Appendix A

Charge to Task Force on International Issues in Science and Engineering

NSB-99-32

February 18, 1999

CHARGE
NSB TASK FORCE ON
INTERNATIONAL ISSUES IN SCIENCE AND ENGINEERING

The significance of science and technology in the global context has grown dramatically and both private sector and government cooperation in international science and engineering have assumed a more prominent role. The complex and systemic biological, economic, and ecological problems of the 21st Century will demand more information, more participation by the scientific communities of all nations, and more cooperation between these communities and political decision-makers.

Within its Strategic Plan (NSB-98-215) the National Science Board has identified the global context of science and engineering as a topic of major importance. The Plan expressed the need for a fresh assessment of the roles and needs of science and engineering in the international arena and for a coherent strategy that supports a productive relationship between scientific and foreign policy objectives.

The NSB Task Force on International Issues will undertake two tasks.

1. With respect to science and technology in the international context, the task force will:

- Review the role and contributions of science and engineering research and education in both highly developed and developing countries and examine the Federal institutional framework of policies and agency relations that support fundamental research and education in the international setting;
- Assess the experience of other nations with respect to key issues in science and engineering, research and education; and
- Develop recommendations for enhancing the Federal institutional framework of policies, agency relations, and international cooperation.

2. With respect to the NSF role in international science and engineering research and education, the task force will:

- Review the NSF role in fostering international cooperation in fundamental science and engineering research and education and in their coordination with foreign policy; and
- Develop recommendations for an effective leadership role for NSF in international science and engineering in the 21st century.

In conducting its work, the task force will consult widely with other agencies and organizations and with science and technology officials of other countries.

Eamon M. Kelly
Chairman

Appendix B

Summary of Task Force Hearings

Hearing on the Global Framework and Modes of Interaction in International Science and Engineering

Friday, July 30, 1999
8:00 a.m. – 3:20 p.m.
National Science Foundation, Room 1235, Arlington, Virginia

Hearing on the Global Economy, Human Resources, and International Exchanges

Friday, October 29, 1999
8:30 a.m. – 4:00 p.m.
National Science Foundation, Room 1235, Arlington, Virginia

Hearing on Global Science and Engineering: Foreign Perspectives, Multicultural and International Organizations

Tuesday, November 16, 1999
9:00 a.m. – 5:30 p.m.
National Science Foundation, Room 1235, Arlington, Virginia

Agenda

The Global Framework and Modes of Interaction in International Science and Engineering

Friday, July 30, 1999–Room 1235

8:00 a.m.	**Welcome and Introduction,** Diana Natalicio, Chair, NSB Task Force on International Issues in Science and Engineering
8:10 a.m.	**Keynote Speakers: What Are the Challenges and/or Issues?** Rita Colwell, Director, National Science Foundation D. Allan Bromley, Sterling Professor, Yale University
9:00 a.m.	**I. Panel: Role and Responsibilities of the U.S. Department of State** (Stanley Jaskolski, Moderator) John Boright, National Academy of Sciences Rodney Nichols, New York Academy of Sciences J. Thomas Ratchford, George Mason University Mary Beth West, U.S. Department of State Current or recent U.S. Science Counselors: Anthony (Bud) Rock, U.S. Embassy, Paris Paul Maxwell, University of Texas at El Paso Marco DiCapua, Lawrence Livermore National Laboratory John Zimmerman, Science Applications International Corp.
10:30 a.m.	**Open discussion**
10:45	**Break**
11:00 a.m.	**II. Panel: U. S. Government Agencies' Modes of Interaction** (Mary K. Gaillard, Moderator) Delores M. Etter, Deputy Under Secretary of Defense for Science & Technology Sharon Hrynkow, Assistant Director for International Relations, Fogarty International Center, NIH Rolland Schmitten, Deputy Assistant Secretary for International Activities, NOAA Robert S. Price Jr., Acting Deputy Assistant Secretary for Science & Technology Policy & Cooperation, DOE Michael F. O'Brien, Deputy Associate Director, Office of External Relations, NASA Alan Hecht, Principal Deputy Assistant Administrator for International Activities, EPA
12:45 p.m.	**Open Discussion**
1:00 p.m.	**Lunch** (By Invitation) **Luncheon Speaker: "Congressional Perspectives on Global S&E"** Michael Quear, House Committee on Science

2:15 p.m. **III. Panel: The U.S. Government Policy Formulation Process** (Luis Sequeira, Moderator)
Kerri-Ann Jones, former Associate Director, White House Office of Science and Technology Policy
Richard Morgenstern, Senior Economic Counselor, U.S. Department of State
James Decker, Deputy Director of the Office of Science, U.S. Department of Energy

3:15 p.m. **Closing Remarks**
Diana Natalicio

3:20 p.m. **End of hearing**

Summary

I. Keynote Addresses: "What Are the Challenges and/or Issues?"

NSF Director ***Colwell*** noted that international activities are one of the highest priorities of NSF. In the United States, collaborations occur much more frequently within national borders than across them. The GEMINI project that involves seven countries was cited as an excellent example of international collaboration. Due to cost and complexity, support of large-scale projects demands international collaboration. Expanding the number of countries contributing to the global scientific enterprise will help us achieve a globally integrated scientific system. But the United States must focus on the evolving role of developing countries to help achieve this goal. It is in the long-term scientific interest of the United States to do so. Colwell posed three questions for the task force to consider: 1) What models might NSF adopt to facilitate the joint funding of international cooperation? 2) How can NSF involve more younger scientists and engineers in international cooperative scientific research and education? and 3) Should the NSF devote resources to establish partnerships with USAID, the World Bank, the Department of State, private foundations, etc. in order to make available scientific expertise?

Bromley asserted that science and technology were lacking in U. S. foreign policy. Consequently, this lack has caused difficulty in the past and will continue to do so in the future. Because the United States does not consider science and technology an integral part of its foreign policy, the Department of State (DOS) does not seek Foreign Service Officers with backgrounds in science to fill its science positions. Bromley recalled that during the Reagan Administration, an Executive Order to fill science posts with scientists was ignored. An idea to use the Foreign Commercial Service (FCS) to gather scientific information and data failed; NSB and NSF should try to revive this idea with DOS. Due to the lack of emphasis and integration of science and technology in foreign policy, the United States has become known as an unreliable partner in some major international projects; the International Space Station is an example of this, with design changes made by the United States without consulting its partners. The United States needs better communication with its partners.

II. Panel: Role and Responsibilities of the U.S. Department of State

Boright stated that the National Academy of Sciences (NAS) report on science at DOS is nearly completed and should be available in September. In his view, "science for policy" and "policy for science" overlap extensively. In the case of the former (science for policy), we must have a system for the global science community to integrate itself. This system, however, cannot be motivated by DOS and U.S. embassies entirely. DOS should be interested in doing "policy for science." DOS can be a player, but scientists will need to do the major work in this regard. Key issue is money. DOS has no money to fund international activities.

Nichols stated that the theme for this panel has been reviewed many times before, but getting changes implemented has and will be difficult. Quality of DOS staff work for international projects should be first-rate and uniform – it currently is not. Foreign Service Officers and Ambassadors do S&T but do not have much time to do it well. Nichols recommended clarifying not only DOS, but also government-wide objectives in S&T, setting priorities, and advocating needed resources. DOS needs more resources and not just in science. In the next century, the roles of various agencies involved in science will change: as the DOS role diminishes, the role of NSF and others will need to expand. OSTP must also increase its role. Currently, S&T in international affairs are not thriving at either NSF or DOS according to Nichols.

Ratchford reviewed previous reports on the subject. Process for integrating policy and science is very weak in the United States. U.S. technical agencies should be tasked to meet science policy needs of DOS. The NSF should play a special role in sending staff to overseas posts for temporary assignments as NSF has the human resources to do this.

West stated that resource constraints are extreme at DOS. Negotiations consume the bulk of staff time and demands are increasing as multilateral environmental issues proliferate. Since its creation in 1973, DOS/OES (Bureau for Oceans and International Environmental and Scientific Affairs) has initiated hundreds of bilateral and multilateral science activities. The role of DOS is to gather and use scientific information; science feeds the policy-making process. Science is one of the major foreign policy goals. Antarctic Treaty is an example of this. There are also science-focused international activities that support foreign policy for science (i.e., the Space Station). There is a clear need to strengthen DOS partnerships with technical agencies.

Rock gave the first presentation providing the perspective of an Embassy Science counselor. The function of Embassy Science Officers defies description as the role and function of a science officer have changed dramatically over the years. Science Officers actually occupy positions with special emphasis on issues with technical consequence; they are not science positions per se. Because S&T has helped transform world economies, Environment, Science, and Technology (EST) offices do S&T as it helps in the development of U.S. foreign policy. Addressing the promise of biotechnology is one example of this; however, the advancement of science is not the mission of a Science Officer. Science literacy is needed in science posts rather than scientists. Foreign Service Officers (FSOs) need to be able to distinguish a technical issue from a policy one. In his current capacity, Rock serves the needs of 23 technical U.S. agencies.

Maxwell saw his role as Science Counselor as that of an advisor, first to the Ambassador and then to main State. He also provided advice to other Federal agencies (i.e., OSTP) and non-government sectors. Maxwell stated that a science background is necessary in order to recognize opportunities. DOS needs to re-establish the Science Deputy Assistant Secretary (DAS) position in OES, perhaps as the Principal DAS. Additionally, DOS needs to recruit FSOs with science credentials. Finally, and most importantly, a clear, strong signal must be sent within and outside of DOS that science is a key component of U.S. foreign policy.

DiCapua described in some detail the work he did for a diverse clientele (i.e., NOAA, DOE, Health and Human Services) while he was Science Counselor in China. All issues that he worked on were rife with technical and foreign policy concerns. He said his biggest challenge was dealing with the political volatility of issues. “One size fits all” philosophy does not work well in embassies; what it takes to be a successful Science Counselor in Beijing is not necessarily the same thing it takes to become a successful Science Counselor in Paris. DiCapua agreed with the idea of having a cadre of temporary duty officers from other agencies for particular embassies.

Due to the great number of visitors he received, ***Zimmerman*** viewed his role as EST Minister Counselor in Moscow as more of a tour guide than a working scientist. In order to meet their specific needs overseas, Zimmerman remarked that the U.S. Department of Agriculture (USDA) established the Foreign Agricultural Service (FAS) and the Department of Commerce (DOC) established the FCS. In essence, they have created their own mini State Departments. Zimmerman suggested that NSF may wish to consider doing something similar.

III. PANEL: U. S. GOVERNMENT AGENCIES' MODES OF INTERACTION

Etter stated that research at the Department of Defense (DOD) is focused on security threats for the 21st century and that DOD international activities involve primarily research on materials, sensors and electronics, and telecommunications. DOD S&T is a partnership with service labs, the Defense Advanced Research Projects Agency (DARPA), universities, and industries. She also described programs with other government agencies (i.e., DOE, NASA) and other nations.

Hrynkow stated that the mission of the NIH is to uncover new knowledge that will lead to better health for all humanity. The Fogarty International Center is devoted entirely to international activities. NIH mechanisms for research support involve competitive grants and contracts, and training (intramural and extramural). At any given moment, there are 2000-3000 foreign scientists on the NIH campus, all of them paid for by NIH at a cost of $100 million per year. Fully half of all postdocs at NIH are from other countries. NIH works all over the world. The AIDS International Training and Research Program is a model for advancing global health agenda. The Biodiversity Program, cosponsored by USAID and NSF, screens tropical flora and fauna for new drugs. The Multilateral Initiative on Malaria involves the European Union (EU), Japan, and Africa. Nearly $70 million is devoted each year to support scientists from the developing world. In development are plans for partnerships in Health and Economics, Bioethics, Genomics, and Clinical Research. NIH also partners with NSF on the Ecology of Infectious Diseases.

Schmitten described how NOAA is collaborative by nature and how NOAA is decentralized with respect to international affairs. NOAA's international mission is environmental assessment and prediction, and environmental stewardship. Budgetary constraints limit NOAA's involvement internationally. NOAA is working with USAID, the U.S. Geological Service (USGS), and NSF on a number of international projects.

Price described how the DOE international mission is woven into all of their activities: national security, energy, and environmental monitoring. International offices are found throughout DOE divisions, however, international activities account for less than 1 percent of the DOE total budget. Work with developing countries was reborn under President Clinton and many new agreements were signed. He indicate that the new Secretary of Energy is interested in involving developing countries especially with regard to implementing the Kyoto Protocol. DOE and other agencies need to rethink strategies on how to better communicate science goals to the public in order to avoid international embarrassments such as the Superconducting Super Collider (SSC). DOE is in favor of sending more technical people to embassies but sometimes DOS balks at accepting them.

O'Brien stated that NASA has 3000 international agreements with more than 100 nations. Benefits to NASA are pooling of financial resources and access to foreign sites. International cooperation does have downsides: increase in management complexity, technical and programmatic risks as well as political risk. Guidelines for international cooperation must be mutually beneficial, partners must be government agencies, and projects must have technical merit. The best current example of international cooperation at NASA is the International Space Station (est. total cost = $50-60 billion) involving 15 nations working through 5 space agencies.

Hecht described the international mission of EPA: 1) protect U.S. citizens along U.S. borders; 2) reduce global threats; (3) reduce cost of environmental protection in the United States; 4) promote U.S. technology and services abroad; and 5) strengthen environmental protection overseas. EPA is very decentralized with multi-office mission responsibilities. EPA utilizes a number of modalities for international cooperation: technical assistance, training and capacity building, industrial ecology related to zero waste, and trade and environment issues, and research, both basic and applied. Hecht then listed a number of examples of international activities at EPA, some of which included developing countries. Typically, U.S. agencies are not fleet-footed enough to take advantage of opportunities, especially with developing countries.

IV. Luncheon Speech: "Congressional Perspectives on Global S&E"

Quear contends that Congressional support for international science cooperation is probably as nebulous and bifurcated as it is within the Administration. Due to the passing of George Brown, he fears that international science cooperation has lost its biggest supporter on Capitol Hill and there is no one poised to fill the void. Part of the problem with international science cooperation in Congress is that the definition of what is international science cooperation varies from person to person and agency to agency. Quear believes that the most successful partnership in science for the United States is with Israel. His opinion in based on the fact that a binational science endowment was bestowed by the U.S. Government back in 1976 and that the interest generated from the endowment supports the science partnership. There is no annual appropriation process and the Israelis feel they are equal partners. There is no similar model for any other country. Congressional funding for international science cooperation is not the problem; Quear has never seen any appropriations bill where the budget request for international activities was ever cut. The problem is getting agencies to set priorities and submit requests for international activities. He noted that Congress rarely receives any budget requests from the agencies specifically for international activities.

V. The U.S. Government Policy Formulation Process

Jones discussed three questions: 1) Is there a dichotomy between science for policy and policy for science? Her short answer was "Yes" and "No". It depends on where you are in a particular process, what issues you're dealing with, the situation, the country – it's highly variable. At the highest level of policy objectives, there is consistency. 2) How does the current science policy process work? Jones described the National Science and Technology Council, its Committee on International Science, Engineering, and Technology, and the role of the Office of Science and Technology Policy (OSTP). OSTP is the lead within the White House for science policy. OSTP is both proactive and reactive. OSTP connections to agencies are as important as OSTP connections to the White House. Congress is a player in the process and is constantly asking questions and providing suggestions. Highly technical issues are oftentimes easier to deal with than political or bureaucratic ones. The process identifies and tries to address long-term issues. The problem is really how to maintain momentum on a longer-term issue when you have so many competing issues. 3) What are the specific needs of the U.S. science and technology community in the international setting? Most importantly, "doors" need to open for scientists; this is what DOS does. Scientists also need resources for international activities. Who pays? What is really needed are more knowledgeable spokespeople for scientists to represent them in the international setting. More communication on the value of S&T is also needed. Industry does not always value international experience.

According to ***Morgenstern***, DOS is not now, never has been, and probably never will be, considered a scientific agency. Five U.S. agencies account for over 50 percent of the S&T budget, and DOS is not among them. He believes there is a continuum of science for policy and policy for science at DOS. Science goals for DOS: ensure that policymakers have ready access to information and analysis, and that this information is incorporated into policies; help to organize large projects; facilitate the S&T-type agreements by engaging in the political and diplomatic connections necessary to make scientific exchanges work; and build institutional connections essential for the long-term strengthening of science at DOS. Near-term objectives: bring in a senior science advisor; develop roundtables with scientists and senior DOS officials (one such roundtable has already been held); and improve science training of DOS officials. Only 5-6 percent of DOS officials have a science degree. However, a critical mass of trained people does not necessarily ensure that good science will follow.

Decker stated that international collaboration is a very integral part of the domestic programs at DOE. However, a separate budget for international activities at DOE would never make it through the budget process. The two largest areas for international collaboration are high-energy physics and fusion research. The most recent large international collaboration is the DOE/NSF partnership in constructing the large hadron collider (LHC). Foreign policy considerations are not usually the driver for science projects, but sometimes they can help initiate them (i.e., Japan, China, and Russia). Curiously, throughout the Cold War, DOE collaboration with Russia on fusion research and high-energy physics continued. At DOE, cooperative activities are identified at the scientific level and then brought to the Office of Science. For example, the DOE/NSF agreement on the LHC was done this way and has worked well. The most difficult part was dealing with Congress. Other countries that have parliamentary systems do not understand why we have such problems. The International Thermonuclear Experimental Reactor (ITER) is an example of a well-conceived, large international project that the United States will no longer be part of due to a changeover in Congress. Foreign support for large projects is essential, but it is very difficult to maintain political support in the United States for long-term projects. It is also difficult to get agencies to come to the table on large projects because they have to have a vested interest. For most fields of science, scientists cannot make significant international cooperation happen by themselves; government involvement is essential.

Agenda
Global Economy, Human Resources, and International Exchanges

Friday, October 29, 1999–Room 1235

8:30 a.m. **Welcome and Introduction**
Diana Natalicio, Chair, NSB Task Force on International Issues in Science and Engineering

8:45 a.m. **Introduction to NSF Overseas Offices**
Pierre Perrolle, Director, Division of International Programs]
NSF Overseas Offices
(Diana Natalicio, Moderator)
David Schindel, Director, NSF Europe Office
Masanobu Miyahara, Scientific Affairs Advisor, NSF Tokyo Regional Office [Interviewed by William Blanpied, Head, NSF Tokyo Regional Office]

9:30 a.m. **Role of Office of General Counsel in NSF's International Activities** Lawrence Rudolph, General Counsel, NSF

9:50 a.m. Break

10:00 a.m **Programs and Projects that Support International Exchanges: Views from the Field**
(Luis Sequeira, Moderator)

1. **Ocean Drilling Program (ODP)**
   Kathryn Moran, Director, Ocean Drilling Program, Joint Oceanographic Institutions
   Brian Huber, ODP Foraminifer Paleontologist, Smithsonian Institution
2. **International Long-Term Ecological Research (ILTER)**
   James Gosz, Professor, Biology Department, University of New Mexico, and Chairman of the ILTER Network Committee
   Debra Peters, Research Scientist, USDA-ARC, Jornada Experimental Range, and ILTER Researcher

11:15 a.m. **New Partnerships for New Opportunities in a New Era**
(Pamela Ferguson, Moderator)
Thomas Malone, University Distinguished Scholar Emeritus, North Carolina State University

11:45 a.m. **National and International Trends**
Robert Wood, President-elect, Industrial Research Institute

12:15 p.m. **Lunch** – *(Informal buffet lunch provided for invited speakers and NSB* members)

1:00 p.m.	Introduction of Keynote Speaker Diana Natalicio **Keynote Address: The Globalization of International Science & Technology** Roland Schmitt, President Emeritus, Rensselaer Polytechnic Institute
1:45 p.m.	**Industry Perspectives** (Mary K. Gaillard, Moderator) Gordon Brunner, Chief Technology Officer, The Procter & Gamble Company Warren M. Strauss, Director of Global Worldwide Regulatory Organizations, Monsanto Corporation
2:30 p.m.	**Human Resources** (Mary K. Gaillard, Moderator) Richard F. Vaz, Associate Dean, Worcester Polytechnic Institute Natalie A. Mello, Director of Global Operations, Interdisciplinary and Global Studies Division, Worcester Polytechnic Institute Robert Grathwol, Director, Washington Office, Alexander von Humboldt Foundation
3:15 p.m.	**Break**
3:30 p.m.	**State Perspective** (Diana Natalicio, Moderator) Richard Bendis, Kansas Technology Enterprise Corporation
4:00 p.m.	**Closing Remarks and Adjournment** Diana Natalicio

SUMMARY

I. NSF OVERSEAS OFFICES

NSF EUROPE OFFICE

Schindel gave examples of his functions in the three basic mission objectives of the Europe Office: representation of NSF to all countries and international organizations in Europe; reporting on S&T developments in Europe and disseminating NSF information; and identifying, promoting, and facilitating opportunities for cooperation in Europe. Representation: Schindel served on the delegation to NATO's Science Committee, was an observer at the recent meeting of the European Science Foundation, and participated in the G-8 Working Group. Reporting: unlike science journalism, his reporting is tailored to NSF needs, and he highlights areas of interest to NSF in "real-time" reports of meetings attended. Facilitation: Schindel was involved in discussions about research training and mobility programs; reform of Italian science and its 300 research institutes; and European Union/U.S. cooperation and interactions in materials research.

NSF TOKYO OFFICE

Perrolle noted that, in addition to generic functions similar to those of the Europe Office, the Tokyo Office serves as liaison on a variety of fellowship and exchange programs and assists NSF-funded researchers in Japan. Perrolle summarized the first 20 years of the Tokyo Office (1960-1980), using slides prepared by ***Miyahara.*** The Tokyo Office started after a binational committee designated NSF as lead U.S. agency for a new program, intended to redress the imbalance in the flow of personnel. Although the ratio for long-term student exchanges has changed little over the past 25 years, exchanges of shorter-term duration have become better balanced. The U.S.-Japan Cooperative Science Program continues today and is the longest running bilateral program of NSF; the majority of activities under the program involve exchanges of a few days (e.g. seminars and workshops) to a few weeks (e.g. collaborative research). Participating scientists totaled more than 25,000 from 1961-1998; about 47 percent were from the United States

In a prerecorded videotape, ***Miyahara*** covered the NSF-Japan relationship since 1980. During the 1980s, frictions due to the increasing trade imbalance between the United States and Japan occasioned a review of the overall U.S.-Japan relationship, including S&T. In 1988, the Japanese Government began several initiatives to improve American access to research facilities and institutes in Japan. NSF is the U.S. agency for recruiting and nominating candidates. The initiatives include a summer institute for graduate students, postdoctoral fellowships, and a special fund for senior-level researchers. More than 1300 Americans have participated in these programs to date. Miyahara then described his vision of the Tokyo Office serving a regional function, promoting S&T collaboration with other economies in Asia that are emerging as S&T powers in the 21st century.

II. ROLE OF OFFICE OF GENERAL COUNSEL IN NSF'S INTERNATIONAL ACTIVITIES

The Office of the General Counsel (OGC) is the legal adviser and advocate for the NSF. ***Rudolph*** described OGC's role in the U.S. Antarctic Program to illustrate OGC's wide range of involvement in international issues. In the 1980s, OGC helped lay the groundwork for the exemplary environmental practices that now exist at NSF's research stations in the Antarctic. In the process, OGC has also forged a strong partnership with the State Department on matters affecting the Antarctic Treaty. State relies on NSF/OGC to help frame issues and participate as a lead agency in the interagency Antarctic Policy Working Group. OGC has worked closely with the Office of Polar Programs (OPP) to strengthen our Antarctic Conservation Act enforcement program. OGC and OPP together play a pivotal role in international negotiations involving the Protocol on Environmental Protection to the Antarctic Treaty and the ongoing development of a liability Annex that will define each country's financial exposure to environmental harm or damage that occurs in the Antarctic, even if solely as a result of an accident. The State Department relies on NSF's ability to balance sound environmental stewardship with the conduct of scientific activities in the Antarctic, and OGC will continue to define and assert this balance in Treaty discussions on this liability Annex.

Another key domain for OGC is intellectual property rights, an issue that affects all NSF Directorates and the scientific and engineering communities. OGC participated in developing the U.S. position that successfully questioned the soundness of a proposed international treaty on database protection that could have interfered with the open exchange of scientific data among scientists. Among other issues, OGC identified proposed changes to U.S. immigration laws that would impact the availability of visas for foreign scientists; co-sponsored with the Division of International Programs (INT) a State Department symposium on the legal requirements for international agreements; and assisted INT and the Astronomy Division in several aspects relating to GEMINI (involving the construction and operation of twin 8-meter telescopes in Hawaii and Chile): obtaining export licenses from the Commerce Department, helping negotiate and draft the international agreements, and persuading the U.S. Customs Service to allow duty-free entry of the GEMINI telescope mirror into Hawaii. OGC is fully engaged on the difficult and controversial issue of patenting the human genome. Rudolph foresees the Foundation increasingly partnering with more countries on large-scale scientific projects; the increased complexity of these agreements will require OGC involvement.

III. PROGRAMS AND PROJECTS THAT SUPPORT INTERNATIONAL EXCHANGES: VIEWS FROM THE FIELD

1. OCEAN DRILLING PROGRAM (ODP)

Moran described ODP as a research program that is thoroughly international: in funding, governance, and operations. With support from a wide array of countries, regional consortia, and multinational organizations, ODP studies the earth, specifically tectonics and the environment. An international science group staffs the research ship. Funds are given directly to NSF, which contracts with the Joint Oceanographic Institutions (JOI), a non-profit organization. Its annual operating budget is $45-46 million. JOI subcontracts ship operations to Texas A&M University, and to Columbia University for borehole services. A thousand specialists devote time each year to ODP. JOI has a science advisory group; ODP's advisory structure is composed of several panels, all international, that provide advice on all aspects of the program. The Head of the Science Committee is in Germany. Industry is also involved. ODP is a model for international science management.

Huber described the daily routine of the ODP cruises on which he participated. Collaborative teamwork is essential to achieving cruise objectives. Because ODP draws scientific talent from a large number of countries, it can mobilize much deeper expertise in particular research specialties than would be available from a pool limited to one or only a few countries. The close interaction aboard ship among researchers working in one disciplinary area, as well as the interaction among different laboratories on board the vessel, fosters partnerships and friendships. Huber believes his scientific career has been advanced significantly due to ODP and international collaboration.

2. International Long-Term Ecological Research (ILTER)

Gosz cited a need to create opportunities in terms of science in the terrestrial environment and to integrate efforts better: on an individual basis, across disciplines, and across nations. ILTER is a network of researchers at sites around the world that exchange data that adhere to common standards. Although ILTER is only six years old, many countries around the world have adopted the model and joined the network, because ILTER enables countries to gather information that allows them to better manage their resources. ILTER is a research platform; it is not a monitoring effort. Because data gathered for only 1-2 years can be misleading, the need for long-term ILTER sites is clear. Since different cultures can interpret the same set of data differently, an international effort safeguards against parochialism. Gosz then described the generic process by which a site becomes part of the ILTER network. It requires identification of a candidate site, finding a "champion," governmental endorsement, convening of a workshop with other network members, and formation of a national committee.

Peters described her participation in a U.S.-Hungary project involving comparisons of grasslands. The project goals are to sample vegetation at six research sites in two countries. The project involves scientists from both sides at various stages of their careers and has included an exchange of graduate students and training of undergraduates. NSF/INT funded the initial planning grant and has helped tremendously in facilitating project development. The partners bring complementary strengths. The U.S. strength is experimental manipulations; the Hungarians have a very strong background in analyzing pattern. The project's successes include technology transfer from Hungary to the United States (analytical solutions) and from the United States to Hungary (simulation modeling); education and training of students; and scientific productivity and achievements. A major problem, Peters said, is obtaining funding for principal investigator (PI) salaries and graduate student support; these items are normally not provided in INT grants. Doing research with just INT funding is very difficult to accomplish.

IV. New Partnerships for New Opportunities in a New Era

For ***Malone***, the International Geophysical Year (IGY) in 1956 marks the opening of "a new era in the history of the human race," capitalizing on advances in science and technology. He commended to the task force three lessons from the IGY's success: the effective partnership between the governmental and nongovernmental sectors; NSF's leadership in guiding that partnership and in orchestrating Federal interagency cooperation; and the engagement of nongovernmental leadership that recognized the opportunity for new partnerships.

Malone noted a recent trend toward renewed emphasis on international S&E. In 1994, an NRC paper prepared for the World Bank challenged the world to make knowledge the organizing principle for society. By 1999, the World Bank had published the results of an international conference on Knowledge for Development. It is now maintaining a website (*www.globalknowledge.org*) to nurture a Global Knowledge Partnership. In September 1999, the Kellogg Commission on the Future of State and Land-Grant Universities published a report on *Returning to Our Roots — A Learning Society*. This kind of a society is now considered by educators to be within our grasp. Clearly, new patterns of interdisciplinary collaboration must be created among the physical, biological, health, social and policy sciences, engineering, and the humanities. There is an opportunity for leadership by the NSB in nurturing these partnerships. Malone mentioned a new initiative, a Western Hemisphere Knowledge Partnership 21 (WHKP 21) to address these issues in the Americas during the 21st century.

V. National and International Trends

Wood said that issues affecting the development and commercialization of science and engineering in the United States and around the world are of great concern to the Industrial Research Institute (IRI). IRI's International Committee fosters IRI-like organizations in other countries, organizes international R&D discussion meetings, and develops information about R&D in other countries. Among recent activities, IRI has hosted R&D roundtable discussions focusing on opportunities with the Czech Republic and Hungary. Increasing global competition is a key agenda item for Chief Executive Officers (CEOs) and Chief Technology Officers (CTOs) in major corporations, as noted in two IRI Position Statements that Wood handed out. Wood then cited some key R&D trends, showing an increase in industry investment in R&D; leveling off of U.S. Government funding of industrial research since 1993; tripling of R&D expenditures in the United States by foreign-owned companies since1987; and close to tripling of R&D spending by U.S. companies in other countries during the same period. More than half of these U.S. investments are in just five countries: Germany, the United Kingdom, Canada, France, and Japan. Wood urged the task force to adopt recommendations and policies that encourage strong academic research and educational programs; enable the effective transfer of technology to industry; and foster the ability of industry to develop and commercialize new technology.

VI. Keynote Address: The Globalization of International Science & Technology

Schmitt discussed Thomas Friedman's view that globalization has produced "fast world" and "slow world" countries, making the concept of First, Second, or Third World no longer appropriate. He believes that technology is driving globalization in governments as well as industry. He then discussed the global availability of human resources and the globalization of research, as supported by NSF data on science and engineering trends in: degree production (United States behind Europe but ahead of Asia); graduate enrollments of U.S. citizens (decreasing since 1994); graduate enrollments of foreign citizens in U.S. universities (increasing since 1994); and numbers of foreign-born engineering students enrolled in U.S. universities who choose to return home (significantly increased this decade compared to last). The United States depends significantly on foreign-born scientists and engineers; they comprise 28 percent of the entire S&E labor force in the United States. Regarding research facilities, in the 1980s, foreign firms established labs in the United States and U.S. firms established labs abroad. In the 1990s, all firms go to where they can get the S&T they need; borders and oceans are no longer significant barriers to these activities. Schmitt articulated strategy recommendations for the U.S. Government, for the Department of State, and for the National Science Foundation, to be prepared for the challenges presented by globalization. He believes the United States must support and strengthen the global S&T capacity in nations moving toward democratically based, market-oriented, and merit-driven systems. For the Department of State, existing international S&T organizations (e.g., ICSU, The International Institute for Applied Systems Analysis (IIASA), and NATO Science) need continuing attention, support, and strengthening. For NSB/NSF, the challenge is to craft imaginative programs to respond to globalization, as NSF has done successfully in the past with other challenges, (i.e., Small Business Innovation Research (SBIR), the Experimental Program to Stimulate Competitive Research (EPSCOR), the Engineering Research Centers (ERC)s, etc).

VII. Industry Perspectives

Brunner said that the goal of Procter & Gamble (P&G), to be the lead innovator with superior technology-based products, gives it a vital interest in making sure that public policy is supportive of global innovation. P&G has 19 significant laboratories around the world. 40 percent of P&G's R&D personnel are outside of the United States. The collaboration of P&G technologists from around the world provides insights and connections that are clearly superior to what any single region can provide. This collaboration leads to better product designs, earlier market exposure, and, ultimately, faster global product expansion. Global R&D has been a huge asset not only for P&G but also for the United States. Economic benefits to the United States are in jobs (new opportunities), tax revenues (over $1 billion from P&G in 1998), and shareholder value (P&G stock price increase). Overall, the globalization of R&D is good for U.S. companies, the U.S. economy, and, most importantly, benefits every U.S. citizen.

Strauss discussed the current international controversy over issues of food safety and genetically modified organisms. The precautionary principle, as defined by the EU, is an approach to risk management that is applied in circumstances of scientific uncertainty, reflecting the need to take action in the face of a potentially serious risk without awaiting the results of scientific research. The G-8 has charged OECD to look at biotechnology and report back in June 2000 on how the OECD and the G-8 should be studying the issues regarding food safety and related matters. Strauss described the debate within that forum as over whether science should be the fundamental basis or whether the precautionary principle or other factors should be included in the decision. Strauss opined that countries have the right to manage risk however they wish within the framework, but when one totally decouples risk assessment from risk management, one loses much of the knowledge and the scientific underpinning. Strauss then described another forum, the Codex Alimentarius, which is a governmental organization, funded by the Food and Agricultural Organization (FAO) and the World Health Organization (WHO), to develop standards, guidelines, and codes of practice to protect the health of consumers and ensure fair practices in food trade. The General Principles Committee of Codex is currently dealing with the precautionary principle and factors other than science that are relevant in food safety standards. Strauss believes that the primacy of science and what that means to risk assessment and risk management is very important for the United States, as well as for industry in general. Equally important is how scientific research and understanding is interpreted by WHO, FAO, and the World Trade Organization.

VIII. Human Resources

Vaz described the Global Perspective Program at Worcester Polytechnic Institute (WPI) as an innovative, project based, outcome-oriented approach to undergraduate education. Under this program, all WPI students must complete three project degree requirements in order to graduate. One of these, the Interactive Qualifying Project, requires the student to research and report on a problem that examines how science or technology interacts with societal structures and values. An increasing number of WPI students are completing the project requirements abroad. Students and faculty travel together to various WPI Project Centers around the world to work on real-world problems, typically for government agencies, or NGOs and non-profits, and sometimes for corporations. The students receive academic credit. A typical project involves a two-month sojourn in the host country, coinciding with one instructional term. The cost to the student is a negligible amount higher than on-campus. The program has proven to be an effective recruiting tool for potential incoming freshmen. Vaz described in detail one such international project that was based in Thailand. Following Vaz, ***Mello*** described the more traditional type of exchange program that WPI also offers. She also described WPI international initiatives for eliminating cost barriers, re-entry programming, and faculty development.

Grathwol described the Alexander von Humboldt Foundation (AvH) in terms of its guiding principles, its programs, and its particular strategy of follow-up. A guiding principle of AvH is the creation of a life-long partnership and worldwide network; it tries to maintain contact with all former re-search fellows and research awardees. Thus there is a network of more than 20,000 researchers in more than 120 countries. The follow-up program supports a variety of activities, such as subsequent research stays in Germany; fellowships to support German post-docs to collaborate with Humboldt "alumni" at their institutions outside Germany; and colloquia and regional meetings of Humboldtians, held both outside Germany and in Germany. In addition, there are 85 Humboldt clubs and Humboldt associations in 50 countries around the world. The follow up program is the major link between one time sponsorship and a life long relationship. Grathwol expressed interest in exploring possible cooperation between AvH and NSF.

IX. STATE PERSPECTIVE

Bendis recounted the origin and achievements of the Kansas Technology Enterprise Corporation (KTEC). KTEC was a response to a slump in the mid-1980s of the three primary Kansas industries, aviation, agriculture, and petroleum. The ensuing recession prompted a move to diversify and strengthen the economy. KTEC was created as the single entity responsible for all S&T programs in Kansas. It is a holding company that manages a portfolio of programs, investments, subsidiaries and affiliates that operate as for-profit and not-for-profit entities. Although created by the state government, KTEC has the powers and functions of a private corporation, with the ability to own equity and make investments. The KTEC mission is to create, grow, and expand Kansas's enterprises through technological innovation. Bendis views technology as the engine of economic growth, and science as the fuel for technology's engine. Internationally, KTEC has relations with Africa, Asia, Europe, and Latin America. A number of European companies have a presence in Kansas, and Kansas is an exporter to Europe. Bendis mentioned KTEC support for SBIR and noted that KTEC finances both academic and industrial research that leads to new or improved products.

AGENDA
GLOBAL SCIENCE AND ENGINEERING: FOREIGN PERSPECTIVES, MULTICULTURAL AND INTERNATIONAL ORGANIZATIONS

Tuesday, November 16, 1999—Room 1235

9:00 a.m.	**Welcome and Introduction** Diana Natalicio, Chair, NSB Task Force on International Issues in Science and Engineering
9:10 a.m.	**Third Annual Competitiveness Survey: How the U.S. measures up** (Stanley Jaskolski, Moderator) Charles Evans, Council on Competitiveness
9:30 a.m.	**Panel: U.S. Organizations Involved in International S&E Cooperation** Craig Dorman, Office of Naval Research (teleconference from London) Richard Getzinger, American Association for the Advancement of Science
10:15 a.m.	**Break**
10:30 a.m.	**Panel: Partnership Programs** (Mary K. Gaillard, Moderator) Robert Eisenstein, NSF Mathematics and Physical Sciences Directorate; U.S.-Israel Binational Science Foundation (BSF); OECD Global Science Forum Gerson Sher, Civilian R&D Foundation (for the Independent States of the Former Soviet Union) John Hardie, International Development Research Centre (Canada) Erick Chiang, NSF Office of Polar Programs, U.S. Antarctic Program
12:30 p.m.	**Lunch**
1:00 p.m.	**Panel: Foreign Models and Perspectives of International Science and Engineering Cooperation** (Pamela Ferguson, Moderator) Dominique Martin-Rovet, Attaché for Science and Technology, Embassy of France Takao Kuramochi, Science Counselor, Embassy of Japan Jorge Litvak, International University Exchange, Chile
2:30 p.m.	**Introduction of Keynote Speaker** Diana Natalicio
	Keynote Address: Globalization of the Science and Technology Workforce in the United States Mary Good, Venture Capital Investors, Inc.

3:15 p.m. **Break**

3:30 p.m. **Panel: Development Assistance and International Organizations**
(Luis Sequeira, Moderator)
Ray Kirkland, Agency for International Development
Michael Crawford, World Bank
Laurence Wolff, Inter-American Development Bank

5:30 p.m. **Adjourn**

SUMMARY

I. THIRD ANNUAL COMPETITIVENESS SURVEY

Evans discussed the Changing U.S. Competitiveness Agenda and the role of the Council on Competitiveness, which looks at how the sources of competitive advantage are shifting, international competition is growing, and the leadership role of the United States is changing. The insufficient investment of the United States in the development of the nation's talent pool is resulting in an outlook for U.S. innovation that is not as strong. Evans noted three factors contributing to the creation of competitive advantage – Internet connectivity, innovation clusters, and collaboration to leverage costs, risk, and resources. An initiative to ramp up U.S. productivity and growth has three compelling priorities. These priorities are: shoring up weaknesses preventing the U.S. economy from realizing its innovation potential; building on strengths differentiating the U.S. innovation platform from that of other countries; and expanding global opportunities to capture the benefits of technological leadership.

II. PANEL: U.S. ORGANIZATIONS INVOLVED IN INTERNATIONAL S&E COOPERATION

Dorman, in a teleconference from London, emphasized the importance of international issues in the coalition operations in which the Department of Defense is involved. One concern discussed was technology movement, particularly the possibility that the United States could end up working against countries with whom it has previously collaborated. The Department of Defense has put forth international cooperation programs related to the development of hardware, software, and operational capability and the development of actual systems and capabilities. The Navy runs basic programs to identify information in which it is interested, including visitor programs to provide interaction at the bench level, conference promotion, and collaborative R&D programs.

Getzinger presented an overview of selected activities of the American Association for the Advancement of Science (AAAS), as well as comments on two components of the charge to the task force, related to the Federal institutional framework for educational research and NSF's leadership role in the 21st century. AAAS activities include publication of the premier Science magazine, a number of programs including science education, science policy, and international programs, and affiliate relationships with worldwide organizations, providing a huge research base. Getzinger expressed the opinion that the task force should closely examine NSF playing a stronger role in institutional relationships dealing with research and education as well as NSF having an expanded role in the human impacts on the global environment.

III. PANEL: PARTNERSHIP PROGRAMS

Eisenstein described the establishment and subsequent operation of the U.S./Israel Binational Science Foundation (BSF). The BSF is funded from the interest, currently about $13 million per year, on an endowment jointly established by the United States and Israel. It makes grants primarily in the areas of health and life sciences, physics, chemistry, and mathematics, for binational cooperative projects. Efforts are presently underway to expand the program to include researchers from other parts of the Middle East region. The original endowment for the BSF used Israeli residual foreign aid money and a matching contribution through a State Department appropriation. This endowment frees the BSF from dependence on budgetary allocations from the sponsoring agencies or from the legislatures. The binational Board of Governors of the BSF meets annually to oversee the policy and programs; their oversight helps assure that the BSF criteria of scientific excellence, mutual benefit, and equitable balance are maintained.

Sher discussed the makeup of the Civilian R&D Foundation for the Independent States of the Former Soviet Union (CRDF) and its four basic cooperative programs, all of which require a minimum level of cost sharing. The principal program, the Competitive Grants Program, adapts the NSF system and philosophy of merit review to the making of cooperative research grants. Sher underscored the importance of continued NSF funding for CRDF, to strengthen the regional infrastructure. Achievements of the CRDF include funding human resources infrastructure; developing a model for industrial R&D collaborations; building institutions; and empowering U.S. programs. Sher pointed out that because CRDF is a private organization, it has more flexibility in decision making, responding to opportunities, and program design. He believes that the CRDF model should be replicable as long as there is commitment to the general goals of bridging categories of cooperation and assistance.

Hardie described the creation of the Canadian International Development Research Centre (IDRC) in 1970 to encourage and support research into the problems of developing regions and to assist the regions in building up research capabilities. The IDRC is funded so as to enable a degree of independence from the Canadian political system. Hardie noted that the focus is placed on production and knowledge sharing of all kinds, as well as the application of scientific and technical knowledge to the social and economic advancement of developing regions. The IDRC has emphasized social and technological innovation rather than science and technology, and has shifted toward more partnerships and joint ventures with other donors in order to expand the quality and quantity of resources devoted to mobilizing and enhancing research capability.

Chiang provided a historical background of the U.S. Antarctic Program that traces its origin to collaboration regarding the International Geophysical Year. Chiang described how the Antarctic Treaty provisions establish cooperation amongst nations operating on the continent, resulting in the creation of an environment rich in opportunity for multilateral partnerships. While the State Department represents the United States in policy issues, it does not take an active role in activity coordination amongst the cooperating nations. NSF's stewardship for U.S. interests and environmental protection in the Antarctic has led to the evolution of the NSF Office of Polar Programs. Chiang expressed the opinion that the success of the treaty system with respect to international cooperation is attributed to the scientific objectives, the mutual benefit provided by the collaboration among international organizations, and the direct involvement of program directors and managers enabling the establishment of boundary conditions and the subsequent commission of resources for project implementation.

IV. Panel: Foreign Models and Perspectives of International Science and Engineering Cooperation

Martin-Rovet described the shift of French educational focus from dissemination of the French language/culture to the aim of training scientists and engineers. Because the few students who travel from the United States to France do so to study humanities, not science, and the French students who travel to the United States generally do so to study science, Martin-Rovet emphasized the need to balance the exchange of French and U.S. students, as well as the need to make better mutual use of the capabilities of both countries. Martin-

Rovet discussed the objectives of the Centre National de la Recherche Scientifique (CNRS) in the United States–to represent French science, facilitate contacts between French and American scientists, and provide enhancement and fund cooperation–and the manner in which the CNRS evaluates programs and provides peer review for the political bodies. Efforts are currently underway to integrate academic research with industry, provide education in the handling of technology transfer, and increase visibility of French science. Martin-Rovet discussed the availability of fellowships for U.S. post-doctoral students to travel to France, noting the lack of interest in these fellowships, and discussed negotiated agreements between the CNRS and universities such as the University of Illinois as well as the attempted integration with industry.

Kuramochi described the 1995 enaction, in response to economic difficulties, of the Japanese Science and Technology Law, the Law's purpose in promoting the research development environment and aiming Japan for a leadership position in science and technology, and the resulting development of the five-year Science and Technology Plan, aimed at improving educational opportunities in national labs and universities, improving the environment in R&D sites, and opening labs to the world. As Kuramochi noted, a review of the performance of the five-year plan has shown that it has helped bring science and technology to national policy levels. Special coordination funds have been provided to promote interagency science and technology, recognizing the importance of having joint programs among agencies. Kuramochi described collaborative U.S./Japan agreements, including the Science and Technology Agreement negotiated under President Reagan and Prime Minister Takeshita and the Common Agenda, a cooperative partnership program created in 1993 to tackle global issues bilaterally. As an example of a very specific project, Kuramochi described the International Cooperative Research Project of 1989 which provided five years of international joint research funded in-kind by Japan and its partner, the research to be performed at the best-suited research institutes. Fellowship programs were established in 1988 to correct imbalances in the number of scientists performing research in Japan. Kuramochi discussed the recent kick-off of the Millennium Project targeted toward information, Japanese societal issues, and the environment.

Litvak discussed the comparatively high Chilean investment in science and technology in relation to other Latin American countries, noting the low level of investment in comparison to the United States The Millennium Science Initiative has been negotiated with the World Bank to create high-quality research units and has resulted in a subsequent controversy in a country where research has traditionally been university based. The University of Chile has an initiative aimed at promoting international research collaboration by stimulating international interest in the university's programs and projects and by mobilizing external resources through collaborative activities. The promotion of research alliances has proven the most winning strategy by providing grants for development, awards from foundations and other grantors, and major in-kind collaborators such as Lucent Technologies. Litvak indicated that there is a need for private sector investment in science and technology, noting that increased funding for research by international collaboration provides the best strategy.

V. Keynote Address: Globalization of the Science and Technology Workforce in the United States

Good presented NSF-generated data regarding the drop in U.S. investment in R&D in relation to the Gross Domestic Product (GDP), noting that U.S. institutions lack the understanding of the significance of these changes. There has also been a dramatic shift in funding sources for U.S. research as private sector funding has increased in relation to government funding. Workforce data indicate an increasing percentage of foreign-born doctoral students in science and technology. The dependence on foreign nationals in the U.S. science and technology enterprise has caused issues of concern in terms of unemployment and depressed wages, particularly wages paid to graduate students and university post-doctoral students. Good indicated an uncertainty regarding whether the availability of foreign students discourages U.S. native talent from pursuing scientific careers. Good indicated that while the United States has created revenue by its edge in the sale of intellectual property, the availability of intellectual property around the world will simply make the playing field more even. In R&D expenditures, the United States is neglecting important educational opportunities by not creating new engineers outside of the health sciences. Good expressed the opinion that the United States must refocus its research funding at the Federal level to create the best quality people in the world. The free flow of scientists must be allowed since the majority of science is done outside of the United States, creating the need to know what is happening elsewhere so as to enable global capitalization.

VI. Panel: Development Assistance and International Organizations

Kirkland described the mandates of the U.S. Agency for International Development (USAID) as the promotion of sustainable development and the provision of humanitarian assistance. It has established as its goals broad-based economic growth, building sustainable democracies, human capacity building through education and training, population stabilization/human health protection, environment protection, and humanitarian assistance in crises and transitions. USAID established a policy in 1997 laying out the standards and criteria for determining research priorities. Among the areas which USAID has identified as not fitting its criteria is research for training scientific or technical personnel. Due to economic considerations and the incidences of students failing to return to their home countries, USAID has shifted its capacity building endeavors from bringing overseas students to the United States for training to providing in-country and on-the-job training in conjunction with applied research activities. Kirkland discussed the channeling of the budget to the areas of population, health, nutrition, and agriculture, indicating that much of the research is programmatically oriented.

Crawford discussed the evolution of the World Bank's science and technology funding, noting the Bank's attempts to increase the size of grants to top people and the remaining problems resulting from researchers working in isolation. A new approach has been adopted by the Bank which is discussed in the Knowledge for Development Report, the Bank's flagship statement on development. One conclusion made in the report is that for advanced countries, knowledge may be the most important factor in determining the standard of living. The Bank has made a large commitment to support science and technology and is working on the development of a science and technology strategy covering all sectors and raising the profile of support for science and technology. The Bank will attempt to cooperate with partners in international, national, and nongovernmental organizations and will seek to use its convening power and resources to invigorate science in the developing world.

Wolff addressed the current science and technology situation in the region, critical regional needs, the Inter-American Development Bank's (IDB) previous role, the IDB's new strategy, and the IDB's instruments for supporting science and technology. The critical needs in the region are to incorporate new technologies into processes through better international cooperation as well as a need to increase the amounts and effectiveness of science and technology investment and investment in primary through higher education. In its previous role, the IDB focused on institutional strengthening of science research and funding institutions but those reviews concluded that the payoffs were inadequate with respect to changes in the productive sector and utilization by industry of new technologies. The new strategy focuses on ensuring that technological development can take place by encouraging innovation, supporting technology development rather than simply supporting research, being more selective in supporting science research and training while encouraging links with the productive sector, increasing the overall investment in education and training, and increasing support for developing countries.

APPENDIX C

LIST OF CONTRIBUTORS TO THE REPORT

The task force held hearings and consultations with experts and stakeholders representing a wide range of perspectives; convened an international symposium on models for S&T budget coordination and priority setting, cosponsored with the NSB Committee on Strategic Science & Engineering Policy Issues; received briefings from key representatives of a number of Federal agencies; and received comments on a draft of the final report from many of these participants. The name and affiliation of those who participated in this process are listed below.

Name	Organizational Affiliation at Time of Initial Participation
Experts and Panelists	
Barreto de Castro, Luiz A.	Empresa Brasileira de Pesquisa Agropecuaria – EMBRAPA
Bendis, Richard	Kansas Technology Corporation
Bertenthal, Bennett	National Science Foundation
Blanpied, William	National Science Foundation
Boright, John	National Academy of Sciences
Bromley, D. Allan	Yale University
Brunner, Gordon	The Proctor & Gamble Company
Chiang, Erick	National Science Foundation
Colwell, Rita	National Science Foundation
Crawford, Michael	The World Bank
Decker, James	Department of Energy
Di Capua, Marco	Lawrence Livermore National Laboratory
Dorman, Craig	Office of Naval Research
Durning, Jo	UK Office of Science and Technology
Eisenstein, Robert	National Science Foundation
Eliasson, Kerstin	Swedish Ministry of Education and Science
Etter, Delores	Department of Defense
Evans, Charles	Council on Competitiveness
Getzinger, Richard	American Association for the Advancement of Science
Gibbons, John	Consultant
Good, Mary	Venture Capital Investors, Inc.
Gosz, James	University of New Mexico
Grathwol, Robert	Alexander von Humboldt Foundation
Hardie, John	International Development Research Centre
Hecht, Alan	Environmental Protection Agency
Hrynkow, Sharon	National Institutes of Health
Huber, Brian	National Museum of Natural History
Jones, Kerri-Ann	Formerly at Office of Science and Technology Policy
Kirkland, Ray	Agency for International Development
Kramer, Bernd	Embassy of Germany

Kuramochi, Takao	Embassy of Japan
Lane, Neal	The White House
Litvak, Jorge	International University Exchange, Chile
Malone, Thomas	North Carolina State University
Martin-Rovet, Dominique	Embassy of France
Maruyama, Tsuyoshi	Japan Science and Technology Agency
Maxwell, Paul	University of Texas at El Paso
Mello, Natalie	Worcester Polytechnic Institute
Miyahara, Masanobu	National Science Foundation
Moran, Kathryn	Ocean Drilling Program, Joint Oceanographic Institutions
Morgenstern, Richard	Department of State
Neureiter, Norman	Department of State
Nichols, Rodney	New York Academy of Sciences
O'Brien, Michael	National Aeronautics and Space Administration
Perrolle, Pierre	National Science Foundation
Peters, Debra	USDA-ARS Jornada Experimental Range
Price, Robert	Department of Energy
Quear, Michael	House Committee on Science
Ratchford, J. Thomas	George Mason University School of Law
Reynolds, Andrew	Department of State
Rock, Anthony	Department of State
Rudolph, Lawrence	National Science Foundation
Schindel, David	National Science Foundation
Schmitt, Roland	Rensselaer Polytechnic Institute
Schmitten, Rolland	National Oceanographic & Atmospheric Administration
Sevin, Jacques	Centre National de la Recherche Scientifique
Sher, Gerson	U.S. Civilian R&D Foundation
Strauss, Warren	Monsanto Corporation
Stroud, Graham	European Commission
Vaz, Richard	Worcester Polytechnic Institute
West, Mary Beth	Department of State
Wolff, Laurence	Inter-American Development Bank
Wood, Robert	Industrial Research Institute
Yang, Heeseung	Korea Institute of S&T Evaluation and Planning
Zimmerman, John	Science Applications International Corporation

Other Reviewers

De Graaf, Adriaan	National Science Foundation
McLanahan, Elizabeth	National Oceanographic & Atmospheric Administration
Roskoski, Joann P.	National Science Foundation
Sunley, Judith	National Science Foundation

APPENDIX D
ACRONYMS AND ABBREVIATIONS

AAAS	American Association for the Advancement of Science
AIDS	Acquired Immune Deficiency Syndrome
AvH	Alexander von Humboldt Foundation
BSF	U.S.-Israel Binational Science Foundation
CISET	Committee on International Science, Engineering, and Technology
CNRS	Centre National de la Recherche Scientifique
CRDF	Civilian R&D Foundation for the Independent States of the Former Soviet Union
DARPA	Defense Advanced Research Projects Agency
DAS	Deputy Assistant Secretary
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
DOS	Department of State
EPA	Environmental Protection Agency
EPSCOR	Experimental Program to Stimulate Competitive Research
ERC	Engineering Research Center
EST	Environment, Science, and Technology
EU	European Union
FAO	Food and Agricultural Organization
FAS	Foreign Agricultural Service
FCS	Foreign Commercial Service
FSO	Foreign Service Officer
GAO	General Accounting Office
GDP	gross domestic product
GNP	gross national product
HHS	Department of Health and Human Services
ICSU	International Council for Science
IIASA	International Institute for Applied Systems Analysis
IDB	Inter-American Development Bank
IDRC	International Development Research Centre
IGY	International Geophysical Year
ILTER	International Long-Term Ecological Research
INT	Division of International Programs
IRI	Industrial Research Institute
ITER	International Thermonuclear Experimental Reactor
JOI	Joint Oceanographic Institutions
KTEC	Kansas Technology Enterprise Corporation
LHC	large hadron collider
MNC	multinational company
NAS	National Academy of Sciences
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NGO	non governmental organization

NIH	National Institutes of Health
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NSB	National Science Board
NSF	National Science Foundation
NSTC	National Science and Technology Council
ODP	Ocean Drilling Program
OECD	Organization for Economic Cooperation and Development
OES	Bureau of Oceans and International Environmental and Scientific Affairs
OGC	Office of the General Counsel
ONR	Office of Naval Research
OSTP	Office of Science and Technology Policy
P&G	Procter & Gamble
PI	principal investigator
R&D	research and development
S&EI	*Science & Engineering Indicators*
S&E	science and engineering
S&T	science and technology
SBIR	Small Business Innovation Research
SSC	Superconducting Super Collider
STH	science, technology, and health
U.K.	United Kingdom
UNESCO	United Nations Education, Scientific, and Cultural Organization
U.S.	United States
USAID	United States Agency for International Development
USDA	U.S. Department of Agriculture
WHO	World Health Organization
WPI	Worcester Polytechnic Institute