U.S. Industry Drives Growth in R&D Spending

Research and development (R&D) spending in the United States reached an estimated $220.6 billion in 1998, according to a report by the National Science Foundation (NSF), which can be found at website www.nsf.gov/sbe/srs/nsf99335/start.htm/. The report attributes most of the inflation-adjusted 5.3% increase over the estimated $205.6 billion spent on R&D in 1997 to industry. Steven Payson, author of the NSF Division of Science Resources Studies (Special Report), *National Patterns of R&D Resources: 1998*, said that industry has provided the largest share of financial support for R&D in the United States since 1980.

Preliminary 1998 estimates show industry R&D spending increased in real terms 7.7% over 1997 to $143.7 billion, or 65.1% of the total. Federal support increased 0.8% to $66.6 billion, for a record low of 30.2% of the total.

Payson said, "Nearly all ($140.8 billion) of the industry R&D funds will be devoted to R&D performed by industry itself, with the remainder directed toward academic R&D ($1.8 billion) and R&D performed by other nonprofit organizations ($1.0 billion)."

Industry, including industry-administered federally funded research and development centers (FFRDCs), is expected to perform 75.1% of total U.S. R&D in 1998. Of this, 85% will come from industry's own funds; federal funding will account for the remaining 15% (down from the all-time high of 32% in 1987), according to the report.

According to the report, most R&D spending (61.8% or $136.4 billion) is for development. Applied research accounts for 22.6% or $49.8 billion, and basic research for 15.6% or $34.4 billion.

The special report also delineated other highlights:

- The 1998 expected U.S. ratio of R&D to Gross Domestic Product of 2.61% is the highest since 1992.
- Total R&D is substantially concentrated in a small number of states. In 1995, the most recent year for which figures are available, the six states with the highest levels of R&D expenditures were, in descending order, California, Michigan, New York, Massachusetts, New Jersey, and Texas. They accounted for about half the national R&D total.
- The highest ratios of R&D to Gross State Product in 1995, in descending order, were in New Mexico, the District of Columbia, Michigan, Massachusetts, Maryland, Delaware, California, Connecticut, Rhode Island, and Washington.
- Defense-related R&D spending fell to 16.4% of the U.S. (federal plus non-federal) total in 1998, down from a high of 31.8% in 1987.

Trends in Research Investment Cause Concern for Continued U.S. Industrial Growth

The National Research Council's (NRC) Board on Science, Technology, and Economic Policy (STEP) commissioned studies of 11 industries in the manufacturing and service sectors to examine the reasons for improved U.S. industrial performance in the 1990s compared to the 1980s. The materials-related industries examined included steel, chemicals, biotechnology, powder metallurgy parts, computing, semiconductors, and computer disk drives. In previous studies of industry competitiveness, the service sector was overlooked because manufacturing was considered the backbone of the economy and more vulnerable to international competition. But because services generate three-quarters of the gross domestic product, employ 80% of the work force, and consume the production of commercial aircraft, drugs, and other goods, the board concluded that its analysis should be expanded to include the service sector.

Although STEP found that not all sectors of the economy and work force have benefited from the economic turnaround, this decade has seen positive trends in industrial performance, as demonstrated by increased output, export market share, and profitability. According to the NRC report, *Securing America's Industrial Strength*, competition in the United States and abroad compelled companies to switch product lines, downsize and move operations abroad, and improve their manufacturing processes. The trucking, banking, food retailing, and most manufacturing industries also invested heavily in information technology that enabled them to introduce new products and services and to operate more efficiently. As a result, the structure of most industries looks very different than it did in the 1980s. At the same time, public policies that emphasize federal budget deficit reduction and low domestic inflation, interest, and exchange rates have supported industrial growth.

However, the report identified areas that need attention. National data and the board's case studies suggest a downward trend in public and private funding of certain research fields. According to the report, as a result of budget deficit reduction and changes in agency missions, the federal government's support of electrical engineering research declined 36% between 1993, when research funding peaked, and 1997, the last year for which data on actual federal obligations are available. For electrical engineering research at universities, federal support dropped 32% during the same period. Other fields that experienced reductions of 20% or more in the same period include physics, mechanical engineering, and the geological sciences. Some of the industries that rely on the physical sciences and engineering fields—electronics, chemicals, and computing—improved profits while cutting back their support of research that could produce long-term benefits. STEP said that the reasons for these shifts in priorities and their implications for the future need to be evaluated.

STEP recommends that carefully chosen statistical data, collected nationally on a recurring basis, should be used to help track changes in research and innovation, as well as to help design and evaluate public policy. For example, science and technology indicators and data fall short in illuminating the applications of information technologies in a cross-section of industries. The report recommends changes in current surveys.

STEP recommends an examination of the skills required of the high-technology work force and how well U.S. institutions and non-U.S. sources are meeting the need, particularly for information technologies. Immigration quotas have been raised, some academic degree and skills training programs have expanded, and companies are paying higher premiums for skilled labor in the United States or seeking it abroad. Despite these measures, it is not clear whether there will remain a shortfall that may inhibit U.S. economic growth and innovation, and what should be done to alleviate it, the report said.

According to the report, intellectual property is an increasingly valuable commodity, and protection of rights—through patents, copyrights, and penalties for misappropriating trade secrets—is a crucial incentive to investment and creativity. Strengthening and extending these rights in the United States and elsewhere in the past 25 years were appropriate and probably necessary, the report said. On the other hand, the report continues, doing so has proved contentious, increasing litigation costs and sparking claims that these changes sometimes discourage competition, research, and the communication of research findings.

Copies of the report are available for $29.00 from the National Academy Press, 2101 Constitution Ave., NW, Washington, DC 20055, USA; tel. 202-334-3313 or 1-800-624-6242. The companion volume, *U.S. Industry in 2000: Studies in Competitive Performance*, is also available from the National Academy Press for $65.00. □

The Optical Society of America
~ *and* ~
the Materials Research Society

INVITE APPLICATIONS FOR THEIR

2000–2001
Congressional Science and Engineering Fellowship

PROGRAM: The Fellow spends one year working as a special legislative assistant on the staff of a member of Congress or Congressional committee. Activities may involve conducting legislative or oversight work, assisting in Congressional hearings and debates, and preparing briefs and writing speeches. The Fellow also attends an orientation program on Congressional and executive branch operations, which includes guidance in the Congressional placement process, and a year-long seminar series on science and public policy issues. These aspects of the program are administered by the American Association for the Advancement of Science for the OSA/MRS Fellow, and those Fellows sponsored by nearly two dozen other scientific societies.

PURPOSE: To provide OSA and MRS members with an invaluable public policy learning experience, to contribute to the more effective use of optical and materials science knowledge in government, and to broaden awareness about the value of scientist and engineer-government interaction among OSA and MRS members and within the federal government.

CRITERIA: A prospective Fellow must demonstrate a record of success in research or scholarship, in a field relevant to materials and/or optical science and technology. The Fellow must also demonstrate sensitivity toward policy issues and have a strong interest in applying scientific and technical knowledge to public policy issues. The Fellow must be able to work quickly and communicate effectively on a wide variety of topics, and be able to work cooperatively with individuals having diverse viewpoints. An applicant is expected to be a Member of OSA or MRS (or an applicant for membership) and have a doctorate.

AWARD: The Fellow will have a one-year appointment beginning September 1, 2000. The Fellowship stipend will be $40,000 to $47,000, plus money for health insurance, and travel and relocation expenses to the Washington, DC area. Final selection of the Fellow will be made in early 2000.

APPLICATION: Candidates should submit the following materials by **January 14, 2000**: (1) a detailed vita providing information about educational background, professional employment and activities, professional publications and presentations, public policy and legislative experience, and committee and advisory group appointments; (2) a statement of approximately 1,000 words addressing the applicant's interests in the fellowship, career goals, contributions the applicant believes he or she can make as an OSA/MRS Fellow to the legislative process, and what the applicant wants to learn from the experience; and (3) three letters of reference, specifically addressing the applicant's ability to work on Capitol Hill as a special legislative assistant, sent directly to the address below.

Application Material Should be Sent To

OSA/MRS Congressional Science and Engineering Fellow Program
c/o MRS
506 Keystone Dr.
Warrendale, PA 15086-7573
USA

The deadline for applications is January 14, 2000

For additional information contact MRS at (724) 779-3004 x501 (oare@mrs.org) or OSA at (202) 416-1418 (ebaldw@osa.org).

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