Policymakers Look to Stem Migration of High-Tech Manufacturing Overseas

The migration of high-tech semiconductor manufacturing overseas from the United States is provoking strong concern among policymakers in Washington D.C., thanks to a proliferation of reports and studies warning of the potential long-term economic impact of this trend. In a white paper to Defense Secretary Donald Rumsfeld in June, Sen. Joseph Lieberman (D-Conn.) called on the Pentagon to halt the loss to the U.S. economy caused by the shifting of high-technology semiconductor chip manufacturing to overseas competitors. Lieberman is the ranking member on the Senate Armed Services Airland Subcommittee.

The Lieberman white paper is only the latest in a series of reports and studies devoted to the issue of U.S. manufacturing moving offshore, including one from the National Association of Manufacturing, also released in early June, although without the focus on high-tech and national security. The President's Council of Advisors for Science and Technology (PCAST) has appointed a subcommittee to explore the issue, with a report due later this year, and the National Academy of Sciences (NAS) released a report in May, titled "Securing the Future: Regional and National Programs to Support the Semiconductor Industry," that devoted an entire chapter to the impact of overseas manufacturing.

According to Rep. Mike Honda (D-Calif.), whose district encompasses Silicon Valley, the NAS report is responsible for bringing to the attention of policymakers "the methods other nations are using to attract the industry away from its traditional home."

Honda shares many of Lieberman's concerns. "Right now, we are seeing high-tech manufacturing move abroad, which is beginning to lead to the departure of research and development," Honda said. "This has happened before in other fields, in order to capitalize on the proximity of the R&D and manufacturing functions. Siemens is already shifting R&D work to Asia, and Intel is building plants in Asia, partly because those countries already have an educated workforce in place."

The Lieberman white paper focused in large part on the potential long-term national security consequences of this trend. However, the U.S. military accounts for less than 1% of worldwide demand for semiconductors, according to Daryl Hatano, vice president of public policy for the Semiconductor Industry Association (SIA). "You can't drive the issue of keeping manufacturing onshore through the military," he said. SIA is more concerned with such issues as tax incentives and other subsidies that serve as economic incentives for domestic manufacturers in China, Taiwan, Europe, and Korea. In contrast, said Hatano, "Our federal government leaves economic development incentives to the states, which have more limited resources to apply."

Until 2001, the United States held the largest share (more than 30%) of the worldwide semiconductor market. That year, the Asia Pacific region (excluding Japan) surpassed the United States in market share. SIA projects that the U.S. portion of the market will fall to 20% in 2005, while the Asia Pacific's share will grow to 40%. While U.S.-owned companies maintain 77% of their manufacturing capacity domestically, recent statistics from Semiconductor Equipment and Materials International (SEMI) indicate that only 30% of the capital equipment required for semiconducting manufacturing is being sold in the United States.

"That implies that in the future, we're going to see less invested here in the U.S. and a corresponding decrease in capacity," said Hatano.

Of equal concern are education and workforce issues. The NAS report linked the dwindling U.S. pool of undergraduate and graduate students in the sciences to corresponding cuts in federal funding for university research in disciplines relevant to information technology, including materials R&D and engineering. While private R&D investment has been growing at a healthy rate, federal spending has not kept pace. And while corporate spending grew to nearly 60% of national R&D in the last two decades, "industry has devoted greater resources to product development than basic research, upon which future economic growth will ultimately depend," the report found. In contrast, Europe and Asia Pacific are rapidly expanding national and regional programs, with substantial increases of both direct and indirect funding.

To address the problem, the NAS report called for the allocation of more resources for university-based research to better address the technical challenges faced by the semiconductor industry, which include the development of novel methods and materials as well as next-generation lithography. It also recommended the development of three-way partnerships among industry, academia, and government to catalyze progress in future process and design. Such partnerships would encourage collaboration among the sectors, increase funding for current programs, and create incentives for more students to study science and technology.

Similar recommendations are contained in Lieberman's white paper, which called for increasing federal R&D funds in technology fields related to the semiconductor industry; a renewed focus on programs aimed at increasing the number of science and engineering graduates to meet future workforce demands; and funding cooperative research programs to promote government-industry partnerships that focus on critical cutting-edge research for the continued growth of the industry.

Honda supports both increasing federal funding for R&D in microelectronics and focusing on programs to increase the number of science and engineering graduates, particularly U.S. citizens at the BS and MS degree levels needed in the semiconductor industry.

"The data shows that students tend to follow the funding, because that provides them with opportunities to engage in research," Honda said, pointing to the rise in the number of students studying the life sciences when funding for the National Institutes of Health increased. "Conversely, as funding levels declined in the physical sciences, the number of students studying these subjects declined, which will lead to major shortages in the S&T workforce in years to come. Increased investments in R&D in areas beneficial to the semiconductor industry will certainly bring funding into materials."

However, Honda believes that the workforce problem begins long before the college undergraduate level, and hence supports fundamental changes in the U.S. K–12 system of science education.

"We need to develop a group of students who are excited about science and engineering and have the basic understanding of these fields that is needed for them to be successful at the BS, MS, and PhD [degree] levels," he said.

JENNIFER OUELLETTE

Chile to Increase Resources for S&T

In an agreement between the Chilean government and the World Bank, Chile will receive $100 million toward science and technology (S&T), as reported in the June 18 issue of *Chile News*, published by the International Press Department of Chile's Communication and Culture Secretariat. The money will be received in equal parts over a six-year period.

According to the newsletter, Chile invests 0.7% of its gross domestic product in S&T, which is now expected to rise to 1.2%, the figure set by President Ricardo Lagos as the goal for 2006. The additional

funding is expected to be used to train 1000 new scientists and 500 doctoral candidates in worldwide institutes; to support scientific research with upgraded facilities and equipment; to establish collaborative consortia with industry to add value to Chile's natural products, including innovations in mining and metallurgy, through the use of emerging technologies; to create cooperative networks with leading research centers worldwide; and to promote a productive interface between business and academic professionals.

The newsletter also reports that the European Commission has approved S&T relations with Chile, thereby enabling Chile to participate in the European Union's 6th Research Framework Programme for the 2002–2006 period.

Chen Jiageng Science Prize Foundation Instituted in China

Chinese Academy of Sciences (CAS) President Lu Yongxiang announced on June 17 the creation of the Chen Jiageng Science Prize Foundation in Beijing. The foundation is sponsored by CAS, the Bank of China, and governmental departments in charge of science, technology, and education. Its mission is to promote science and technology (S&T) in China by rewarding Chinese scientists who have made innovations, said Lu, who is also vice chair of the National People's Congress, China's top legislature, and president of the foundation.

CAS identifies Chen Jiageng (1874–1961) as a celebrated overseas Chinese leader, educator, and industrialist. A science prize named after him was set up by the Chen Jiageng Foundation in 1988. Altogether, 55 Chinese scientists from various fields have received the award.

The newly established science prize foundation will present its award every two years in five fields: mathematics and physics, chemistry, life science, geoscience, and technological science. Each prize recipient will receive 300,000 RMB (USD ~$36,000).

India's CSIR Labs Involved in Developing Fuel Cells

Several laboratories of the Council of Scientific and Industrial Research (CSIR) in India are involved in the development of fuel cells as an alternative for hydrocarbon resources, which are fast being depleted. These laboratories have been allocated funds of nearly 3 crore rupees (USD ~$650,000) for the fuel-cell research and development (R&D) program. The Indian Institute of Chemical Technology has developed a stand-alone version of a methanol-based fuel cell. The Electrochemical Institute has demonstrated the operation of a polymer electrolyte membrane fuel cell using platinized carbon electrodes with hydrogen and air at ambient temperature and pressure. The Glass and Ceramic Institute has developed electrolytes, cathodes, and anodes for a solid-oxide fuel cell. The National Chemical Laboratory has developed a series of catalysts for reforming liquid feed stocks such as liquefied petroleum gas and methanol as well as fuel-cell stacks for proton-exchange membrane fuel cells.

Australia Boosts Research Links with China

Australian Science Minister Peter McGauran announced five joint Australia–China research projects under the Innovation Access Program, which is part of the Backing Australia's Ability innovation strategy.

"These grants support Australian researchers who are undertaking collaborative research projects, alliances, and workshops with Chinese partners," McGauran said. "In one, Shanghai Jiaotong University will work with CSIRO Exploration and Mining to demonstrate a new kind of turbine technology that promises to not only mitigate greenhouse gas from coal mines, but also recover waste energy to generated electricity."

McGauran said that the other areas of research include development and applications of aluminum and magnesium alloys for automotive components; application of molecular genetic analysis to pesticide resistance in insects, and data mining in oil and gas exploration and exploitation.

Under the Australia–China Fund for S&T Cooperation, both countries agree to co-fund science and technology projects up to a total of AUD $250,000 per year from both countries. The next round of competitive grants under the Australia–China Fund will be held in November 2003.

For additional information on the program, access Web site https://sciencegrants.dest.gov.au.

EU and U.S. Forge Links to Provide Sustainable Energy Sources for the Future

European Research Commissioner Philippe Busquin and U.S. Secretary of Energy Spencer Abraham signed an agreement in Brussels on June 16 on fuel-cell technology that aims to strengthen research links by bringing together European Union (EU) and U.S. researchers from both the public and private sectors. Key challenges for fuel cells to become commercially competitive are cost reduction, improved performance, and durability. Research and technological development will explore how these barriers can be overcome.

Busquin said, "With this agreement and the publication of the summary report of the [European Commission's] High Level Group on Hydrogen and Fuel Cells, we have made real progress toward building a sustainable future for [the two parties]."

The agreement will drive forward the development of joint initiatives in seven fuel-cell-related areas:

- transportation vehicle demonstrations, including fueling infrastructures;
- fuel cells as auxiliary power units;
- codes and standards for fuel infrastructure, vehicles, and auxiliary power units;
- fuel choice studies and socioeconomic assessment of critical materials availability for low-temperature fuel cells;
- solid-oxide fuel cells and high-temperature fuel-cell turbine hybrid systems;
- support studies, including socioeconomic assessment of critical rare-earth materials for high-temperature fuel cells; and
- direct methanol and polymer electrolyte membrane fuel cells for transportation and stationary applications. □

Book Released on President of India Includes His Contribution to Materials

In June, India's Prime Minister Shri Atal Bihari Vajpayee released in New Delhi a book depicting the multifaceted personality of the president of India, A.P.J. Abdul Kalam, authored by Shri R. Ramanathan, a long-time associate of Kalam. The book has been published in Hindi and four other Indian languages as well as English. During his speech at the launching of the book, *Who is Kalam?*, Prime Minister Vajpayee quoted a passage noting the president's contribution to materials science in terms of India's development: "Dr. Kalam is a pioneer in introducing composite materials in India. They are very strong and light and ideally suited for space and aircraft applications. The first plant to use the carbon–carbon fiber was set up by him in Trivandrum when he was working in the Department of Space. Later, when he saw the plight of polio-affected children fitted with heavy artificial legs, he felt that a Floor Reaction Orthosis made with composite materials would weigh much less."