workers companies needed for many years and now there aren’t jobs,” Rice University’s Richard Tapia says. “Our problem right now is an educational one. Technology follows science, so we have to have good, strong science education. But there is nothing wrong with teaching students and placing their education within the context of global economics. Engineering schools can do both: encourage the innovation, but also keep in mind that we are training people for good jobs. We need the flexibility to do both.”

NEXT MONTH: What engineering schools can do to stem the tide of jobs moving offshore.