

EXECUTIVE SUMMARY

INTRODUCTION

In the 21st century, advances in science and engineering (S&E) will to a large measure determine economic growth, quality of life, and the health and security of our planet. The conduct, communication, and use of science, all intrinsically global, are increasingly important in addressing many critical global issues. Awareness of the importance of investing in S&E research and education has grown throughout the world, and many countries have taken steps to expand such investments. The ability of science and engineering to contribute to societal goals, address global problems, and make useful contributions to foreign policy relies to a high degree on global communication and cooperation in science and engineering.

New ideas and discoveries are emerging from all over the world and the balance of S&E expertise is shifting among countries. Many research problems require scientists and engineers in different countries to work together. Collaborative activities and international partnerships provide increasingly important means of keeping abreast of new insights and discoveries critical to maintaining U.S. leadership position in key fields. They also contribute to building more stable relations among communities and nations by creating a universal language and culture based on commonly accepted values of objectivity, sharing, integrity, and free inquiry.

International S&E collaboration encompasses a complex network of activities, with numerous participants and stakeholders, including industry, universities, professional societies, international organizations, private foundations, and governments. In the context of the United States, the Federal Government has played a significant role over the years in promoting international S&E activities through the work of its agencies with S&E missions, and by supporting research with international dimensions by scientists and engineers at U.S. universities. Science and engineering have also been important components of major foreign policy issues, such as arms control and global climate change. The role of the Federal Government will continue to be critical in supporting communication and collaboration in science and engineering. How to improve the effectiveness of the Federal role in international science and engineering is the subject of this report.

The National Science Board (NSB)¹ has periodically assessed the role and needs of science and engineering in the international arena. In February 1999, the NSB established a Task Force on International Issues in Science and Engineering. The task force was charged with addressing two tasks. The first was to develop recommendations for strengthening the Federal institutional framework of policies and agency relations that support S&E research and education in an international setting. The second was to develop recommendations for an effective leadership role for the National Science Foundation (NSF) in international science and engineering in the 21st century.² The task force engaged in an extensive review of relevant policy documents and reports and held hearings and consultations with experts and stakeholders.

The following key themes emerged during this information-gathering exercise:

- The need for more effective coordination of the U.S. Government's international S&E and S&E-related activities and greater consistency in meeting its international commitments;
- The importance of increased international cooperation in fundamental research and education, particularly with developing countries and by younger scientists and engineers; and
- The need to improve the use of S&E information in foreign policy deliberations and in dealing with global issues and problems.

Based on these findings, the Board has concluded that serious re-examination of the United States Government's role in international S&E research and education and the contribution of these activities to foreign policy is essential. Retaining the status quo would jeopardize future U.S. economic and scientific leadership and diminish the Nation's ability to address important global problems. New approaches to the management and coordination of U.S. international S&E activities are needed if the United States is to maintain the long term vitality of the U.S. economy and its S&E enterprise. The Board urges implementation of seven specific actions and makes the following overarching recommendation:

¹ The National Science Board serves as the governing board of the National Science Foundation and provides advice to the President and the Congress on matters of national science and engineering policy.

² The Board discharged this latter role by producing the report "Toward a More Effective NSF Role in International Science and Engineering." It is available on the NSB web site at the following url—<http://www.nsf.gov/nsb/documents/2000/nsb00217/nsb00217.htm>.

KEYSTONE RECOMMENDATION

The U.S. Government should move expeditiously to ensure the development of a more effective, coordinated framework for its international S&E research and education activities. This framework should integrate science and engineering more explicitly into deliberations on broader global issues and should support cooperative strategies that will ensure our access to worldwide talent, ideas, information, S&E infrastructure, and partnerships.

FINDINGS AND RECOMMENDATIONS

A. U.S. GOVERNMENT PREPARATION FOR, COORDINATION AND MANAGEMENT OF, AND COMMITMENT TO ITS INTERNATIONAL S&E RESEARCH AND EDUCATION ACTIVITIES.

Although U.S. Government involvement in international S&E related activities is growing, a clear picture of the activities of the various Federal agencies and the degree of coordination among them is lacking. Effective coordination and management require more extensive and more timely information about international S&E activities even though such information is often difficult to gather and interpret and mechanisms for communicating and sharing this information are not always adequate.

In many cases official international S&E agreements have no associated budget authority. Only a small fraction of overall Federal expenditures for international S&E activities is derived from specifically designated international program budgets. This lack of designation frequently leads to a paucity of funds for management, coordination, and communication of internationally focused activities. Appropriate structures and mechanisms for effective coordination and management are needed to eliminate unnecessary duplication, prevent inefficiencies, and facilitate synergy. An additional problem is the difficulty of maintaining interest in and support for long-term international projects, which has led to the United States becoming perceived at times as an unreliable international S&E partner.³

RECOMMENDATION 1

The Office of Science and Technology Policy (OSTP) should strengthen its international focus to ensure an effective, integrated, visible, and sustained role in monitoring, coordinating, and managing U.S. international S&E research and education activities. As part of this effort, OSTP should actively encourage Federal agencies

³ Two examples are the International Thermonuclear Experimental Reactor (ITER), which the Department of Energy withdrew from in 1999 due to budget cuts and the International Solar Polar Mission, which the National Aeronautics and Space Administration withdrew from in the early 1990s due to severe budget cuts.

to identify and increase the visibility of their international S&E research and education activities, to provide an adequate level of funding for these activities, and to allocate adequate funding and resources for their coordination and management. The Office of Management and Budget should prepare an annual international S&E budget crosscut, similar to its annual research and development (R&D) budget crosscut, that includes international activities found outside specifically designated international program budgets.

RECOMMENDATION 2

OSTP should encourage agencies to develop more effective mechanisms for gathering and disseminating information about U.S. collaboration and partnerships in international S&E activities and similar activities in other countries, with emphasis on fundamental research and S&E education.

RECOMMENDATION 3

The United States Government should promote the development of international S&E policy aimed at facilitating international cooperation in research and education. The formulation and implementation of policies related to areas such as immigration, intellectual property rights, and the exchange of scientific information and personnel should include consideration of their impact on international cooperation in research and education.

B. ENCOURAGEMENT AND FACILITATION OF EXPANDED S&E RESEARCH AND EDUCATION COLLABORATION AND PARTNERSHIPS WITH OTHER NATIONS, PARTICULARLY BY YOUNGER SCIENTISTS AND ENGINEERS AND WITH DEVELOPING COUNTRIES.

Scientific leadership requires access to people, knowledge, and S&E infrastructure, wherever they are found. The ability to communicate and interact with scientists and engineers in all corners of the globe greatly benefits the U.S. S&E enterprise as do the contributions of foreign-born scientists and engineers who migrate to the United States and work in our universities and research laboratories.

Two areas deserve special attention: increased participation in international S&E activities by younger scientists and engineers and increased collaboration with developing countries.

Participation by Younger Scientists and Engineers: U.S. students who study and conduct research abroad not only learn more about the countries they visit but also enhance their skills and capabilities, ultimately making them more productive participants in the U.S. labor force. However, it is often difficult to

convince younger scientists and engineers to become involved in international cooperative S&E research and education activities because of limited incentives and a widespread perception in many fields that time spent abroad may be detrimental to one's career.

RECOMMENDATION 4

Federal agencies should encourage and support policies and programs that provide incentives for expanding participation in international cooperative research and education activities by younger scientists and engineers.

Collaboration with Developing Countries: Knowledge and human capital are supplanting physical capital as the major ingredients for sustainable economic development. Most developing countries are aware of the need to build their science and engineering infrastructure capacity, and especially their human capacity through education and training. In the S&E realm, traditional forms of development assistance are being replaced by international cooperation that contributes to sustainable development through creation of the necessary infrastructure, including human resources. Interaction through collaboration and partnerships is not only more likely to promote sustainable development in today's world but also to make developing countries more effective partners in global problem solving.

RECOMMENDATION 5

Federal agencies should encourage development of human and physical infrastructure for science and engineering in developing countries through partnerships with international, multilateral, and private organizations providing support to developing countries for S&E research and education.

C. SCIENCE AND ENGINEERING INFORMATION FOR FOREIGN POLICY AND GLOBAL PROBLEM SOLVING.

For several years there has been growing concern that the attention given to science and engineering in foreign policy deliberations is inadequate. Consistent with a number of earlier studies on this topic, the recent National Research Council (NRC) report, *The Pervasive Role of Science, Technology, and Health in Foreign Policy: Imperatives for the Department of State*,⁴ emphasized the need for a fundamental change in the orientation of the U.S. foreign policy community. Specifically, the report recommended strengthening the capabilities of the State Department in areas involving S&E considerations through the commitment of agency leadership, an improved organizational structure, and an informed and motivated staff.

⁴ National Research Council, Office of International Affairs, *The Pervasive Role of Science, Technology, and Health in Foreign Policy: Imperatives for the Department of State*, Washington, DC, 1999.

RECOMMENDATION 6

The U.S. Government, especially the Department of State, with its primary responsibility for U.S. foreign policy, should recognize and address the importance of science and engineering in achieving its objectives. Mechanisms should be identified to improve communication among science officers, other U.S. embassy personnel, and science and engineering staff of other Federal agencies, including those working abroad, to facilitate sharing of information critical to planning and decision making, and to improve the general flow of information on critical S&E issues.

RECOMMENDATION 7

The U.S. Government should strongly endorse the spirit of the recommendations of the 1999 NRC report to the State Department and ensure that responses to those recommendations are implemented expeditiously. Because developing an appropriate U.S. capability in this arena requires a long-term concerted effort, effective change will require a multi-year, multi-Administration, and bipartisan response, with appropriate levels of funding.

CONCLUSION

The development of an effective framework for science and engineering in the international arena is a critical priority for assuring U.S. global leadership in the decades ahead. This framework must be based on clear policy objectives and effective institutional arrangements, and supported by appropriate development and sharing of information. The findings and recommendations presented in this paper identify key areas for attention and action. The National Science Board is prepared to assist in this endeavor.