SCIENCE POLICY

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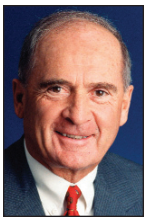
U.S. Competitiveness in IT Depends on Innovation



George Scalise

Innovation is the key to continued U.S. prominence in the information technology industry, according to George Scalise, president of the Semiconductor Industry Association (SIA). Speaking in late October at the 2004 Industrial Physics Forum hosted by the IBM T.J. Watson Research Center in Yorktown Heights, N.Y., Scalise based much of his commentary on the conclusions and recommendations of a recent report from the President's Council of Advisors on Science and Technology (PCAST) on maintaining a competitive edge in IT and manufacturing. Scalise chaired the PCAST subcommittee that produced the report.

Scalise cited the critical role played by semiconductors in establishing U.S. leadership in practically every major technology developed over the last 40 years. In an era where corporate outsourcing is a cause for concern, some 70% of U.S.-owned wafer fabrication facilities are located in the United States. The country also houses roughly 27% of the sales and 55% of the silicon industry's worldwide employment. Global sales of U.S.-based semiconductor companies are expected to total more than $100 billion in 2004.

Nationwide, the picture is less rosy. The PCAST report found that the manufacturing share of the U.S. gross domestic product (GDP) and employment has halved over the last 50 years, although productivity has increased and output has remained steady. Improvements in IT drive fully one-half of the U.S. GDP and two-thirds of its productivity gains.

"It's not enough for the U.S. to be good today; what's important is how good we are going to be tomorrow," said Scalise. "We've had a good run, but can we maintain that into the future?"

While outsourcing has dominated recent discussions on competitiveness, PCAST is more concerned by the increasing ability of non-U.S. competitors not just to manufacture commoditized products cheaply, but also to develop their own innovative new products and industries.

"U.S. high-tech leadership is not automatically assured, and we must do the right things in order to preserve its continued technological prominence," the PCAST report said.

Government subsidies are not the answer, either for the IT industry or the manufacturing sector, according to the report. Instead, the focus should be on enhancing the university research and development (R&D) base in the United States, improving education in science and technology, and developing related workforce skills. Scalise spoke in support of ongoing efforts to double the budget of the National Science Foundation, pointing to the European Union's recent decision to increase basic research funding from 2% to 3% of its GDP.

"We need to keep up to compete," he said. He favors making permanent the recently extended congressional tax cuts for R&D investment. Scalise also cited the need for even more tax incentives to "preserve the viability of stock options" and enhance the U.S. entrepreneurial climate.

Maintaining a thriving R&D manufacturing environment and "innovation ecosystem" are the keys to assuring continued U.S. leadership in the IT industry, according to the report.

"The big winners are those who develop talent, techniques, and tools so advanced that there is no competition," said Scalise, citing the need for "unquestioned superiority" in nanotechnology, biotechnology, information science, and engineering.

Nanotechnology is of particular interest to the IT industry, which expects existing complementary metal oxide semiconductor technology to reach its limits within the next 10–15 years.

"There is a 15-year gap between the latency period from research to production [of new technologies]," said Scalise, adding that the time to focus on developing alternatives is now. The Nanotechnology Research Initiative (NRI) is a joint effort between industry, academia, and the federal government to pave the way for innovations in nanotechnology. The NRI's objectives include establishing five interdisciplinary R&D centers in the United States and developing a "roadmap" for nanoelectronics, including the development of next-generation devices, materials, tools, and manufacturing techniques.

The IT market is increasingly consumer-driven, thanks to popular devices such as cell phones, digital cameras, and DVD players, and Scalise expects those trends to continue, with an even greater need for lower power and lower cost.

"In the 1980s, very few of us would have predicted the unique convergence in the 1990s that produced the Internet revolution," said Scalise, who believes that almost everything we own in the future will have electronic components, all networked together. "I believe convergence will continue to be an important factor in driving IT hardware and software demand."

The PCAST report on IT manufacturing and competitiveness can be accessed at Web site www.ostp.gov.

JENNIFER OUELLETTE

U.K. Finds Materials Engineers in Short Supply

Materials engineers are in short supply in the United Kingdom, and it will remain that way for a few more years. When the Institute of Materials, Minerals and Mining (IoM^3) conducted a survey of engineering recruitment among professional institutions, it found that the engineering field in general had problems in hiring qualified graduates. The survey last year found particular challenges in recruiting materials specialists.

"The materials community headed the table of those companies which were indicating a shortage of good people," said Bernie Rickinson, chief executive of the IoM^3. "I sense that the materials area has not changed for the better and if anything the demand for good materials people has become even more acute."

One sector painted a less gloomy picture. Aerospace companies, said Rickinson, "indicated that they were quite happy with supply and demand." Mike Hicks, Chief Technologist–Materials for Rolls-Royce, confirms that the company has been able to meet its growing needs for recruits.

Rolls-Royce works hard to attract graduates, said Hicks. The company works with schools and universities to spread the word that this is a high-tech business with interesting work.

"We are able to cream off the better kids," said Hicks. However, he adds, "talking to people in other businesses, their situation is much more difficult."

The current shortage of engineers and researchers with expertise in materials is a result of a significant decline in the percentage of university students studying engineering. The student population in U.K. universities grew by 18.8% between 1996–1997 and 2001–2002. The number of science students rose 15.7% for life sciences but decreased by 10.2% for physical sciences, one of the key routes into materials. In 1996–1997, physical sciences accounted for 4.2% of students, falling to 3.2% in 2001–2002.

The good news is that the long and steady decline may have come to an end. Some universities now report significant increases in the enrollment of engineering students.

John Kilner, head of the Department of Materials at Imperial College, one of the top universities in the United Kingdom, said that until recently "it was pretty

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gloomy here." After reaching a low of 35 new students two years ago, enrollment has risen to 80 this year. Early indications suggest that the numbers could be even higher in the next few years, said Kilner.

"The biggest single cause of the rise is the increase in the number of students arriving from China," said Kilner. This could, he suggests, be a "post-9/11" phenomenon, with students finding it difficult to get the visas they need to study in the United States.

Kilner points to an equally optimistic outlook at the postgraduate level. Imperial's materials department has doubled the number of students in its PhD program in recent years. Here, too, students from China are an important part of the intake.

Industry will still have trouble finding materials specialists for a few more years. As Kilner said, the time lag in graduating new students means that the numbers will continue to decline in the immediate future.

Poor pay for engineering, and the attraction of careers in finance, may have contributed to the decline in engineering recruitment. Here, too, Kilner sees signs of hope. Engineering salaries are increasing, something that is not lost on students choosing degree courses. Hicks of Rolls-Royce agrees that "the salaries we are offering at the moment are very attractive compared with people going into other professions."

Materials courses may also have benefited from a new examination syllabus for physics created by the Institute of Physics. This now has a "materials" module. Hicks is also enthusiastic about the imminent arrival of a school-level exam course in materials science.

Better recruitment by universities may also have contributed to the growing interest in engineering courses. Kilner said that Imperial College has been "very active in schools liaison."

In general, universities have improved their marketing skills, said Graham J. Davies, head of the School of Engineering at Birmingham University. "Most universities are getting a lot cannier about doing their recruitment." They have, he said, become much smarter in their market research and marketing, recent "inventions" for many British universities.

MICHAEL KENWARD

Output of Latin American S&E Articles Nearly Triples

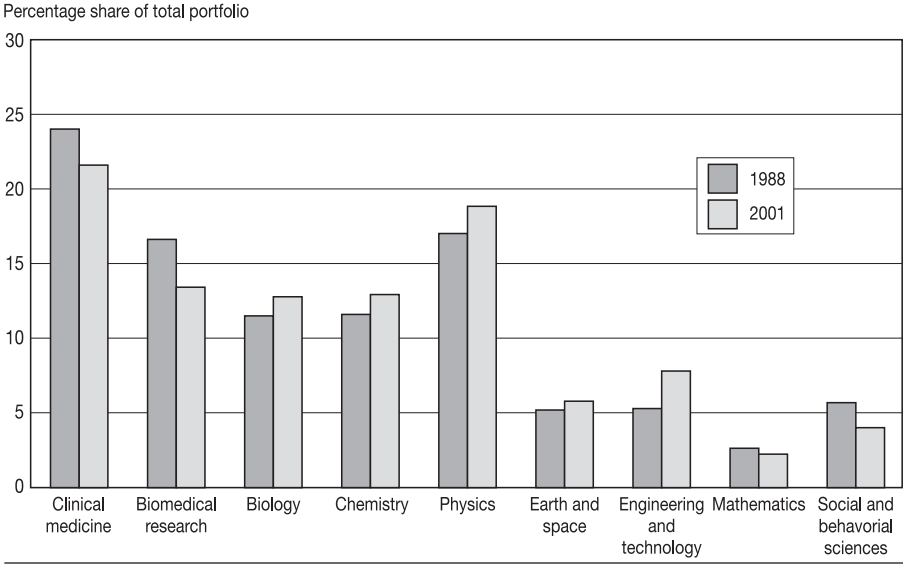
A study conducted by the U.S. National Science Foundation (NSF) has found that science and engineering (S&E) article output by seven Latin American countries rose by almost 200% between 1988 and 2001. The report, released in September, examines this rapid rise of output by researchers in Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, and Venezuela.

Argentina, Brazil, Chile, and Mexico generated close to 90% of the region's articles in 2001, with Brazil, as the highest producer, quadrupling its output between 1988 and 2001. Of these countries, Mexico is the second-highest producer of S&E articles, more than tripling its output during this time period. While the field distribution of the articles is weighted toward the life sciences, the greatest increases have been seen in engineering and technology, biology, and the physical sciences—chemistry, physics, and earth and space (see Table I).

Key international collaborators with the countries in this region include the United States, France, the United Kingdom, Germany, Italy, and Canada. The number of countries collaborating with Brazil nearly doubled, increasing from 46 countries in 1988 to 103 in 2001. Brazil is also the key collaborator among the Latin American countries.

Citation trends for S&E articles from these seven countries were also examined. The report, "Latin America Shows Rapid Rise in S&E Articles" (NSF 04-336), can be accessed at www.nsf.gov/sbe/srs. □

Table I: Portfolio of Science and Engineering Articles for Seven Latin American Countries: 1988 and 2001



Source: Institute for Scientific Information, Science and Social Science Citation indexes; CHI Research Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. Extracted from Figure 2 of NSF 04-336.

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