



CENTER FOR THE STUDY OF THE PRESIDENCY

REPORT TO THE  
PRESIDENT-ELECT 2000

# ADVANCING INNOVATION:

IMPROVING THE S&T  
ADVISORY STRUCTURE  
AND POLICY PROCESS



REPORT TO THE  
PRESIDENT-ELECT 2000

**ADVANCING  
INNOVATION:**  
**IMPROVING THE S&T  
ADVISORY STRUCTURE  
AND POLICY PROCESS**



CENTER FOR THE STUDY OF THE PRESIDENCY  
WASHINGTON, D.C.

WINTER 2000

The Center for the Study of the Presidency  
 1020 19th Street, NW · Suite 250  
 Washington, D.C. 20036  
 202-872-9800 Fax: 202-872-9811  
 Center@thePresidency.org

**About the Center for the Study of the Presidency**

The Center for the Study of the Presidency (CSP) is a non-partisan, non-profit 501(C)(3) organization dedicated to serve as a central resource on issues affecting the modern Presidency. As the foremost organization in the United States dedicated to the study of the American Presidency, the Center provides a much needed institutional memory for the White House in today's changing national and global environment.

**Other CSP publications of interest:**

*Triumphs and Tragedies of the Modern Presidency: Seventy-Six Case Studies in Presidential Leadership* (Praeger Press, 2000) ISBN 0275-97352-2  
*Presidential Studies Quarterly* (ISSN 0360-4918)

*Dialogues on Presidential Leadership: The President, Congress, And the Media* (Washington, D.C., 2000)

*In Harm's Way: Intervention and Prevention* (Washington, D.C., 2000)

*Constructing the Presidency for the 21st Century*, by David M. Abshire (Washington, D.C., 1999)

*The Character of George Washington*, by David M. Abshire (Washington, D.C., 1989)

---

Copyright © 2000 Center for the Study of the Presidency  
 1020 19th Street, N.W., Suite 250, Washington, D. C. 20010  
 www.thePresidency.org

All rights reserved  
 Printed and bound in the United States of America

Library of Congress Cataloging Pending

Advancing Innovation: Improving the S&T Advisory Structure and Policy Process

ISBN \_\_\_\_\_

1. Innovation-United States. I. Title

Selected Remarks From a Fall 2000 Dialogue  
 Co-Sponsored by The Center for the Study of the Presidency and  
 the American Association for the Advancement of Science

SELECTED REMARKS  
 FROM A FALL 2000 DIALOGUE  
 CO-SPONSORED BY  
**THE CENTER FOR THE STUDY  
 OF THE PRESIDENCY**  
 AND THE  
**AMERICAN ASSOCIATION FOR  
 THE ADVANCEMENT OF SCIENCE**

*Made possible, in part,  
 by a generous grant from the  
 Richard Lounsbery Foundation, Inc.*

## FOREWORD

**E**VEN AS THE HIGH-TECH HIGH FLYERS shed trillions of their Wall Street values, no one challenges the notion that innovation remains the crown jewel of our economy, well being, and national security. Certainly, the economic benefits of innovation are well documented. Half of the nation's economic productivity in the last half century is attributable to innovation and technology. So, too, are the national security benefits, including the fall of the Berlin Wall and fragmentation of the former Soviet Union. The health benefits of a vigorous basic research program—most notably the successful mapping of the human genome—hold out hope that years of physical suffering will be lost and countless human lives will be saved.

Of course, the way forward is never certain. Like Lewis and Clark, the leaders of scientific and innovative expeditions must willingly take risks, adapt to new information, explore the next horizon, document discoveries, and invite others to verify, and even popularize, the dominant features of the new terrain they have crossed. In short, regardless of discipline, leaders need a plan and a willingness to be both flexible and resolute. Today, the U.S. research and innovation enterprise has earned, and continues to require, concrete financial support. The Center believes that this enterprise, which touches us all in such fundamental ways, also requires Presidential attention, as Thomas Jefferson so wisely bestowed on his explorers.

Indeed, pathbreakers of the U.S. scientific community are very much like their famous predecessors. The nation's anticipation is great: the end of the Cold War and a temporary federal budget surplus have created a sense that breathtaking advances in science, technology and innovation will occur automatically, even daily. Many want to follow in the footsteps of the leaders: high tech companies regularly rocket off, some seemingly able to defy economic gravity, others crashing quickly to Earth. And the cartographers—the policymakers who must make sense both of the larger map and troublesome details—are only now marching into the base camp, burdened with concerns: America's growing dependence on foreign-born technology workers; the need to protect individual privacy and intellectual property rights; the digital divide; and questions regarding the export of technology, e-commerce taxation, and eroding S&T governance structures.

Recently, the Center for the Study of the Presidency gathered together 20 distinguished scientists, policy experts, Congressional staff, and representatives of industry and academia to talk about the future of U.S. research and innovation. This report is a product of that session, which ended with a keen sense that policymakers need to make the right choices, or risk our place as the nation most dominant in scientific research, innovation, technology and education.

The group also agreed that the Bush Administration could take concrete steps to ensure the vitality of U.S. research and innovation initiatives. The Center believes that the new President should:

- ▶ Appoint early a distinguished advisor who, like Alan Greenspan in monetary policy, works with Congress, the mission agencies, and the Office of Management and Budget to actively manage our "innovation portfolio."
- ▶ Encourage far greater input from the private sector when setting research priorities and long-term R&D funding.

- ▶ Strengthen the Office of Science and Technology Policy and charge that office with overseeing a budget process that now is driven by the mission agencies and OMB.
- ▶ Vastly upgrade the current S&T advisory structure, which falters for lack of consistent involvement by key people, and more frequently engage key agencies, including the Office of U.S. Trade Representative and the Departments of Treasury, State, Commerce and Energy, in key policy issues.
- ▶ Develop a powerful interagency advisory structure to address non-R&D issues in trade, education, privacy, intellectual property rights, and the like.
- ▶ Work with Congress to develop creative, long-range research objectives and to set aside funding for the basic research and educational initiatives needed to meet those objectives.

Competitor nations are building the foundation of their challenge to America in the decades ahead. It is critical that the new Administration strengthen the S&T advisory structure and policy process. We believe support for such an initiative is both broad and deep.



David M. Abshire  
President

**EDITORIAL STAFF**

<b>Editor-in-Chief</b>	David M. Abshire, President Center for the Study of the Presidency
<b>Editors</b>	Thomas M. Kirlin, Program Director Center for the Study of the Presidency
	Anne G. K. Solomon, Senior Associate Center for Strategic and International Studies
<b>Design and Layout</b>	Hal Baskin The Baskin Group, Inc.
<b>Proofreading</b>	Allison Porter The Porter Consulting Group

**TABLE OF CONTENTS**

<b>Foreword</b>	iv
<b>Advancing Innovation: Emerging Themes</b>	1
<b>Advancing Innovation: A Dialogue</b>	
1. Thinking Strategically About Innovation	7
2. The White House Advisory Structure	9
3. Setting A National Research Agenda—And Setting It In Motion	22
4. Innovation and Economic Performance	26
5. National Security	31
6. Why A Presidential Initiative Is Needed	34
7. Budgets, Congressional Funding and Reform	37
8. International Issues and Opportunities	48
9. Summary	53
<b>Appendix:</b>	
A Brief History of Science Policy	56
<b>List of Participants</b>	60
<b>Acknowledgments</b>	62

Graphs and tables from *Science and Engineering Indicators 2000*,  
National Science Board, National Science Foundation (Washington, DC 2000)

## ADVANCING INNOVATION: EMERGING THEMES

### A. The R&D Policymaking Environment Has Changed Significantly

#### 1. National and global events are changing the way federal policy is made (Watkins, Rooney, Branscomb, Carnes):

- ▶ The end of the Cold War and “the end of more than two decades of structural deficits in the federal government means that two powerful political drivers of science and technology policy have disappeared.” (Rooney, Watkins)
- ▶ “During the Cold War the U.S. government focused on strengthening its own technical capabilities and those of defense firms dedicated to development and production for government. Today, officials are asking how can government empower the private sector.” (Branscomb)
- ▶ The federal government is “weak both in policy research and analytic capability....We haven’t been able to build infrastructures, mechanisms and institutions inside the government” to create “a business environment where technical innovations can flourish.” (Carnes)

#### 2. The private sector now dominates research and development (R&D) investment, especially commercial development in key sectors (Branscomb, Rooney):

- ▶ The private sector invests three dollars in R&D for every federal dollar. (Teich, Rooney)
- ▶ “The Feds paid 90 percent of the cost of the federal highway system. Now we are building an intellectual highway system and the federal government is going to contribute two percent.” (Branscomb)
- ▶ Our thinking should be “more strategic and longer term.” As the economy becomes more technologically intensive, federal investment probably needs to grow as a fraction of the economy” and “a larger fraction of federally funded research should be long-term.” (Branscomb)

### B. “The Fundamental Principles of Federalism are Being Tested.”

#### 1. Governance structures are not keeping pace with innovation and the need for long-range research (Carnes, Neal, Watkins, Branscomb):

- ▶ “The fundamental principles of federalism are being tested....Internet taxation is a good example....[The lines of authority are so blurred that] 18 different federal agencies think they have some role to play in developing policy for e-commerce.” (Carnes)
- ▶ Most Administrations last four years, whereas major scientific projects may take 10 years. “We have hit a [planning and budget] ceiling...that limits our science.” (Neal)

#### 2. The Congressional budget process is fractured.

- ▶ All nine agencies that participate in the 1996 National Oceanographic Partnership Act “must now go before 43 committees in the House and Senate

to win authorization and appropriations approval....These new relations need to be addressed because we are doing business in a new way.” (Watkins)

**C. Our Science Advisory Structures, Policy Processes and Long-Range Vision are Flawed**

**1. Presidents tend to view science policy as “important” but not “urgent.” (Yochelson)**

- ▶ “Decisions about science and technology don’t naturally flow in and out of the Oval Office.” In fact “the whole process is very episodic...and linked to other issues.” (Yochelson)

**2. Recent Presidents have not always been well served by their coordinating bodies.**

- ▶ The National Science and Technology Council “has performed erratically” (Nichols), and its predecessor, the Federal Coordinating Council for Science, Engineering and Technology, lacked political clout unless “Cabinet members and independent agency heads” actively participated. (Bromley)
- ▶ “Making the President the chairman [of the White House coordinating body]...is a great idea. But it only works if the President shows up and participates.” (Bromley)

**3. “Senators Barbara Mikulski and Kit Bond recently said that federal science policy lacks vision, and I think they are right. We can do better.” (Branscomb)**

**D. Presidential Action Is Needed to Make Innovation a National Priority**

**1. Science and technology policy is vital to our nation’s economy, quality of life and national security:**

- ▶ “The federal government is the monopoly financier of new knowledge creation in our society.” (Rooney).
- ▶ “Much of the university-based physical engineering, science and mathematics depends on the Department of Defense (DOD).” This research, and work done for the Defense’s Advanced Research Projects Agency (DARPA), should be viewed as “part of the overall S&T apparatus” in support of both national security and innovation capacity. (Nichols)
- ▶ The federal government forms important partnerships with industry and foreign governments. (Weiss, Bond, Branscomb)

**2. “The pathetic thing is that we have a plethora of reports on how to fix these important issues, and we still haven’t made the necessary changes!” (Watkins)**

- ▶ “A very strong base for bipartisan action on science policy exists in the Congress. Almost no other issue enjoys this support.” (Watkins)
- ▶ The President, as Commander-in-Chief, must “re-establish the link between innovation policy and national security.” (Abshire) Doing so would elevate science policy. (Yochelson)

**E. The President Should Strengthen Core Elements of the Current Advisory Structure**

**1. Assistant to the President for Science and Technology:**

- ▶ “To be effective, you will need to elevate the science advisor so that the important is not crowded out by the urgent.” (Yochelson, Abshire)
- ▶ Early appointment of the science advisor is critical. (Branscomb, Nichols, Bromley, Teich)
- ▶ So is Capitol Hill credibility (Wells, Yochelson), but perhaps most important is “the personal relationship between the advisor and the President.” (Bromley, Yochelson)
- ▶ The science advisor should help set priorities, craft the R&D budget and work with Congress. (Watkins, Bromley, Branscomb, Yochelson)
- ▶ The science advisor should “go around with the President and the Office of Management and Budget (OMB) director and talk to members of Congress” about priorities, budgets, and the possibility of creating “a joint committee session” so that “everyone really knows” the importance of long-range research and innovation. (Watkins)

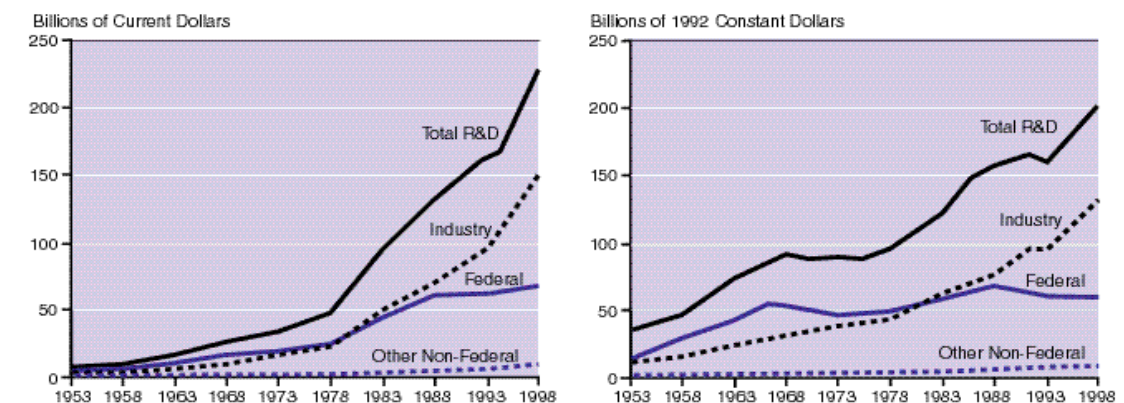
**2. The Office of Science and Technology Policy:**

- ▶ As director of OSTP, the science advisor should add a chief of staff and “double hat” associate directors to appropriate OMB elements so that OSTP can more effectively command resources. (Watkins)
- ▶ The number of OSTP professional staff should be increased so that the director and staff can better handle “all of the regulatory, fiscal, legal and business environment policies that impact the innovation process.” (Carnes, Nichols)
- ▶ Although the Office of Management and Budget traditionally has taken the lead in interagency activities, “I would ensure very strong OSTP interactions with the Security Council, the Economic Council, the Domestic Policy Council, Council on Environmental Quality and the Office of the U.S. Trade Representative, among others.” (Nichols)

**3. The President’s Committee of Advisors for Science and Technology:**

- ▶ PCAST also “needs to be elevated...and better staffed” (Nichols) because

**National R&D Funding, by Source: 1953-98**



industry “has to gain greater visibility” with the President on key policy issues. (Watkins)

- ▶ The President should task PCAST members with a select few major national issues to which they can make a significant contribution. (Bromley, Wells)
- ▶ However, “you can’t stick inside the White House an advocacy group for one small segment. Their role is to help the President with science for policy, not to promote the interests of science.” (Bromley, Teich)
- ▶ One way to avoid advocacy is to appoint PCAST members to other “interconnected advisory groups.” (Watkins)

**F. The President Should Create an Integrated Interagency Advisory Structure that Directly Links Research and Innovation to National Goals**

**1. This body would create “greater anticipatory capacity” and help establish long-range research priorities: (Watkins, Branscomb, Nichols)**

- ▶ “There is an absolute need for better integration, coordination and communication at all levels within the White House, within the Executive Branch, between the White House and Congress, and within the S&T community.” (Watkins)
- ▶ “The National Economic Council (NEC) needs not only to propose economic policies to the President, but to examine as well the impact of economic policies on our innovative economy. Neither OSTP nor NEC alone can do it.” (Branscomb, Carnes)
- ▶ “To manage the multiplicity of committees on the Hill and in the agencies,” the President might propose a process “outside the normal appropriations process” that looks closely “at the federal government’s entire R&D portfolio,” in the context of what industry and other countries are doing. (Carnes)

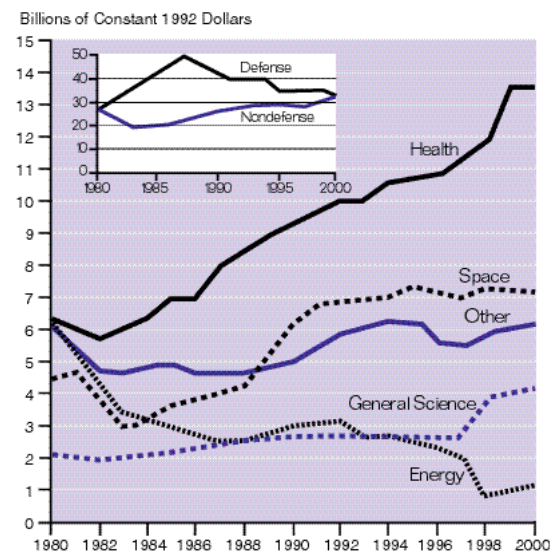
**2. The President, science advisor and Secretary of Defense should consider strengthening the Defense Science Board, so that it can better help set military R&D priorities. (Nichols)**

**G. The Federal Government Should Set Creative, Long-Term Research Goals**

**1. Our research goal should be “to work at the frontiers of knowledge or work close enough to those frontiers so that we can exploit, without delay, new discoveries and developments whenever and wherever made.” (Bromley, Yochelson)**

- ▶ “We need a research and innovation policy, not a science and technology policy..., [in part because] the distinction between science and technology is vanishing.” (Branscomb)

**Federal R&D Funding, by Budget Function**



Notes: Other includes all nondefense functions not separately graphed, such as agriculture and transportation. The 1998 increase in general science and decrease in energy resulted from a reclassification.

- ▶ “We need a creative research strategy with an enabling characteristic, coupled with research skills that we are still developing. The final step is figuring out what kind of research an innovation-based economy requires.” (Branscomb)
- ▶ Policymakers want accountability, benchmarks, and a “connection between science investments and...public benefits.” (Nichols, Branscomb)

**2. Policy design—not policy analysis—is the real challenge:**

- ▶ “When I was in government, policy analysis was not my problem. It was how to stop doing dumb thing and do *any* of the smart things.” (Branscomb)
- ▶ “We need to focus on the fonts of wealth creation. And I think the strongest rationale for a vigorous research and innovation policy is that these activities are the real keys today to our economy....The public at large is now beginning to understand their importance. Certainly the people on the Hill get this connection.” (Rooney)
- ▶ “It is perfectly appropriate for DARPA to explore fields in which the military value is not yet clear, provided there is a good intellectual case” for doing so. (Branscomb, Abshire)

**3. The core mission agencies needed to implement long-range research and innovation are effectively managed, but education and balanced funding remain a challenge:**

- ▶ “We did not talk much about the National Science Foundation or the National Institutes of Health...two bastions of basic research...[because] people think these agencies are running rather well.” (Teich)
- ▶ However, “there appears to be a growing funding imbalance” among the agencies. (Teich)
- ▶ More importantly, neither NSF nor the Department of Education has effectively reformed K-12 science and math education. (Nichols, Branscomb)

**4. Moreover, the national laboratories need clearer research direction and sustained funding: (Branscomb)**

- ▶ “National laboratories are unique in dealing with long-range technological, multi-disciplinary problems...[some of which] are larger than a university can handle.”
- ▶ “National labs also contribute to human resource development.” (Branscomb)

**H. Congress is Ready to Work with the White House**

**1. “Congress is key, regardless of the specifics of our national research policy.” (Watkins)**

- ▶ “Nobody says, ‘By God, you elect me and you will have the finest S&T policy in the country.’ Eyes glaze over, forget it.” (Watkins)
- ▶ Nevertheless, “the timing is right” to work with Congress. (Watkins, Abshire, Bromley) Bi-partisan support is evident on a number of fronts: increased NSF and NIH funding, growing membership in caucuses (biotech, the Internet), circulation of a resolution to increase R&D funding across the board (S. 296), and increased appropriations for FY2000 military R&D.



**2. Members of Congress want a “managed investment environment,” agency accountability and an integrated budget: (Watkins, Bromley, Branscomb, Nichols)**

- ▶ Congress is not about “to help any President restructure committees and subcommittees. But perhaps the President and Congress could create a joint commission to examine, in a bipartisan way, how Congress responds to Executive proposals. We do have a sick structure.” (Bromley)
- ▶ A revived and revamped Office of Technology Assessment (OTA) might assist the policy process, provided reports are issued in a timely fashion. (Nichols, Branscomb)

**3. A rigorous White House budget process would make the overall policy process more vigorous:**

- ▶ “All the agencies should be forced to help develop a unified budget for OMB and a unified presentation” to “the various committees that thought they had jurisdiction.” (Bromley)
- ▶ “We ought to get to a five-year budget cycle on some of the long-range projects...and work with Congress...to give the research base in this country some stability.” (Watkins)

**I. The U.S. Must Better Manage its International Research and Trade Affairs**

**1. “The United States is a terrible partner in big international science projects” (Branscomb), in part because “you can’t go to other nations late in the game and ask for money” (Watkins) and in part because, too often, we cancel programs or change plans unilaterally. (Teich)**

- ▶ “The State Department isn’t even at the table when [agencies] make bilateral S&T agreements. We have over 200 in the Department of Energy alone—and 10, at the most, are worth doing.” (Watkins)

**2. Several organizational remedies are available:**

- ▶ The President could “give OSTP, the National Science Foundation and the mission agencies much more international responsibility, and State fewer responsibilities;” (Nichols)
- ▶ The President could challenge the new Secretary to more effectively incorporate science and technology policy in a rejuvenated State Department or lose current S&T responsibilities; (Abshire)
- ▶ State could “align its science policy with its economic policy.” (Solomon)

**3. Because of his or her access to the President, the national science advisor should be involved in such international issues as:**

- ▶ Direct foreign investment, which “goes in both directions...” and “generally is better for the United States.” (Nichols)
- ▶ Granting temporary visas to foreign-born technical professionals. This “really is an education issue, viewed from a different angle” that foundations may be better suited to address than the NSF or Education Department. (Branscomb)

**ADVANCING INNOVATION: A DIALOGUE**

**1. Thinking Strategically About Innovation**

**ABSHIRE:** I want to say a few words about the Center for the Study of the Presidency and how we developed this idea of a Report to the President-Elect 2000. Having served in and out of Administrations, having seen some triumphs and some real disasters, it struck me how Presidents and their top advisors don’t learn from past successes and mistakes. When they have great successes, they don’t analyze the reasons for the successes. When they have failures, those failures get repeated, as they were dramatically in Watergate, Iran-Contra, and the recent impeachment.

So we got the idea of a Report to the President-Elect, which has three tracks. Track one is guided by a Council of Scholars, who are led by historian Michael Beschloss, Presidential advisor David Gergen, Princeton professor Fred Greenstein, and Harvard emeritus professor Dick Neustadt. With their assistance we are producing more than 76 case studies, crisp accounts of recent successes and failures. For example, we have taken the “First 100 Days” in office of all of the Presidents since FDR, who popularized that expression, even though what we really are talking about is the first six months or so. We also have a number of case studies on executive/legislative relations, foreign affairs, legislative initiatives, and the science and technology advisory structure and policy process. These are all gathered together in *Triumphs and Tragedies of the Modern Presidency: Seventy-Six Case Studies in Presidential Leadership*, which Praeger Press has published.

The second track is a subset of the first and focuses on leadership and values. We talk about values, not ethics, because ethics rules have been written in a way that runs people out of government. Talented people find it difficult and unattractive to come into government because government officials have tried to over-regulate conduct, both before people enter public service and after people leave. So we have proposed a two-day immersion session on leadership and values for Cabinet and sub-Cabinet people. The first session would be held at Camp David.

We are fortunate to work on this part of our project with the wonderful Center for Creative Leadership at Greensboro, which has existed for 30 years and trained CEOs, Vice Presidents, and Brigadier Generals. We are also working with the new Harvard Center for Public Leadership that Professor Ron Heifetz and David Gergen have organized, and with the Council on Excellence in Government and the Federal Executive Institute. So this segment of the Report is in good shape.

The last track looks at ways to update and reform the policy process in two areas. The first is national security, where more than 80 people have contributed—from Dean Joe Nye, who put together a discussion session at Harvard, to the Bush Library, where former President George H.W. Bush spoke on military interventions, to a number of sessions at the Center for the Study of the Presidency. The real challenge here is to reform the rigid Cold War structure. Interestingly, Presidents Truman and Eisenhower provide a good model for the reform challenges we face. They transformed the government from a hot World War II to the Cold War by taking a number of bold steps that revamped the way strategy was developed and implemented. Now, we have moved from

the Cold War to the post-Cold War, but the transformation has been in bits and pieces and not well thought out. So it's no wonder that our military interventions have increased four-fold since the fall of the Berlin Wall. We simply are not organized to think ahead and so we react to crises rather than shape the strategic environment.

To change this posture, the Center advocates a major strategic assessment of our entire national security system. The assessment would be far broader than the Pentagon's because we need to examine the impact on security of advances in science and technology, the State Department, and the intelligence community. We need to also determine and how Members of Congress can be involved in this so that the Legislative and Executive Branches can start to reconstruct consensus in this important area. For example, we suggest changing the President's Foreign Intelligence Advisory Board, which I served on, into a strategic board with much broader responsibilities and a broader information base. We need information so that we can keep pace with the science, technology, and financial revolutions that affect national security today. Fortunately, Vice President-Elect Dick Cheney could help lead this effort.

Congress is interested in our ideas, too. Both Senators Ted Stevens and Dan Inouye are in our Congressional Advisory Group. Among other improvements, we would like to see a joint strategic committee on national security, one that does not authorize legislation or appropriate money, but takes an over-arching interest in this vital issue. A fuller presentation on this matter is contained in our publication, *In Harm's Way: Intervention and Prevention*, which reflects the input of more than 80 leading military and government officials, Presidential scholars, Members of Congress—and even former President George Bush.

We believe that science, technology, and innovation is the other area that needs fundamental reform, but this issue is quite different from national security. For example, as Commander in Chief, the President controls the national security structure. He can authorize a reformation, but he does not control the private sector. So the real key is being better connected to the ongoing revolution in science and innovation. One way to connect is to update the Presidential advisory structure so that it includes more input from the private sector. Another way is to improve the White House

**R&D as a Percentage of Gross Domestic Product**

Sweden	3.85
Japan	2.92
South Korea	2.89
Finland	2.78
Switzerland (1996)	2.74
United States	2.60
Germany	2.31
Israel	2.30
France	2.23
Netherlands (1996)	2.09
Denmark	2.03
China (Taipei)	1.92
United Kingdom	1.87
Australia (1996)	1.68
Norway	1.68
Canada	1.60
Belgium (1995)	1.58
Iceland	1.56
Austria	1.52
Singapore	1.47
Ireland	1.43
Czech Republic	1.19
Slovak Republic	1.18
Costa Rica (1996)	1.13
New Zealand	1.10
Italy	1.08
Russian Federation	0.95

interface with Congress. The President can also use the bully pulpit to alert the public to key science, technology, and innovation issues.

Tom Kirlin has led our effort here. He organized several informal discussion sessions that provide a foundation for today's session. Also he has developed flip sheets and a background paper on the evolution of the science and technology process that are in your packets.

**2. The White House Science Advisory Structure**

**KIRLIN:** Thank you, Dr. Abshire, and welcome everyone to a dialogue on improving the science advisory structure and policy process. The Center is not a science policy organization, and we are grateful that the American Academy for the Advancement of Science is co-sponsoring this event. What we hope to identify today are recommendations that would enable the next Administration to build a more robust innovation capacity in the United States, since so much of our economy, quality of life, and national security are dependent on research and innovation.

In several earlier sessions, a small group of us asked whether it was feasible and productive to elevate and enhance the role of the national science advisor, and how that person might better work with the President, Congress, and industry. The first thing we did was agree that strategic thinking is not the same as strategic planning—we have no interest in, or special ability to, identify breakthrough technologies or theories.

This distinction led us to an attempt to define what might be a foundation for good science and technology policy, and we quickly moved toward a definition that stressed innovation capacity and the generation of frontier knowledge. The next challenge was to define the role of government in this effort. And, as has been pointed out before, that role is direct—the federal government funds national labs and can fund university research. It is also indirect—federal and state governments create regulations, tax structures, and educational systems that either spur or limit research and technology.

We then began discussing the more substantive hurdles to building innovation. For example, the federal government only puts one out of every three or four dollars toward investment in research and development (R&D), and most of the private sector funds go toward developing commercial products. We also asked how much leadership government can provide, and how effective the current policymaking process has been.

We identified a number of weaknesses in the present policy system. Everyone agreed that the Office of Science and Technology Policy (OSTP) is understaffed. The budget process is fractured—Congress divides science and technology policy decisions among 13 committees and subcommittees. This process in recent years has been made more difficult with the loss of Congress's Office of Technology Assessment (OTA). In the White House, trade and technology issues don't seem well coordinated. The private sector is often not well engaged in long-term policy planning, in part because businesses uses a quarterly review cycle. Congress, which has an annual budget cycle, is often out of stride with the scientific community, which frequently needs to think of projects along a 5- to 7- to 10-year timeline.

We ended those earlier discussions by talking about the challenges and opportunities that the next President faces. We concluded that the next President has a unique

opportunity—and need—to develop a more effective advisory structure and to impose more order on the policy-making process. The place to start, discussants agreed, is with the science advisor. But to be effective, this individual needs, at a minimum, access to the President and credibility on Capitol Hill, for although innovation is key to our economy and national security, we can very quickly lose any advantage we may now enjoy. And an effective science advisor is critical to creating new policy and managing existing resources such as the mission agencies and national labs.

Today, Rod Nichols, who is President of the New York Academy of Sciences and has been down this road before with the Carnegie Commission on Science, Technology and Government, will lead off with remarks on strategic thinking. Dr. Lewis Branscomb will talk about the role of various science, technology, and innovation communities. William Wells, who has to leave early for a White House meeting, will talk about White House relations with Congress. During our working lunch, Admiral Jim Watkins, a former Chief of Naval Operations and former Secretary of Energy, will talk about links between innovation and national security. Next, Assistant Secretary of Commerce Kelly Carnes will talk about technology, trade and international issues. Dr. Allan Bromley, who served as President Bush's science advisor, will reflect on the opportunities and limitations of that post. We will include question and answer sessions throughout this discussion and ask Al Teich, our co-host at the American Association for the Advancement of Science, to provide summary comments.

### The Current Advisory Structure

**NICHOLS:** I think this is a terrific project, and I think it will have an impact on the next Administration. Let me start by talking briefly about the White House and later about international issues. Along the way, I will discuss selected issues where policy action might be taken.

I believe we have learned a few lessons very clearly over the last decade about the White House. The first is that it is very important for the President to appoint the science advisor early and to involve that person in agency appointments. Allan Bromley was appointed quite late and ended up having very substantial relationships among his colleagues in the White House and a great impact. But I think Allan would agree that the President should appoint his science advisor early.

Proposition two is that the Office of Science and Technology Policy staff needs to be increased. Others here interact with OSTP at least as much or more than I do. But at its present size, my impression is that staff members are mostly engaged in fire fighting—that there is very little opportunity to do any over-the-horizon planning.

Third, I would ensure very strong OSTP interactions with the Security Council, the Economic Council, the Domestic Policy Council, the Council on Environmental Quality, and the Office of the U.S. Trade Representative, among others. And I think that we should return to the bureaucratic practice, used frequently in the past, of joint staffing. This would enable a senior professional staff member with dual reporting channels to go to all of the meetings. Propositions two and three are related—you have to have a larger staff if senior professionals are going to be joint staffers.

There are two more assertions about the White House that I will put forth without any caveats in the interest of time. The first is this—I think the National Science and Technology Council (NSTC) has performed erratically, and I think the transition staff

should look very hard at whether the NSTC in its recent incarnation or its predecessor, the Federal Coordinating Council, really make a difference. And if they don't, we have to invent some new means for interagency coordination. For example, OSTP could take the lead in interagency activities, even though the Office of Management and Budget (OMB) traditionally has done so.

And finally, the President's Committee of Advisors for Science and Technology (PCAST) needs to be elevated. I am not a member, but my impression is that it doesn't meet very frequently, certainly not with the President. And the members don't devote much time to it, perhaps because it lacks adequate staff support. Maybe we should just re-think the organization. There's no point in having honorific bodies that aren't given appropriate staff support.

**KIRLIN:** Thank you, Rod, for getting us off to a fast start. Let me ask for a reaction from Lew Branscomb, emeritus Professor of Public Policy and Corporate Management at the John F. Kennedy School of Government at Harvard, a former chief scientist at IBM, and the author of *Investing in Innovation*.

### The Next National Science Advisor

**BRANSCOMB:** I believe that staffing key jobs is the most critical task the new President faces. There are two reasons why the science advisor needs to be appointed early. First, this individual needs the opportunity to have a say on the key R&D management appointments. Ideally, I think the science advisor ought to be the person through whom those recommendations are made to the President so that he has the requirement to comment on them, not necessarily to veto them.

Second, President Clinton's late appointment of the science advisor meant that the number of OSTP staff was kept to a minimum because, by then, the President had promised voters he was going to cut the size of the White House staff. So you have to get in early to get a piece of the resource pie.

People should also remember that White House staff members really make two kinds of appointments. One group appoints people to substantive jobs and one group appoints people to commissions and boards. The first one is tough enough to manage but the second one is nearly hopeless because this is where you put contributors, most of whom know absolutely nothing but it gives them some prestige.

Let me make a few observations on research and innovation. When Vannevar Bush wrote his famous report and proposed a national research foundation, he included in that plan a special military division. He argued that the armed services themselves can adequately fund and manage incremental R&D that involves weapons systems, but some other body ought to help the Defense Department look at science and identify radical ideas that could transform the military situation favorably.

Defense's Advance Research Projects Agency (DARPA) is that instrument, and it purposely reports to the civilian leadership of the Department. It is perfectly appropriate for DARPA to explore fields in which the military value is not yet clear, provided there is a good intellectual case to say there might be a pony there.

My third comment concerns the technology policy statement that Clinton and Gore issued on February 22, 1993. That statement said nothing about science and almost

nothing about universities. And there was a clamor in the community and people said, “Come on, drop the other shoe.” It took them a year to do so, but Marcie Greenberg ran the project and their report included a lot of obvious things and one very important recommendation. They admitted that the rest of the world thinks that the United States is a terrible partner in big international science projects. And they specifically recommended that the Administration seek from the Congress a full multi-year commitment for international projects. And if Members of Congress believe in the project enough to assure funding once they approve its initiation, then we shouldn’t start a project and then abrogate our responsibility when we change Administrations.

**KIRLIN:** Dr. Bromley, you served as Assistant to President Bush for Science and Technology. How would you tell the next science advisor about that post and how best to work with the President and Congress?

### **Serving in the Bush Administration**

**BROMLEY:** Before I accepted the job, I asked George Bush to promise me three things. First, that I would have access to him whenever I needed it as long as I did not abuse the privilege. Second, would he, for the first time in history, appoint the four associate directors that were called for in the founding 1976 legislation? And third, would he agree that whenever he and I agreed on something that was worth doing, would he provide his full support to make it happen? He agreed to all of these requests and followed through on all of them. That was really critical.

In one of our first meetings, Mr. Bush said, “Look, you know probably better than most from my Yale years, that I don’t know a damn thing about science and technology except that I know how important it is for our nation. Your job is to make sure that I do what is important and essential in the areas of science and technology. In particular,” he said, “why don’t you—after talking to people here—come up with five or six areas that are truly of national consequence, are worthy of Presidential attention, and I will then use the bully pulpit of the Presidency to really back those up.” The question immediately arose: how do you select from all of the vast menu of possibilities the five or six really critical areas?

After looking around, it became clear that there was already a logical body on which to work on this question, namely, the Federal Coordinating Council for Science, Engineering and Technology, with the somewhat unfortunate acronym of FCCSET. The trouble with FCCSET was that it had never really worked because its membership was at far too low a political level; no matter what FCCSET decided or recommended, when the chips were down and the budget crunch was on, the more senior people could—and did—disown the whole operation.

With direct help from the President, we restructured the FCCSET so that it included Cabinet members and independent agencies heads. I also introduced a firm rule—no substitutions, none whatever. If one of the members did not show, that agency was not represented. After a few agencies got their budgets slashed a bit and got some negative things—in their opinion—done to them, it was amazing how attendance picked up and how things moved along.

We spent a lot of time identifying five or six issues that were really worthy of Presidential attention. We felt that the most important areas were mathematics and

science education because everything else that we might try to do was doomed unless we could move forward in those areas. Another area was advanced communications and computation because we felt that we were not really taking effective advantage of the information revolution.

Global climate change was another area identified, not for any intrinsic reason but rather because it had already boiled to the top of the agenda in other developed countries; in a sense, we were simply trying to be protective of our long-range national interests.

Next came biotechnology, clearly an American technology, which we were in danger of losing to the Japanese and the Germans. The federal government had invested in fundamental university-based biology for 40 to 50 years and was now getting the pay-off and clearly we could not allow it to be lost to the American economy.

Much the same argument applied to advanced manufacturing. We had established much of the strength of this nation on the basis of manufacturing and, again, we were making the unfortunate statement that we had moved from an agricultural to a manufacturing and then to a service economy—with the implication that we could eliminate the old economies as we moved into the new. This approach simply does not work. If you are starving, you don’t work very well at manufacturing. And if you don’t eat or manufacture things, there isn’t much in the way of service!

Materials science and technology was important because almost every process that occurs in American industry is limited fundamentally at some point by the behavior of some material. I asked the Oak Ridge National Laboratory to come up with an estimate of the magnitude of this effect. They found that for every degree Fahrenheit that you could raise the operating temperature of the average American industrial process, you got an annual payback of \$2 billion over a wide range of temperature.

Finally, we included international science and technology because, as has already been said, each of the agencies has many international programs, but nobody coordinates them, nobody even knows about them. Our goal was to try to make some sense out of all of these disparate activities.

For example, we created what is now called the Carnegie Group. Most people have never heard of it, and do not know anything about it. The Carnegie Group was interested because we had many meetings with people from other nations but they were always highly stilted, scripted, and formal. Not much was accomplished and everybody went home reasonably happy. With the help of the Carnegie Commission, several times a year we decided to hold totally informal meetings with the senior scientists/advisors to the head of the state—with no staff, no agenda, no meeting report. The idea was simply so that we could get to know one another well enough on a personal basis to pick up the phone and address an international question before it became a problem. I have to tell you, that this worked remarkably well and it is still in existence. It is still working. And the fact that we made personal contacts and developed a fundamental trust enabled us to believe one another when we were on the telephone. These Carnegie Group meetings made a huge difference.

### **The Office of Science and Technology Policy**

**ABSHIRE:** How did OSTP work? What did it do during your tenure?

**BROMLEY:** I appointed all four Associate Directors, and one of them—in industrial technology—for the first time. Bill Phillips was a very wise and experienced individual and, working with him, we produced the first-ever national statement on technology policy. Remember, the official title is “Science and Technology Advisor,” even though most people just use “science advisor.” When I make this point, I am always reminded of Theodore von Karman’s wonderful distinction, “Science studies what is. Technology creates what never was.”

Once we started talking about technology, a whole range of topics surfaced—tax structure, incentives of all kinds, international activity, whether and how we might use the Commerce Attachés in our embassies in the absence of any effective State Department activity in our areas. It is the combination of all of these that must be in place if we are really going to be successful, domestically or internationally.

**KIRLIN:** You said that the Federal Coordinating Council for Science, Engineering and Technology lacked political muscle when you joined the White House staff. What besides top agency participation is needed to get the White House policy apparatus in better order?

**BROMLEY:** I think making the President the chairman of this group, which President Clinton and Jack Gibbons did when they transformed the FCCSET into the National Science and Technology Council (NSTC), is a great idea. But it only works if the President shows up at and participates. In our case, President Bush did in fact meet with the group unless there was something major going on or he was out of town. His presence made all the difference in the world.

George Bush did one other thing that I think is very important. For the first time in 30 years, he revived the President’s Committee of Advisors for Science and Technology. This group gave us access to industry’s leaders, which is more important every year. But it wasn’t an easy thing to do. I came up with a list of names and President Bush said, “Why don’t you draft a letter I will sign it and we will invite them all?” And just about that time the Counsel to the President, Boyden Gray, came charging over the hill saying, “You can’t do that!” Now let me offer a little history. When President Eisenhower requested the first PSAC meeting, the group convened in nine days. When we tried to do the same thing, it took us nine months to wade through all the legal niceties to make the first meeting happen!

Once PCAST came together, I pointed out that the private citizen members had always reported to the science advisor and not to the President, but that since this group was going to report to him and not to me, perhaps he would host a dinner or something to illustrate the difference. He said, “I can do much better than that. We will bring the whole group out to Camp David, and you will be the guests of Mrs. Bush and me for a Saturday.” We had a wonderful time and accomplished a lot. The symbolism of this visit was not lost on Washington. People—including people on the White House staff—began to see that here was a group to which the President was going to listen. The President not only took advice from PCAST members, he enforced the decisions that he endorsed.

Much of the effectiveness of the Science Advisor depends on the personal relationship between the Advisor and the President. It is also absolutely true that the President needs to appoint an advisor as soon as possible. If the science Advisor is not appointed early in the game, then the other 11 Assistants to the President close in, pull the

wagons together, and the Science Advisor has to waste considerable time working his or her way into the system. That was why I was delighted when, on Christmas Eve, President Clinton appointed Jack Gibbons. I hope we can do this again.

#### Is OSTP Effective?

**SOLOMON:** I served as Deputy Assistant Secretary of State for Science, Technology and Health, and I’m not at all certain that we have an effective organizational structure or policy process.

If you start with the White House and look at the research and innovation system today, it looks fairly integrated. Certainly you can loosely talk about government roles, direct roles in terms of supportive research in education, and all of the indirect policies that affect research and innovation in this country. But the question remains—is our science and technology policy system fully integrated, and should it be managed in one place?

Let me give you an example. It is my understanding that OSTP is responsible for science and technology policy, but this responsibility has no real definition. Lately, the National Economic Council (NEC) has taken responsibility for national technology policy. It is also my understanding that although OSTP has one senior person with a dual role in both OSTP and the National Security Council (NSC), it does not have the same kind of official relationship with the NEC and instead has relied on informal personal relationships to coordinate actions between OSTP and NEC. And, once again, how that technology policy responsibility got into the NEC, I am not sure, but I think that is a point that we should examine.

**BRANSCOMB:** Many of us believe that the NEC needs not only to propose economic policies to the President, but to examine as well the impact of economic policies on our innovative economy. Most NEC staff members look at macroeconomic issues. They don’t adequately examine the microeconomic impacts. The current NEC has only two staff members who are truly knowledgeable about technology, so I don’t think the NEC is in charge of national technology policy. We just have two people who have waged valiant battles across the government during the current Administration to try to get government to address technology policy issues.

I believe that OSTP should be in charge of technology policy, but they should do so with the assistance of the NEC because the range of issues and their impacts on innovation are so large. For example, research groups and trade groups have engaged in battle for years over policies governing intellectual property rights, antitrust laws, and the like, and we need to sort out these issues. But neither OSTP nor NEC alone can do it.

**BROMLEY:** Let me emphasize something. Staff in OSTP or in any other agency—under normal working conditions—does not have time to think beyond the next half-hour, everyone is so busy. I used to take all my associate directors about once a month on a retreat completely out of Washington. Then we could ask ourselves, “Why are we here? Where are we going in the long term and how should we adjust our programs to make them more effective?” That was where we tried to get some sense of the longer-term aspects of our responsibilities.

**Developing an Integrated Advisory Structure**

**KIRLIN:** Admiral Watkins, you were Chief of Naval Operations and a former Secretary of Energy. Do you want to comment?

**WATKINS:** Yes. A time-out from daily business helps, Allan, but I think high-level advisory groups are tremendously valuable, precisely because everybody is steaming along on local issues and today's political agenda. Certainly my advisory board at the Department of Energy was critical. It gave me additional backbone and strength on Capitol Hill, and before the Office of Management and Budget. I mean these people really helped me, and they went home and were chastised by their own constituents because the high-energy folks would say, "I think you have to put more here and not so much over here." Well, wow, in the academic community, that is anathema. That is suicide but they did it because they had to do it. They could see that was my job, why should I do it alone? So many were very helpful.

But advisory boards alone are not enough. Cross-pollination among them should almost be a requirement. Take human health as an example. How well do we integrate that across the agencies? We have Agriculture. We have Defense, big in research in health. And all the other agencies, how well is that coordinated?

We are starting to coordinate at least one area of health. When Rita Colwell, a marine microbiologist, took over as head of the National Science Foundation, she got with the National Institute of Environmental Health Sciences right away. We have some major problems here. We're seeing relationships between sea surface temperatures and cholera. We have got all of these things on global warming coming out now, and El Niño affects on health. Are we giving the best advice to our state health officials? Are we giving our best advice to farmers on planting opportunities for next year? Can we get annual or inter-annual predictions that are better than today? The answer is yes. But how do you get people interested in this approach?

You need to bring together the key players from the top agencies and say, "We are going to do a better job of integrating the advisory and policymaking process." We have to keep saying—and doing it—again and again and again. And it takes a constant push by high-level people to get the attention that science and technology deserve. I think PCAST has to be not only renewed, as Allan said, it has to gain greater visibility. I hope that the President will listen to the Director of OSTP and to PCAST recommendations on critical issues.

**PCAST Can Be More Effective**

**BRANSCOMB:** I absolutely agree that PCAST's role needs to be reexamined. Presidents don't have a lot of enthusiasm for PCAST. Moreover, the NSTC doesn't really do much. As you point out, it rarely meets, at least with the President. Its committees, however, have been very active. And some of them have been very effective. So you need to figure out how to take advantage of those multi-agency subcommittees in specialized areas and make that work without creating a cumbersome super-structure that looks on paper like it is doing something it isn't doing.

**WELLS:** PCAST should not be all over the map. It has to focus on a half dozen or so

issues, period, if it is going to help the President. And early in an Administration OSTP and PCAST have to agree on what those half dozen key issues are going to be. You can't let PCAST set the agenda, but its members can help shape the agenda by working through OSTP and others. On the other hand, PCAST ought to be able to bring forward an independent assessment of an issue when they think the Administration is screwing up. In fact, PCAST members ought to be able to bring their points of view directly to the President when the Administration hasn't gotten something right.

Presidential attention to OSTP and PCAST matters. George Bush almost always met with PCAST members. Unfortunately, this has not been of particular interest to Bill Clinton, not that he is uninterested in science and technology, but he is surrounded by people who really don't understand the importance of an institution like PCAST. So they don't schedule him for it. On the other hand, Vice President Gore has shown up for some of these meetings.

But if you are going to have a classy operation in the White House, you have to ask the kind of people to join who are going to devote a lot of time so that things are done right. And if you are going to ask top people to devote precious time to public service, the President must personally be involved in these projects.

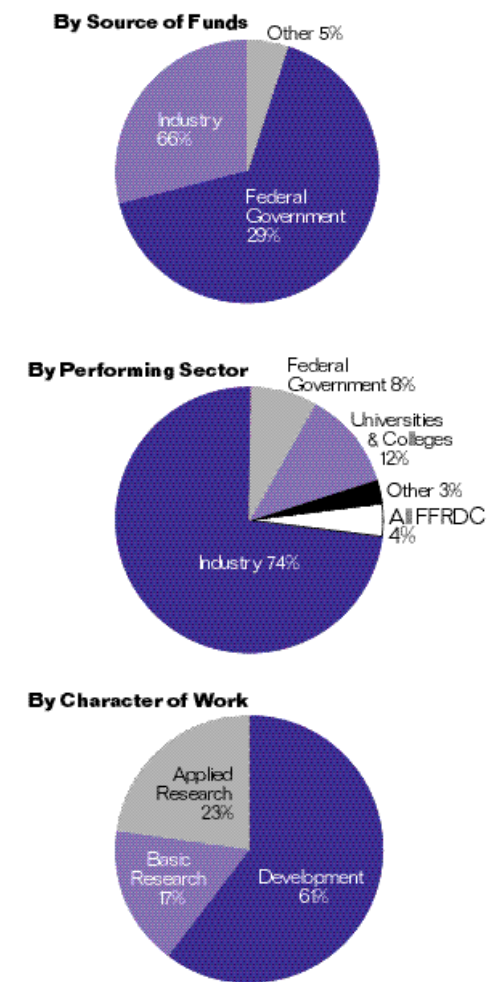
**NICHOLS:** If the President never meets with PCAST, surprise, surprise, very good people are not likely to join that group. If the Defense Science Board's records are not read much or used much by the Director of Defense Research and Engineering or the Secretary of Defense, surprise, surprise, it is hard to get good people for the next generation of appointees.

People don't want to waste their time. They are not becoming millionaires by serving on these committees. There is a much more important variable than politics, and that is the advisory group's impact and relevance and timeliness, and the President's appreciation of advice and his willingness to listen to dissent.

**MR. BROMLEY:** PCAST, I think, is very important for one simple reason—and I illustrate it with what happened one afternoon in the middle of a meeting when President Bush very enthusiastically presented to PCAST his new idea on a particular topic. David Packard, who was sitting across the table, looked at him with some bewilderment and said, "Mr. President, that is the stupidest damn idea I ever heard."

And the President said, "Really?" It is

**National R&D Expenditures: 1998**



FFRDCs = Federally Funded Research and Development Centers  
Note: Data labels rounded to nearest whole number.

vitaly important that someone with David Packard's stature have direct access to the President. And it was important that Packard was prepared to spend time to get up to speed on key issues.

Looking back, I regret not fully utilizing PCAST. When we first organized it, members agreed to spend a week a month working on PCAST activities. They really were prepared to do this pro bono, because they felt it was their duty to the country. Unfortunately, in the early days there were so many other things that had to be sorted out and taken care of that we didn't really task the PCAST with the kind of major national issues to which they could have, and would have, made major contributions. They contributed to many issues, but as time went on, they tended to drift away to other things.

#### **Adding PCAST Members to Integrated Advisory Committees**

**SOLOMON:** Haven't members of PCAST sat on advisory committees of the mission agencies?

**WATKINS:** Yes, there has been overlapping membership in which the President and his Directors for Science and Technology Policy meet with key people on other advisory boards, maybe meet with the chairmen of each of the boards.

These people should not be picked casually but only after negotiations between the Secretary of Defense and the White House. I would say, "Look, we want somebody in here who is also a member of PCAST." Then these people would come together with the principal agencies. You can't do it everywhere, but they certainly ought to have enough to cover, in my case, the four Ns, the National Aeronautics and Space Administration (NASA), the National Oceanographic and Atmospheric Administration, the Navy, and the National Science Foundation. But there could be others. Agriculture comes to mind as very important. The National Institutes of Health (NIH), clearly, has to be included. And you bring those kinds of advisory boards together at a very high level and pretty soon, maybe you have revived PCAST and integrated the R&D policymaking apparatus across the federal government.

**BRANSCOMB:** I remember that years ago Harvey Brooks made the observation that PCAST and its predecessors really cannot be the committee that thinks about the health of science. You can't stick inside the White House an advocacy group for one small segment. Their role is to help the President with science for policy, not policy for science.

I advocated in earlier remarks for the revival of a group of innovation experts in the private sector who could help the Secretary of Commerce. PCAST generally doesn't have that kind of talent on it. So years ago, the Office of Management and Budget looked to CTAB rather than to the Secretary of Commerce for inputs on innovation and related issues.

**WATKINS:** But I think the structure of the advisory board becomes very important. You can take a politically balanced, talented group of advisors in Commerce or Navy research and link it to PCAST. And if we do that, we should get a nod from Capitol Hill, the White House, and everybody else. Now you have something.

#### **Technology is Breaking Organizational Boundaries**

**KIRLIN:** This may be a good time to hear from Assistant Secretary Carnes, who is the Director of the Office of Science and Technology at the Department of Commerce. Dr. Carnes?

**CARNES:** So far, the discussion has focused on more or less traditional R&D areas. I want to spend a moment talking about the non-R&D arena, where we are seeing some of the fundamental principles of federalism are being tested, including the division of responsibility between state and federal legislation.

Internet taxation is a good example. You can't expect commerce in these technologies to flourish if you have 30,000 different taxing regimes at the federal, state, and local levels. But yet, you have traditional roles of local and state governments in regulating those, and setting their own taxes, and a whole lot of vested interest. So what you really have is a very thorny set of issues involving a lot of players who are not only outside the federal government, but also some who are outside the borders of the United States.

And right now, we have no capability to deal effectively with these issues. We are weak both in policy research and our analytic capability. The Office of Technology Assessment is gone. The policy capability that we have at the Commerce Department is woefully under-funded. We cannot responsibly analyze the impact of all of these laws and regulations and policy decisions on technology and innovation.

One of the most important issues outside of the R&D policy process is—how do we create a mechanism that allows us to discover, address, coordinate, and drive to conclusion non-R&D issues in a way that incorporates better private sector input, better research, and better analytical work to guide these efforts?

I think that there are ways to get at some of those issues. Above all, I think it is really important that the President set the tone. He needs to make technology for economic growth an explicit part of the job of the federal government—and the science and technology and innovation infrastructure. Moreover, OSTP should focus not only on science and technology and international issues, but also on providing some assistance to the science advisor so that he can better handle all of the regulatory, fiscal, legal, and business environment policies that impact the innovation process.

I tend to disagree with some of the earlier remarks about the National Economic Council taking over technology just because of its personnel. NEC's mission statement requires that it address technology issues. Maybe the most effective approach would be a joint structure that includes representatives from OSTP and the NEC to work together to coordinate an interagency process that addresses these issues. That means more staff and more funding than NEC or OSTP now have, and funding probably is one of the problems we face here.

As for the Commerce Department, I believe it needs to be strengthened and some outside agencies, like the National Telecommunications and Information Administration, need to be merged with the Department of Commerce rather than left outside as competitors. We also have an imbalance inside Commerce in terms of resources and issues. For example, U.S. trade represents 11 or 12 percent of our economy. In support of this effort, the Commerce Department spends \$30 or \$40 million a year on 100 policy analysts. We have also established an industry advisory council

structure that reaches all the way down to specific sectors. However, no comparable mechanism provides input into the technology policymaking process, even though technology accounts for the other 85 percent of our economic activity.

**Continuity Among Administrations**

**KIRLIN:** Strengthening an advisory structure is key, but how can you maintain programs and structures from Administration to Administration?

**WATKINS:** The issue of transition to a new Administration is never easy. There are four possibilities—Republican to Democrat, Democrat to Republican, or Republican to Republican, or Democrat to Democrat. The latter two are easy. The first two are terrible because all of the strategies that I put in as Secretary of Energy were based on best business practices in the nuclear area. They were born out of Three Mile Island, born out of Chernobyl, and so we set up the World Association of Nuclear Operators, which set up the Institute of Nuclear Power Operators in this country. All of these practices weren't Watkins' invention—I just put them into effect, and they were working well until my successor abolished them all. She didn't like security.

Where did it all go? Where did GAO go? Where did the committees go? The Energy bill used to be 1,000 pages. We worked four years to get it. We finally got it in the last session of the Bush Administration, and now it is dissipated. We had set up the internal communications mechanism to monitor everything and update it biannually to get over and keep the thing alive because it changes. And now our energy policy is a tin cup to the cartel in the Organization of Petroleum Exporting Countries (OPEC).

It is sad to see good strategies disappear because of politics, or good strategies lost because Capitol Hill doesn't recognize the old strategy when it has a new name. To use the analogy in the military, when you have a change in command, you want both parties to win, the one who hands off the baton, and the one taking the baton to run with it. Both benefit if it is done well.

So when reinventing government, one of the things we ought to reinvent is how to be courteous, Democrat and Republican, during the change of Administrations We ought to accept the goodness that most policies are based on. Most are not politically driven. I don't know how you instill basic respect for others, but I think passing the torch should include some kind of a cover letter that says, "For God's sake, leave alone what is good and peck away at what you think is not so good. But make it very clear that that is what you are doing. And don't throw away the things that are up and running and should be left alone."

**Policy Design versus Policy Analysis**

**BRANSCOMB:** Maybe a distinction I sometimes draw would be helpful. When I arrived at the Kennedy School and asked my colleagues, "What is this school about?" They would say, "It is the best school of policy analysis in the world." And I would say, "Well, that may be, but when I was in government, policy analysis was not my problem. It wasn't to figure out what was the best policy, it was how to stop doing dumb things and do any of the smart things. The third smartest thing would be a lot better than what we are doing now." And so I have always been a big advocate of policy design, not policy

analysis because when you design a bridge, you have to worry about these questions and all the rest of the details. Where does the bond issue come from? How do you get an environmental impact statement? Is the sub-surface soil going to support the bridge? What is the traffic under the bridge?

I don't think we can tell the President-Elect how to make policy, but we certainly ought to acknowledge that a description of the best policies doesn't get you very far in the government. You have to figure out whether a particular policy is timely. Can it be implemented? Is it politically ready to be dealt with? Can you involve in the discussion the people who are against it, as well as those who are for it? And will the public buy it if you enact it?

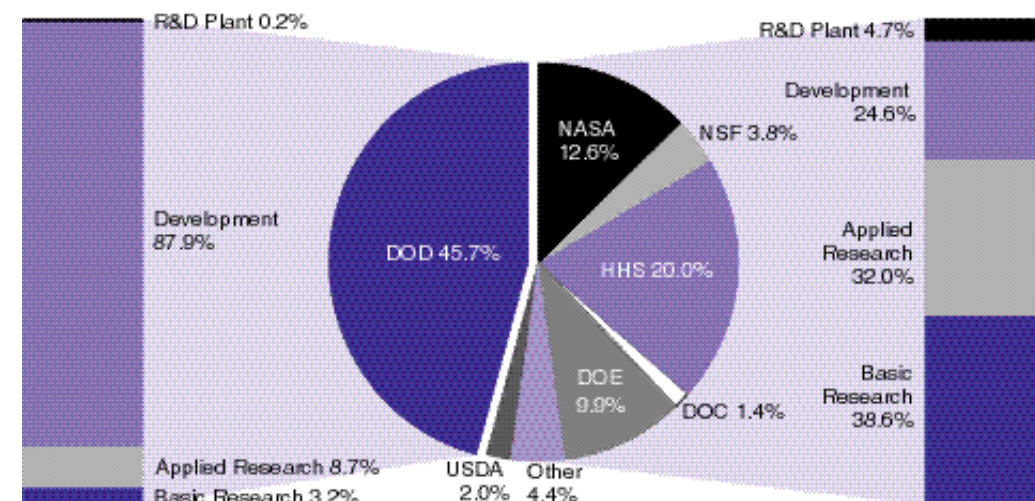
Let me elaborate. Students would sometimes pester me by saying, "Look, we don't like the stuff we write, show us a good policy analysis or a good policy project." So I went to the Office of Technology Assessment and said, "Give me a list of your best projects that you have done in the past, the 10 best." And they said, "What do you mean by 'best?'" "Well," I said, "the best, most factually supported, best quality analysis with the greatest impact." They said, "Oh, you are asking for two lists. Well, here are the 10 best projects we ever did and they had no impact. Here are the ones that had an impact and they were pretty shoddy but they were timely, they were important, they were for the right clients, and we got them there before the issues were cold."

**ABSHIRE:** Lew, I wrote down and underlined what you just said about policy design, not policy analysis. This is what we are attempting, certainly, in our national security reform initiative. We have got about six pages on how to conduct a national security assessment, and how a new Administration could bring Members of Congress in on it. You are right where we want to be.

**The Long-Term Planning Process**

**WATKINS:** Earlier, Lew, you raised a fundamental issue that needs to be addressed. If you are going to demand that the Defense Department produce a five-year research

**Projected Federal Obligations, by Agency and Character of Work: 1999**





program, then why don't we do it within the other research agencies? Many agencies say they want to do that. However, the reason they don't is because OMB pressures them not to. You have budgetary pressures not to do it. Nobody wants to look to the next year. So most departments have one-year budgets. Now, you ask the principal investigators, "What is going to happen next year?" And all they can do is submit another grant request. They are turning out proposals year after year. We ought to get to a five-year budget cycle on some of the long-range projects.

So why not try to work with Congress on this and say, "we know that this is pie in the sky, but we need to give the research base in this country some stability." This point has been made by many people and it gets into foreign affairs because if you are going to commit with a foreign partner to some big project like we are now trying to do with integrated ocean observing systems, you have got to have some kind of stability and continuity in your plan and commitment. And you need continuity not only in the Executive Branch but in the Congressional Branch as well. And if you can do that up front and work with the committees on the Hill, you have something that really is new in the way of doing business.

I really do think stability, the things they talk about in the Allard's Report, a five-year program for all the agencies, ought to be put into effect. I know that this idea is a problem for OMB, but so what? They solve other problems, why can't they solve this one? We should also consider pulling in some talented people in the science and technology area that can really sit in judgment, and also include PCAST members, and really work to develop a set of interconnected advisory groups.

### 3. Setting A National Research Agenda— And Setting It In Motion

**KIRLIN:** Let's move the discussion to another level—how a strengthened and integrated advisory structure might help fashion a national research and innovation agenda, and then set that plan in motion.

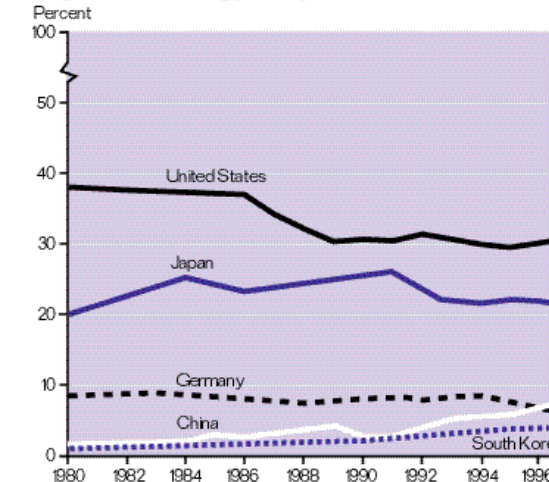
Peter Rooney, you worked in Congress and also know industry. What drivers shape the policy process? Who is—or should be—at the table? How can the policy-setting process be improved?

#### The Budget Surplus and Post-Cold War Opportunities

**ROONEY:** Much of the sclerosis and disharmony that people have talked about today can be attributed, I think, to the end of the Cold War. The end of that threat—and the end of more than two decades of structural deficits in the federal government—means that two powerful political drivers of science and technology (S&T) policy have disappeared.

We have now entered the new politics of surplus. What is interesting is that the two Presidential candidates jumped wholeheartedly into the policy debate about surpluses. However, both have focused exclusively on distributional issues—how to spend or spread the wealth. But we need to focus on the fonts of wealth creation. And I think the strongest rationale for a vigorous research and innovation policy is that these activities are the real keys today to our economy. Perhaps they always have been powerful

Country Share of Global High-Technology Output



drivers, but I think the public at large is now beginning to understand their importance. Certainly the people on the Hill get this connection.

So the link between innovation and economic expansion has to be the preamble to any national research agenda. Once you have the political rationale and command the resources, believe me, the process will accommodate.

**HAPPER:** When I headed the Department of Energy's research program, I was reminded that governments often make the mistake of trying to decide by themselves what the research agenda ought to be. I have

lived through a lot of examples in our own country, but perhaps the most disastrous example was the Lysenko affair in the Soviet Union when Stalin, not science, decided what science was and how it should proceed.

**BROMLEY:** I would like to offer a one-sentence statement of what I think the U.S. policy in science and technology should be. It is something that I have been reasonably successful in selling to the Congress. It is the following: "In those areas of science and technology where our work in the United States does not establish the frontiers, we must be working close enough to those frontiers so that we can exploit, without delay, new discoveries and developments whenever and wherever made."

**BRANSCOMB:** I think our national research strategy should address the problems that nobody else is going to solve in the next decade. And there are a number of them. Nobody is going to quickly solve the issue of global climate change and what to do about it. Nobody is going to solve the energy independence problem, or build a sustainable energy base capable of supporting our growing economy. And nobody is going to develop a research base for education that tells us how to educate people intelligently. And if this is the case, then applied research cannot solve some fundamental challenges. So we need to empower society to make those problems easier to solve. But the way you do that is not by working harder at what you already know, it is by learning some stuff you didn't know that you needed.

Professor Gerald Holten, an historian of science at Harvard University, captured this idea well in his phrase "Jeffersonian science," which he used in an article in *Issues in Science and Technology*. Holten distinguishes between Newtonian research, which is pure science or science that is intellectually driven, and Jeffersonian science, which is a basic research agenda driven by clearly defined national goals. Here, investment is motivated by the importance of the goal and the strategy is creative, competitive, and largely university-based.

If we are going to pursue a national research agenda, we need to defend the Newtonian component, the pure science component. Otherwise, we will forego opportu-

**Federal R&D Obligations, Total and Intramural by Agency: FY 1998**

Agency	Total R&D obligations (millions of current dollars)	Total R&D obligations as a share of Federal total (percent)	Intramural R&D (millions of current dollars)	Percent of agency R&D obligations that are intramural <sup>a</sup>	Percent change in real intramural R&D from prev. year <sup>b</sup>
Department of Defense	34,832.6	48.30	7,750.6	22.25	6.1
Department of Health and Human Services	13,717.8	19.02	2,957.2	21.56	9.3
National Aeronautics and Space Administration	9,850.7	13.66	2,462.7	25.00	4.4
Department Of Energy	5,833.1	8.09	535.1	9.17	24.3
National Science Foundation	2,356.9	3.27	14.4	0.61	3.9
Department of Agriculture, total	1,441.9	2.00	954.9	66.23	3.0
Department of Commerce, total	978.7	1.3	695.1	71.02	3.4
Department of Transportation, total	664.7	0.92	265.8	39.99	36.8
Department of the Interior, total	613.3	0.85	541.9	88.36	3.3
Environmental Protection Agency	606.0	0.84	289.3	47.74	11.1
Department of Veterans Affairs	299.3	0.42	299.3	100.00	17.0
Department of Education	211.8	0.29	9.8	4.63	5.3
Agency for International Development	183.9	0.26	21.0	11.42	-7.8
Smithsonian Institution	134.0	0.19	134.0	100.00	1.9
Department of Justice, total	102.9	0.14	42.2	41.01	0.2
Department of the Treasury, total	74.2	0.10	45.3	61.05	15.7
Social Security Administration	56.1	0.08	6.3	11.23	24.5
Nuclear Regulatory Commission	50.7	0.07	14.0	27.61	-9.0
Department of Labor, total	46.8	0.06	16.8	35.90	25.8
Department of Housing and Urban Development	39.6	0.05	25.0	63.13	16.5
U.S. International Trade Commission	5.8	0.01	5.8	100.00	0.5
Tennessee Valley Authority	2.9	0.00	2.9	100.00	-67.8
Library of Congress	2.5	0.00	2.5	100.00	-11.8
Department of State	1.0	0.00	0.3	30.00	-1.2
Other Agencies <sup>c</sup>	6.9	0.01	5.4	78.26	11.2
Entire Federal Government <sup>d</sup>	72,114.1	100.00	17,097.6	23.71	1.0

<sup>a</sup> Intramural activities include actual intramural R&D performance and costs associated with the planning and administration of both intramural and extramural programs by Federal personnel.

<sup>b</sup> Based on fiscal year GDP implicit price deflators for 1997 and 1998.

<sup>c</sup> Includes: Appalachian Regional Commission, Consumer Product Safety Commission, Federal Communications Commission, Federal Trade Commission, National Archives and Records Administration, U.S. Arms Control and Disarmament Agency, and U.S. Information Agency.

<sup>d</sup> Numbers do not total exactly, due to rounding.

SOURCE: National Science Foundation, Division of Science Resources Studies (NSF/SRS), *Survey of Federal Funds for Research and Development: Fiscal Years 1997, 1998, and 1999.*

**ADVANCING INNOVATION**

nities that later will prove valuable. I think the Clinton Administration has stumbled a bit trying to find a way to have a dialogue with the Congress and to track what I will call “the creative part of the federal research and development (R&D) budget.” Right away the name Twentieth Century Research Fund tells you that this is a political instrument. Nevertheless, in the spirit of an enabling strategy, we need to be able to focus on that component of the federal R&D budget that is truly creative and enabling so that we can develop skills and new options.

In short, we need a research and innovation policy, not a science and technology policy. We need to talk about research and innovation policy for two reasons. Number one, the distinction between science and technology is vanishing. Technology drives science at least as much as science drives technology. Number two, corporate-sponsored basic research is used right away, contrary to what some government scientists say. Industry uses basic research quickly because it tells you how to stop making dumb technology choices. And if you want to choose among technologies, it is basic science that tells you how to choose. And what you learned there can be instantly valuable at the billion dollar level.

What we need is a creative research strategy with an enabling characteristic, coupled with research skills that we are still developing. The final step is figuring out what kind of research an innovation-based economy requires. And the shorthand phrase for this is to recognize that there is a huge and important gap between invention and innovation.

Rod, there is a question you touched on but didn't talk about. The two candidates both promised to double NIH funding but they didn't promise to double anything else, although Bush promised to grow Defense R&D. And actually in his budget allocations, Gore proposed bigger numbers than Bush did for new Defense R&D. So both of them talked about growing NIH and Defense R&D. But a serious issue is the imbalance and how that might be addressed. Rita Colwell, of course, is doing her best in a fairly heroic way to try and get a lot of sympathy in the Senate for the National Science Foundation.

**WATKINS:** Congress is key, regardless of the specifics of our national research policy. And nobody says, “By God, you elect me and you will have the finest S&T policy in the country.” Eyes glass over, forget it.

So we have a real uphill battle. But I think there is hope. The timing is right in the Congress, but I want to make clear that any change in Congress will be hard won. For example, this passage was struck from Representative Vern Ehler's report, *Unlocking the Future*, “In those cases where two or more Congressional committees have joint jurisdiction over, or significant interest in, large, complex issues, the respective committees should take steps to better coordinate their efforts. Wherever possible, the affected committee should consider holding joint hearings and perhaps even writing joint authorization bills.”

Now Vern Ehlers felt very strongly about including this passage and so did I, so I went to see Speaker Newt Gingrich at Vern's suggestion. I said, “You told us at a luncheon speech that you want a totally integrated, comprehensive national science policy where all these things are brought together.” I said, “Let me just tell you my experience. I run 60-plus academic oceanographic science and technology institutions and some of the federal laboratories that work in this area. However, our nine agencies

that participate under the National Oceanographic Partnership Act, which we got passed in 1996, must now go before 43 committees in the House and Senate to win authorization and appropriations approval. You want a comprehensive strategy, and you want us to implement a coherent strategy across nine federal agencies? I think that is wonderful. You need to be part of the partnership, and you need to get key joint committees to come together, many at least biannually, so that members can listen to the strategy, and then we can make our budget submission.”

However, Members of Congress tell us to submit two budgets, a vertical one and a horizontally integrated one. And, they say, “Don’t touch any link in the chain because if someone gets mad at, say, NASA, they might take \$10 million out of NASA’s budget. We have to limit how much we integrate our budget and our programs.” For example, the Navy now relies on NASA for some of its program funds, and the Navy also relies on the National Science Foundation.

My point is that in the post-Cold War period, we have a lot of integration that we did not have during the Cold War. These new relations need to be addressed because we are doing business in a new way. Take the issue of global warming. I don’t see how we can face the threat of actual warming conditions, which, if warming did happen, would have substantial impacts on human health, fisheries, and more than half of a 10 billion population in the decades ahead. I don’t know how we are going to do deal with these possible impacts unless we start understanding the ecosystem so that we can make decent public policy decisions. When we take advocacy actions only, without pursuing an equally vigorous S&T strategy, we are making a huge mistake.

#### 4. Innovation and Economic Performance

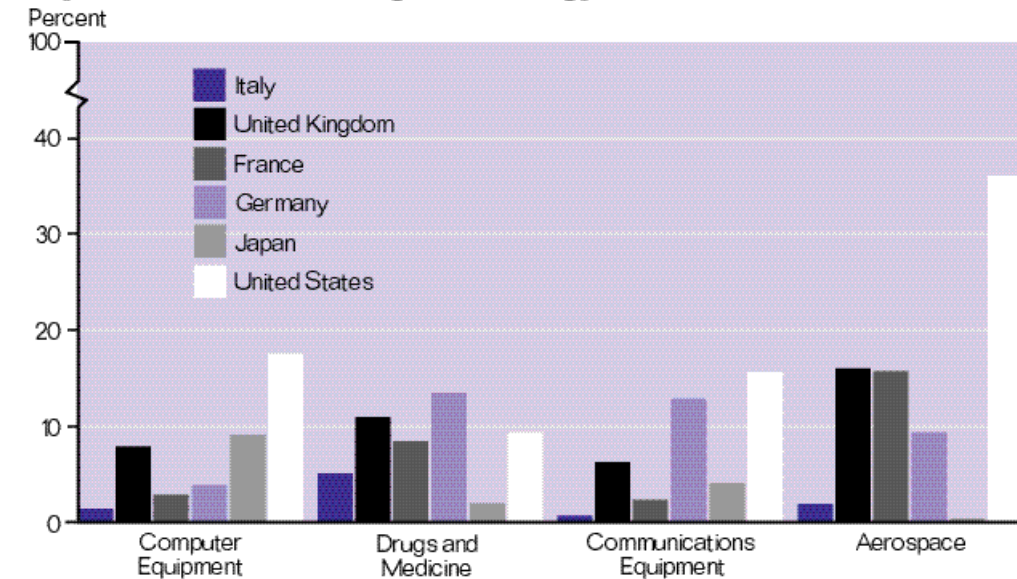
**KIRLIN:** Let’s go into more detail on the economic links before talking about national security and the role of Congress. Dr. Branscomb?

**BRANSCOMB:** The linkages between science, technology, and economic activity are critical for our future. Until 8 or 10 years ago, government and private spending on R&D were about the same. In recent years government R&D has grown quite slowly or hardly at all, whereas private sector investment is now twice that of the government. This raises an interesting question. If the private sector is spending more on R&D, does that mean the government can now spend less? Or does it mean that the federal R&D should try to be a constant proportion, or maybe even a growing proportion, of our gross national product?

We all look at these statistics from time to time, and nobody has a very rational way of dealing with the situation. But I think two implications flow from the current trend. First, if government is doing the right thing in the area of R&D, then indeed, that right thing needs to grow with the economy. In fact, as the economy becomes more technologically intensive, federal investment probably needs to grow as a fraction of the economy. Note that this does not mean we need to increase government R&D at the same pace as the private sector. So little of what we do now actually relates to the private sector in any direct way.

The second issue has to do with the misuse or unintended consequences for society

**Export Market Share in High-Technology Industries: 1997**



of new technologies. If we depend primarily on the market to drive these technologies, and I believe that is the right thing to do, then we cannot expect the companies to put a lot of money into science to explore possible unintended consequences of various innovations. Sure, they will put in some money because they worry about liability, but they won’t do what needs to be done. Government needs to increase its efforts—and funding—to better understand the long-term implications of new technologies, especially if government contributes a smaller and smaller fraction to the nation’s total R&D investment.

#### Empowering the Private Sector

Peter Rooney is right. During the Cold War the U.S. government focused on strengthening its own technical capabilities and those of defense firms dedicated to development and production for government. Today, officials are asking how can government empower the private sector, both profit and nonprofit, so that the private sector has the capabilities and resources to do what the nation needs. The notion of enabling and empowering of non-governmental institutions really should make us think very differently about federal R&D. To some extent, people are examining this issue, but we are not doing so explicitly in our policy thinking or in how we use our institutional structures.

Speaking of structures, we also need to think about our national infrastructure. The federal highway system was the last big infrastructure the government built, and the Feds paid 90 percent of the cost. Now we are building an intellectual highway system and the federal government is going to contribute two percent or some negligible amount. It is all going to get paid for by General Motors, Ford, Chrysler, and Motorola—and whoever else does the electronics along with Motorola.

So what does the government have to do? The government really needs to understand complex infrastructure systems and their vulnerabilities. For example, government needs to take action to create appropriate standards, compatibility,

architecture, and intellectual property rights, while addressing any concerns we might have about where the technology comes from.

Government officials also need to better understand how we're now handling technical risks. Technical risks lie between the time scientists think they have invented something—they may even have built something in the lab that works and have a patent—and the time they can quantify product performance, quantify the cost of production, identify the market, and raise at least \$3 million, which is the minimum venture capitalists grant these days.

Now, where does the money come from for basic technology research? It comes from people mortgaging their homes, from angel investors, and from a few venture capital firms. But it doesn't come very often from government. Of course, this is what the controversial Advanced Technology Program is supposed to be doing. The Small Business Innovation Research program (SBIR) is another program that could work a lot better than it now does. Moreover, many universities are taking a bigger role, but the federal government does not acknowledge this because the Commerce Department runs these programs and really doesn't want anything to do with the universities.

### Federal Policies Have Driven Economic Growth

**CARNES:** Maybe a bit of history would help here. As head of the Department of Commerce's technology policy unit, I can shed some light on technology policy aimed at economic growth, and the role that those policies play in the overall science, technology, and innovation policy agenda. As I talk, I want to cite some lessons that I think we learned during the last seven or so years of the Clinton Administration.

The whole notion of the impact of technology on the economy is based on the intellectual underpinnings started in the Reagan and Bush Administrations, as well as the competitiveness movement that started in the mid-80s and resulted in the formation of the Council on Competitiveness. In the 1980s, Congress passed the Federal Technology Transfer Act, which was a two fer. You make the investment for mission-related purposes but you also hope to get a secondary benefit by impacting the economy. Those principles still make a whole lot of sense.

For example, the Bush Administration began to experiment with new kinds of initiatives that were explicitly focused on competitiveness. The Advanced Technology Program (ATP) is one example that, I think, began with a \$10 million pilot program. The Bush Administration also started the Manufacturing Extension Partnership, which focused more on the use and diffusion of technology than on R&D.

President Clinton and Vice President Gore built on these initiatives when they took office. More importantly, on February 22, 1993, they issued Technology for America's Economic Growth. This document sets forth three or four specific principles, including the goals of strengthening industrial competitiveness, creating a business environment where technical innovations can flourish, and using federal investments in new ideas to forge a closer working partnership among industry, federal and state governments, workers, and universities. We have tried to follow these principles in a lot of our activities over the last several years.

However, we haven't been able to build infrastructures, mechanisms, and institutions inside the government that really allow those principles to be fulfilled.

### National Laboratories

**NEAL:** Can the national laboratories be an economic driver?

**BRANSCOMB:** Less so in the future than in the past, because increasingly, human resources are such a critical part of the national capacity. This is where the universities naturally have a bigger role. On the other hand, I believe the national labs also contribute to human resource development. They do so today, to some extent. But that could well be a place for more mature scientists and engineers to gain more formal training by working on two- or three-year projects.

Moreover, the national labs are stewards of several major shared facilities that we shouldn't try to duplicate in the private sector. National laboratories are unique in dealing with long-range technological, multidisciplinary problems. Some of those problems are larger than a university can handle. However, national laboratories now consume nearly one-half of the government's basic research budget. I used to work in one and loved it, but I am not sure that their contribution to research and innovation equals their compensation.

### Non-R&D Activities Need an Infrastructure

**CARNES:** Lew is right to say that the institutions of government focus almost exclusively on R&D policy, and the focus is at the agency level as opposed to the kind of cross-cutting themes that we have been talking about a lot today. Almost no infrastructure exists to support policy issues that are outside of the R&D arena. These issues are becoming increasingly important, I think, as evidenced by the impact of information technology and the growth of electronic commerce. Cross-cutting policy issues will probably become even more significant as you see the impact of the biotech revolution and its new products, which already are in the pipeline and will be commercialized. A lot of the policies and infrastructures now in place are not only being tested, they are being pushed to their limits.

Here's another example. The technical agencies and the scientific disciplines are not prepared to deal with the impact of electronic commerce, electronic health, electronic pharmacy, environmental technology, biotech, and related regulation. They are not ready to link these emerging industries to the innovation process so that companies make investments in new technology development and deployment. All of this private sector activity now falls outside the realm of the traditional technical agencies. And because they fall outside the domain of any single agency, they get scattered throughout the government. Right now 18 different federal agencies think they have some role to play in developing policy for e-commerce.

Also we are seeing issues that involve state governments, we are seeing international issues and the whole set of issues regarding privacy on the Internet. The Europeans have a completely different approach than the United States, and that's just one group. E-commerce is taking place globally.

**KIRLIN:** What you've both described is a revolution in innovation that has overwhelmed the policy process.

**Where's the Leadership?**

**WATKINS:** The pathetic thing is that we have a plethora of reports—from the National Academy of Sciences, from special commissions, and from the President's Committee of Advisors for Science and Technology (PCAST)—on how to fix these important issues, and we still haven't made the necessary change.

I remember the 1992 Carnegie Commission on Science and Technology and Foreign Affairs. It was a heck of a good report, but nothing happened.

Here is one by Frank Press on Allocating Federal Funds for Science and Technology. The recommendations in here are just as solid today as they were when the report was written. Let me read one or two. "The President should present an annual comprehensive federal S&T budget." Here's another: "The budget should be sufficient to serve national priorities and foster world-class science." It goes on and on. These are not just general words. He backs them up with very specific suggestions.

Also, I was involved in another study, one in which Dr. Neal (who is President Clinton's science advisor) and I testified before Representative Vern Ehler's committee. Vern was challenged by the then-Speaker of the House to get serious about a national science policy, and we testified that we didn't want a new agency. We wanted some basic improvements in the way science policy is made, and it's all here in the report, *Unlocking the Future*. It's a heck of a good report. Vern has a Ph.D. in physics, and one of the points made in the report is fundamental to our future: "Because the scientific enterprise will drive our nation's economy, investment in basic research is a long-term economic imperative." All these are excellent recommendations.

The RAND study is another good one. It says that the United States has entered into hundreds of bilateral and multilateral agreements on science and technology with other nations. The real question is how many of these agreements are worth the powder to blow them? Thirty, maybe.

Take Chernobyl. We have a photo-op with some Russian on how we are going to clean up this tragedy, but we are not going to clean up Chernobyl. We aren't going to get the money to do it right, so to have a bilateral agreement that says we are going to do something only raises expectations within the foreign country. Moreover, the State Department isn't even at the table when we make these agreements because we have bilateral S&T agreements that are generic and very basic. And we lean on those. Somehow we have all of these agreements out there that we say we are going to do—we have over 200 in the Department of Energy alone—and 10, at the most, are worth doing.

These things need to be brought into balance. Take the Supercollider. I was brought in six years late on that project and had to go out with a tin cup to ask the Japanese for \$2 billion to help build it. Watkins asking the Prime Minister of Japan and the Minister of Finance for \$2 billion? I don't think so. President Bush helped me to the degree he could, but I needed Secretary of State Jim Baker, and I needed Jim Baker's predecessor. You can't go to other nations late in the game and ask for money. You have to involve them in the research, the up-front design, so that they will participate in major programs. And you have to reach some kind of agreement on downstream benefits from building the system. We don't do that. So, who is going to pick up the baton and run with it?

**5. National Security**

**ABSHIRE:** I think the President, as Commander in Chief, has to re-establish the link between innovation policy and national security.

When you look out at the world with its promise and its peril—and it is real peril, for our continent is at risk for the first time—the biggest enemy is us. Our Executive and Legislative Branches are disorganized and compartmentalized. True, we are the predominant world power, but we are going to misspend that predominant power unless we can get our act together.

Let me tell you about one idea to reform our national security apparatus. I mentioned this earlier today, but I would like to elaborate a bit. Looking at the post-Cold War era, I began to think that there needs to be a counselor to the President, someone to think long range. Eisenhower, a five-star general, established a National Security Council that separated its operations coordinating board from its planning board. I mentioned this to Fred Ikle, a former Director of the Arms Control and Disarmament Agency and former UnderSecretary of Defense for Policy, and he said, "Look, you served on the President's Foreign Intelligence Advisory Board. That is an established committee. It has been accepted since Eisenhower. It reports directly to the President, not even through the National Security Advisor. And you want a strategic long-range group. Why don't you transform that body and make it your strategic board, make it broader?"

**Linking Innovation Policy to National Security**

Later, several of us met with Joe Nye, Dean of Harvard's JFK School of Government, and a group he put together. We expanded the basic idea and decided that the long-range national security body needs to reach into the technological revolution, the international financial revolution (which can bring down a country in a week), the biological revolution, cyber space—all of this stuff outside the box. And then we started talking about who might chair this strategic body, and we came up with the idea that the new Vice President, Dick Cheney, could do that. There isn't anyone more highly qualified.

This national security model doesn't integrate all of the things we have talked about today, but working with that body would re-establish a direct link between national defense and innovation—an important link that we lost when the Cold War ended.

**BROMLEY:** Let me tell you what happened on my watch. I was late in joining the circle of Presidential assistants, and by that time Brent Scowcroft was really solidly entrenched. Quite apart from that, I have enormous respect and regard for Brent so I quite consciously cut back the military part of OSTP on the assumption that it would be taken care of by Brent. Where I made a fundamental mistake, and both he and I agree now that it was a fundamental mistake, was in not finding a really distinguished individual who could be double-hatted, both in the National Security Council and in OSTP.

**NICHOLS:** The way I suggested this morning.

**BROMLEY:** As you suggested this morning. We tried. We appointed several people and

then dis-appointed them because it requires a very special person to fulfill that double role effectively, but it certainly is worth doing.

**NICHOLS:** I think our discussion of joint staffing and joint appointments has touched on two different levels, full time and part time—which is a very important element in any thinking about a reorganization. So is the budget.

#### **Defense Budgets, R&D, and Commercial Innovation**

**NICHOLS:** Since this session is on national security, I want to focus on two things. First, Jim Watkins alluded to the 6.1 and 6.2 budgets of the Department of Defense (DOD), which are really quite crucial in a lot of different ways. These budget sections are one of the few ways in which the federal government is still supporting physical engineering, science, and mathematics. Much of the university-based physical engineering, science, and mathematics depends on the DOD. Depending on which sub-field you are talking about, approximately 40 or 50 percent of the total academic research funding that comes from the federal government. So the 6.1 and 6.2 budget provisions are not necessarily to be seen only in David Abshire's sense as a part of the Defense Department—they are a part of the overall S&T apparatus geared toward security, broadly defined, and our innovation capability. I think what happens to the 6.1 and 6.2 sections of the Defense Budget are important to our overall innovative capacity.

Second, a similar argument can be made about Defense's Advanced Research Projects Agency (DARPA), which was born two generations ago to provide advanced research for defense and for weapons. Over the last two generations, it has become one of the few places where people often think outside of the box. A lot of the current commercial technology was first developed at DARPA, as everyone around this table knows. Its basic research has had very broad applications. Today, DARPA, I think, is a different agency than it was 25 years ago. Like the rest of the technical agencies, it has had a harder time attracting excellent technical people. And even though it is connected with industry and generally has been pretty good, I think it is an important issue that the next Administration needs to revisit.

The Carnegie Commission toyed with the idea of creating a national DARPA. It would be called NARPA and maybe even be pulled out of the Defense Department. I didn't think then, and don't think now, that it would be a good idea. But if you see DARPA in national terms—as one of the few sources of very high-quality venture technology ideas—you begin to regard defense R&D in a different light.

#### **Organizational Links are Needed—And Are Emerging**

Let me make a point or two about the Defense Science Board. I would argue that this board is in roughly the same shape as the President's Committee of Advisors for Science and Technology (PCAST). Although the Defense Science Board meets more frequently than PCAST, and it has occasionally met with the Secretary of Defense, it is a very different advisory board than it was a generation ago. The new Secretary of Defense, the new science advisor, and the new President have really got to decide what they want from this body. Do you want a Defense Science Board that is strong enough technically and intellectually to debate serious issues in a very broad way, even when an issue is

incendiary like the ballistic missile defense system? Or do you want Members to only debate bureaucratic issues like how much to invest in 6.6?

Second, we have a different kind of committee than we tended to develop over the last decade. OSTP, PCAST, and its predecessors typically have debated with Defense and the Defense Science Board, but one doesn't hear about these debates anymore—that is because they don't have strong people at either end. I believe that the government would be much better served by having strong people at both ends and strong debate going on.

#### **Links to National Security**

**WATKINS:** The links between national security, innovation, and organizational structures are something we have to get right.

For example, I have watched the ocean researchers try to deal with littoral warfare strategy. Where are we now? We are just beginning to invest in the littoral. The Navy is totally connected with regional coastal issues, trying to understand them, not only here but abroad. We have sent research vessels to the Persian Gulf to figure out how we can better conduct a helicopter recovery operation if we have to go into Iran again. We don't know very much about these things and yet we have moved into parts of the world where this knowledge is vital. We are off the coast of Kosovo and off the Sudan, in the middle of all of these complicated areas in the Middle East and so forth, and now off China and everything else, and we don't know very much about it.

So knowledge about the littoral becomes important, and it is important to more than the Defense Department. In fact, the whole issue of national security is about economic security and other things. Boundaries are hard to define. For example, I see such a link between the National Aeronautics and Space Administration, the Navy, the National Science Foundation (NSF), and the National Oceanographic and Atmospheric Administration today—they are all integrally tied with sensor systems, data collection, and other things, and are becoming more closely linked year after year. And that is good, I think. But it is not good if you have an infrastructure that won't permit cross-cutting research and integration of operations. That is a brand new ball game and that is where the big dough is, and we can do it right.

**WATKINS:** Science research really is bipartisan, as someone said. There are not many people interested in budget details, but when you find them, they are great and nobody fights them on it. We huckster for 6.1 for the Navy every single year—to hold it up or leave it alone. With all of the uncertainties in the future and the crazy rogue leadership in the world, we don't know what we are going to need to defeat a biological chemical weapon delivered by rockets and things. So let's keep our pockets open, this is what we should invest in and it is peanuts to Congress.

**ABSHIRE:** Let me just say that we agree with you. We believe that the national security issue is not buying more F-22s. It goes to the heart of the innovation revolution, which argues that we need to develop a structure and policy process that has as its goal strategic foresight and strategic integration.

And we strongly believe that to drive any of this politically, there has got to be a vision. When the new President comes in, if he wants to start out with that touch of near greatness, he has got to have vision in these two areas.

## 6. Why A Presidential Initiative Is Needed

**ABSHIRE:** We are doing business in a new way. The next President needs to move quickly to improve the national security apparatus, which is badly broken and not forward looking at all. The President needs to work with Congress to advance basic research and build the foundations needed to sustain innovation, economic growth, and national security.

Allan, you've served in the White House. How is this best done?

**BROMLEY:** First, the President can give a major talk somewhere on science and technology, indicating his recognition of its importance. This use of the bully pulpit can be enormously helpful. It doesn't have to be more frequent than once a year.

Second—and this is a point I learned after I got out of Washington and began serving as President of the American Physical Society—professional societies and the scientific community can do a lot to help themselves by organizing, getting the attention of Congress, and acting to support the President's message.

I recall a particular time in the 1990s when the American Association for the Advancement of Science predicted that the bottom was going to fall out of the federal funding. It was one of the scariest curves that any scientist has ever seen. The question was, what do we do about this? Senator Phil Gramm suggested doubling the science budget in 10 years; but it was patently obvious that nothing would happen without bipartisan support. Working with some other scientific society presidents, we pulled together 110 of the professional and technical societies in the United States, whose membership totaled about 3.5 million scientists and engineers. By any extrapolation, that membership corresponds to about 10 million voters who tend to vote. So whenever we were able to see the President or senior people in the Senate or the House, we mentioned in passing these 10 million voters, and ears would perk up.

We also organized conferences and put out press releases. We were able to convince both the Administration and Members of Congress that times were really changing, that the sciences were becoming much more interdependent than ever before, and that it was absolutely impossible to predict where the next breakthrough was going to occur. We strongly supported the doubling concept and recruited Senator Lieberman to work with Senator Gramm.

Getting back to our own grassroots, and getting the President to say something from time to time that shows he is serious about basic research, are both important.

### Getting the President's Attention

**KIRLIN:** I want to ask John Yochelson, President of the Council on Competitiveness and former Vice President for International Business and Economics Programs at the Center for Strategic and International Studies, to place science and technology policy in the context of other issues that compete for the President's attention.

**YOCHELSON:** I want to get down to specifics, to how and why a President might pay attention—or not—to science and technology issues.

The President of the United States is much more engaged in national security decisionmaking than he is in either economics or science and technology issues. And that stems, obviously, from the Constitution and the fact that he is the nation's Commander in Chief.

Moreover, the challenge on the operational side is that almost all key decisions occur during a crisis. The solution is to get the right information to the President so that he can act to protect the nation's national security.

In contrast to that, decisionmaking in science and technology is basically about resources, about the allocation of the nation's public-sector resources. S&T decisionmaking almost always has a much longer time horizon than the national security decisionmaking process.

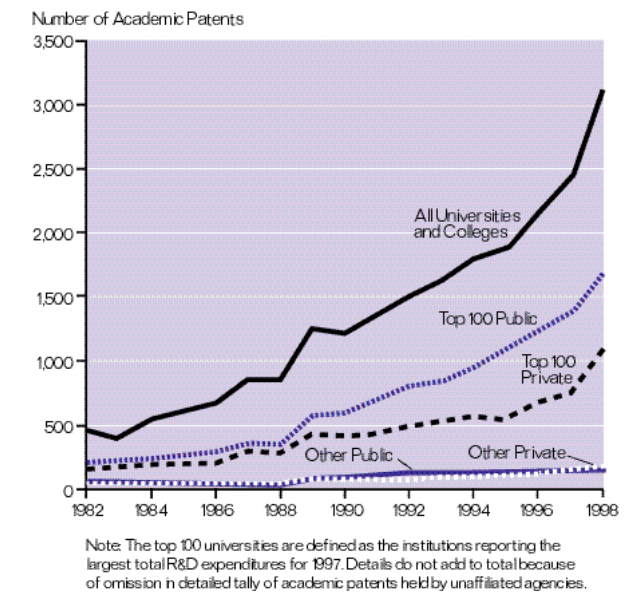
When it comes to economic policy, it seems to me that, from a White House point of view, what really counts is macro-policy. What matters are taxes, interest rates (even if the President doesn't have direct control), trade, and how we are doing as a national economy. The Treasury Department is the dominant agency in this relationship with the President.

By contrast, science and technology decisionmaking is almost exclusively a micro-economic exercise. We can certainly argue that. We can contend, as Alan Greenspan has, that the impact of science and technology is really very broad and explains much of the structural shift in our economy in recent years.

But from the point of view of resource allocation, from the point of view of the President on what has to get done, it really does seem to me that microeconomic decisions far overshadow the macroeconomic ones when it comes to innovation policy. The implications of this, as I see it, are first and foremost, that decisions about science and technology don't naturally flow in and out of the Oval Office. For example, there are neither macroeconomic quarterly reports going to the President on S&T investments, nor regular reports on trade friction with an ally over technology. There are no reports on the need for the President to make an overall budget determination based on innovation issues or resources. This is not to say that microeconomic issues affecting innovation don't get into the Oval Office as part of a deliberation on economic matters, but there's no hook for S&T the way there is for national security.

**KIRLIN:** I think you are right, John. A few weeks ago, I asked Neal Lane, the current national science advisor, and Jack Gibbons, his predecessor, at the end of their State Department presentation about how they were able to get the attention of the President. After some thought, they both said, in effect, "You have to get the President's attention

**Number of Academic Patents Granted: 1982-1998**



whenever you can and the best way to do this is to tie science and technology issues to his message of the day or week.” For example, they said you should take a medical issue, an emergency issue, any issue that you can bring to the front, and fold it in and make relevant the long-term research for science and other technology advances. In short, make your message on basic research part of people’s everyday experience.

### Is there a Role for the Vice President?

**WELLS:** I did a dissertation on how Presidents use scientific and technical advice. I started with FDR and went through Jimmy Carter. One word comes from my research—idiosyncratic. Every President was different. So any recommendations we make have to be tailored to a particular Administration. The scientific community tends to underestimate this lesson, but Presidents select—and respond to—their National Science Advisors in very, very different ways.

**ABSHIRE:** Allan, what do you think if the next Vice President participated more directly or more frequently in the policy process? Can the Vice President be active without taking over the role of the science advisor?

**BROMLEY:** If the relationship between the Science Advisor and the President is workable, then that’s not going to be a problem because the Science Advisor will already be working with the Vice President. It can be done and it has been done and, unless there is an unfortunate relationship between the staff of the President and the Vice President, there won’t be any interference. In fact, the Vice President can help reinforce the importance of science and technology among an Administration’s overall policy goals.

### Congress Has the Last Word

**YOCHELSON:** I want to make another point that I think is fundamental. Everyone knows that Congress is critically important to the policy process, whether its economics, or national security, or science and technology. But when it comes to S&T, Congress really, genuinely has the last word. It doesn’t necessarily have the last word on the environment in which innovation takes place, but it does have the last word on the allocation of resources.

So the test, it seems to me, is how directly involved is the President in S&T matters? I have to conclude that innovation is really important, but not very urgent. Therefore, the President-Elect has got to make a conscious decision as to whether he wants to create a structure in which he can focus on something that is important but not urgent.

That is something that a President really has to decide beforehand. He has to say, “Do I care enough about this that I’m going to create a structure that gets information to me personally and to the top of the White House in some way?” I don’t think that it’s a slam-dunk. I don’t think that it’s a foregone conclusion.

In fact, the inertia makes the whole process very episodic and, since science and technology is linked to other issues, the next President really has to make a conscious decision about this. I don’t want to diminish in any way the importance of research and innovation policy to the economy or to national defense. Certainly the links between science, technology, and defense have weakened over the last decade. That does strike

me as something important. It strikes me as something that further weakens the leverage of the President in the policy process.

If it’s true that science and technology are important, but not urgent matters for a President, and if it’s true that the relationship between science and technology and national security is less than it used to be, then we are faced with a real challenge. Under these circumstances, the President must choose an advisor in whom he has personal confidence, and with whom he has a personal relationship. This advisor is going to be a really important filter. Hopefully, he or she will be able to explain complicated things to the next President the way that George Shultz explained complicated foreign policy issues to President Reagan.

Moreover, this advisor has to know and understand the Congress—and have credibility with Members of Congress—for the simple reason that Congress has the last word. In short, to be effective, you will need to elevate the science advisor so that the important is not crowded out by the urgent.

## 7. Budgets, Congressional Funding, and Reform

**KIRLIN:** Dr. Neal, you saw first hand what Presidents and Congress can do—and undo—with large projects, such as the Superconducting Supercollider. How can the President and Congress create and sustain long-term research projects at the frontiers of knowledge?

**NEAL:** I think the first challenge is determining, roughly, what should be the ratio of public to private research and development funding. How would we decide the level of government funding when, 15 years ago, the government matched the private sector in funding, and now all of that has changed?

**BRANSCOMB:** The easy answer is three percent. It is a great number. Finland invests three percent, why can’t we invest three percent? The right answer is, “Mr. President, the government does a lot of different kinds of R&D for a lot of different reasons.” Then we have got to break out those investments because the right answer should be tied to the requirements of the mission agencies, the value of achieving those missions, and of course, the effectiveness of the R&D strategy used to accomplish those goals.

For example, we would do the math on military R&D the same way a company would decide its R&D budget. The military wants a capability and it can spend the money to sustain the forces, or to build new weapons, or to buy more weapons. It’s a business decision and it isn’t hard to do. The same is probably true in health research, although we probably wouldn’t get an answer that is politically attractive.

The federal government must then take the money that’s left and decide how to spend it. Should it be spent on public/private partnerships, with the private sector taking the lead so we can stimulate the economy? If we go in this direction, are we having an impact on innovation, or are we just distorting the market by replacing private money with public money? Or are we genuinely creating capabilities that the companies can’t achieve themselves?



Then comes a larger questions—what role does our basic research strategy have in sustaining both the skills and the knowledge base that allows the private sector and the public sector to be creative? Here, we need to keep a scorecard. If it looks like it is working in one sector better than another, we can make a case for expanding public funding in that area. And if not, we don't make the case.

**NICHOLS:** I think Homer Neal has put his finger on a profound question and Lew has given a very savvy answer. I have two comments. First, we need to make sure that there are some very high-quality people who keep asking this unanswerable question. Second, we need to monitor what is going on in the major science agencies and in the private sector, and look at a whole set of indicators that are largely qualitative. And if we had five minutes with the incoming President, I think we would have to say, as Lew said, that we don't know the exact answer, but we can give you indicators all the time about whether we are on the right track or the wrong track.

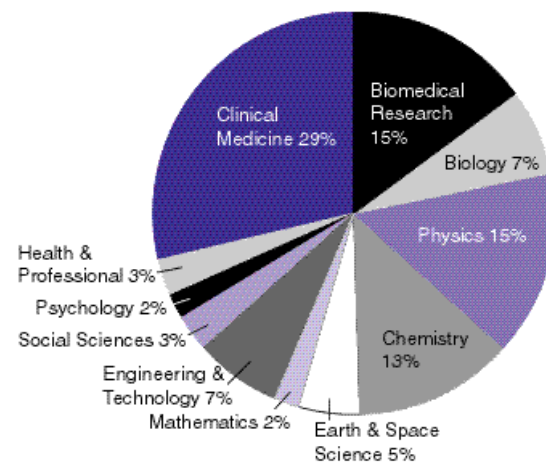
**BRANSCOMB:** This is the kind of question we should put to the President's Committee of Advisors for Science and Technology.

**Working With the Office of Management and Budget to Create a Unified Budget**

**BROMLEY:** I mentioned earlier the importance of the joint Office of Management and Budget (OMB)/Office of Science and Technology Policy (OSTP) activity and how it is essential. In the past, what normally happened was that OMB put together budgets based on the proposals submitted by the mission agencies. Staff at OMB then organized and prioritized these budgets and only at the end of the process did they show anything to OSTP. Moreover, White House science staff had only a few days in which to look at the budget and could say nothing much about it.

I believe that the OSTP Director must work closely with the OMB Director, even if they are bloody when it's over. There just has to be a close working relationship with the Director of OMB. I had the pleasure of working with Dick Darman, one of the smartest men I have ever met, and also one of the most difficult. Dick and I did managed to hammer out an agreement on how we would function. We agreed that our staffs would work together throughout the entire year so that there were no surprises along the way. And when we were finished, just before this was incorporated into the President's budget for submission to Congress, we arranged that all of the participating agencies, in some cases 15 and in one case 18, all sat in Room 150 of the Old Executive Office Building and made their pitches to OMB simultaneously, and with the other agencies listening. That cross-fertilization is enormously important in that everybody knows what everybody else is doing.

**Distribution of the World's Scientific and Technical Articles, by Field: 1995-1997**



Once we had agreed with the agencies and OMB on what each agency was going to contribute during the coming year and, in principle, for five years into the future, those funds were frozen within OMB. This means, of course, that you can't have too many special Presidential initiatives, or you break your budget. We found that five years of advanced planning was about all the federal government could actually handle at one time.

One of the most important rules we put into action was that whenever the recommendations of any of these committees disagreed with the wishes of the agency head or the Cabinet Secretary, the agency head or the Cabinet Secretary won. That rule removed the thought that somehow the White House was trampling over an agency's authority and freedom of action. The fact that this had been agreed upon from the outset meant that, in fact, the issue was never raised.

**Joint Budget Presentations to Congress**

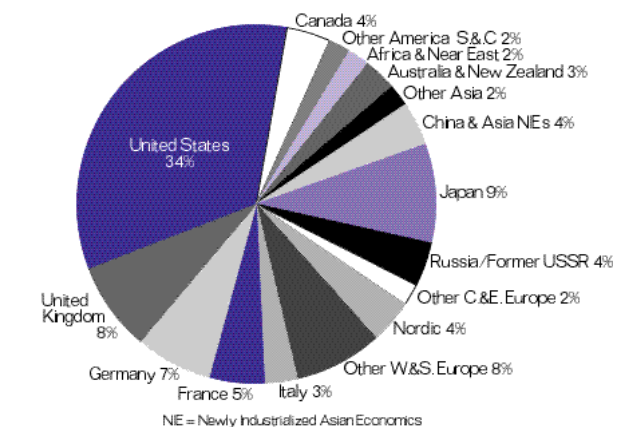
**BROMLEY:** In short, one of the most important developments that we could recommend to the next President is that, prior to sending any program to the Congress, all the agencies should be forced to help develop a unified budget for OMB and a unified presentation to Congress. Then, once a program was submitted to Congress, a joint hearing on a particular program could be presented to the various committees that thought they had jurisdiction.

We used this approach with our mathematics and science education proposal and it turned out to be remarkably successful. We saved an enormous amount of time and effort by having these coherent presentations, both before OMB where you had to focus on your planning and source of money, and then before Congress, which made the final funding decisions.

One of the major strengths of the science and technology enterprise in the United States is the plurality of its support channels. If one agency doesn't like you or your idea, 19 or 20 others might and one will even think your idea is the greatest thing since sliced bread. This characteristic of our government structure is unique in the entire developed world.

But this multiplicity also presents OSTP with a challenge—it must coordinate and communicate with 20 agencies. For example, we found that many senior members of these agencies had never met one another and, furthermore, didn't want to meet one another until they were forced to do so. After a few weeks or months of working together, a remarkable transition took place. People began to realize that they were participating in something of major national importance. They didn't want their agency shown to bad advantage in the media, so they were prepared to really work toward common goals and budgets. They felt a personal involvement.

**Distribution of the World's Scientific and Technical Articles in Major Journals, by Region/Country: 1995-1997**



**Early Consultation with Congress**

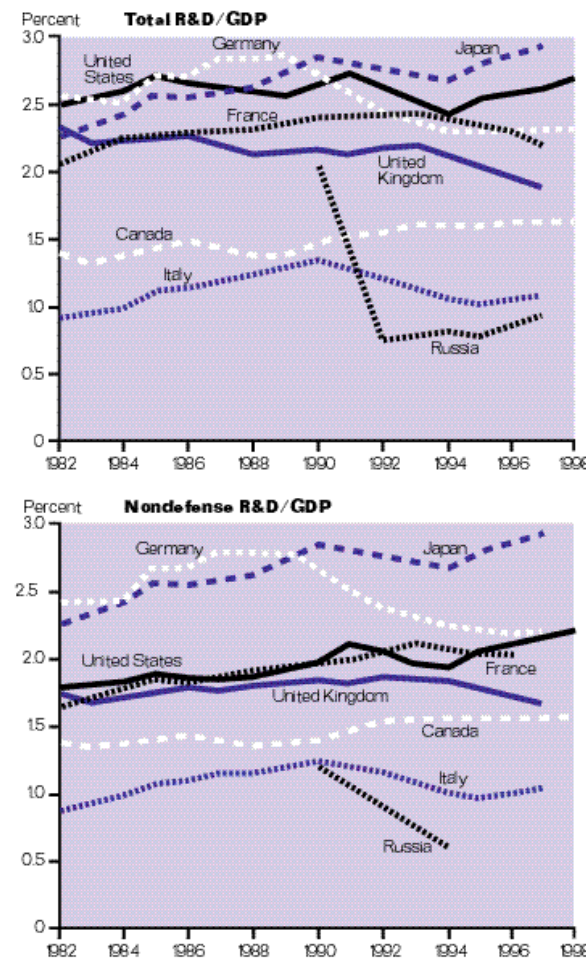
**WATKINS:** I would add that you also need early consultation with Members of Congress, especially the Foreign Relations and Science Committees. You can't surprise them up there. They have to be in from the get-go on these things, so talk to them and bring them to the White House. Bring the State Department over with the right people and the Under Secretary for Global Policy.

These are the things that I think this group can do to put some real pressure on the agencies to restructure. But it cannot be done alone. It must be done in concert with the Congress. The Congressional leadership can be very disingenuous about reform because they are a big part of the problem. Will Representative Sensenbrenner talk to Senator Helms, who chairs the Senate Foreign Relations Committee? Probably not, so it's going to be tough to sell change on Capitol Hill.

We need to engage Congressional leaders and bring them back into the game. And I think it can be done. Part of the President's team has got to use the bully pulpit to make it happen, and the President needs to have the Office of Science and Technology Policy lead the effort. The science advisor, in my opinion, has to be a jewel on this and go around with the President and the OMB Director and talk to Members of Congress. I think we have a tremendous opportunity here. I think the timing is right. I think the interagency cooperation and the collaborative R&D are good ideas. OMB is not ready to integrate across agency budgets but they do allow an alternate budget presentation on the Hill. I think we need to horizontally integrate where we can and show—perhaps in a joint committee session—what we are doing over time so that everyone really knows.

For example, only about 20 percent of the Defense Department R&D budget is really research. So doubling it shouldn't prick anybody. I certainly agree that Rita Colwell is doing the right thing at the National Science Foundation, calling for a doubling of the NSF budget, which we fully support. Over time, I think the Hill is going to do it, and I think some staff in OMB already support it. She went over to them and the Hill with a budget. So I think there are some good signs now that her innovation and research budgets are getting about a 20 percent increase. She got it through OMB that way, so that is a good sign that these kinds of numbers are getting the right attention.

**R&D as a Percentage of GDP, G-8 Countries**



**BROMLEY:** But we have to address an institutional problem as well—one of which most people are unaware. The NSF Director is an Executive Level two whereas the Director of the National Institutes of Health (NIH) is an Executive Level four, reporting to an Assistant Secretary. The way the system works, the Director of NSF automatically goes to meetings and discussions from which the Director of NIH is excluded. I tried for four years to fix this and it turns out that it is not fixable within the Department of Health and Human Services (HHS) because other DHHS branches think that NIH already has too much clout.

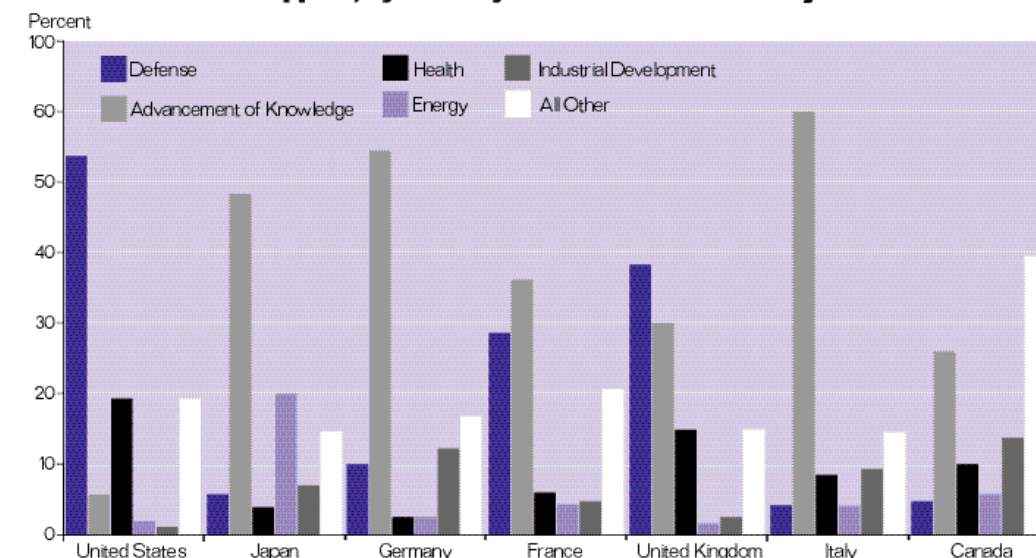
**Long-Term Commitments for Large Projects**

**NEAL:** Let me raise another issue. Over the last 30 years or so there has been a discontinuity in the length of the term of a Presidential Administration. Most last for four years. However, the average time required to complete a major scientific project keeps growing.

In the 1960s, we could get money for a reasonably big project that lasted a year or two, and do it under the same Administration. In the 1970s, projects started to take two or three years. And in the 1990s, we needed four to eight years or so. Crossing that sort of three or four-year period, I think is extremely significant. We need to ask the next Administration to look at ways of dealing with this. Otherwise, we will have hit a ceiling and the United States will not do any big projects that take more than six or seven years. And that limits our science.

**BRANSCOMB:** The French are good at this and we ought to follow their lead. The Administration and Congress should agree to support four or five big, strong, general purpose national labs, mostly energy labs but maybe not all. And then they should say that one-third of the budget on each of these laboratories is at the disposal of the

**Government R&D Support, by Country and Socioeconomic Objective: 1997-1998**



Notes: R&D is classified according to its primary government objective, although it may support any number of complimentary goals. For example, defense R&D with commercial spinoffs is classified as supporting defense, not industrial development. R&D for the advancement of knowledge is not equivalent to basic research.

science advisor. If there is an urgent need for a crash effort in some area of science and technology, the President would have the authority to re-program current efforts on the condition that during the very next budget cycle, he would have to go to the Congress and put his request in the appropriations cycle and get authority to do it. Congress could say, “No, you had the authority, you did it, but we don’t want you doing it and you have to stop.” But, nevertheless, The President could start, he could put 100 people on a problem tomorrow because the national labs are the only place we have in the country where the government, at least in principle, controls a block of talent like that. Under the current system, you could spend a year just trying to contract a company to do the same job.

### Accountability in a Managed Environment

**BRANSCOMB:** Budgets and organizational structures need to change, and they are, but we need to better understand how this change is happening. David Guston, a Rutgers professor, has already started. He looked at the post-Vannevar Bush science policy regime and the emergence of a new science policy in the post-Cold War era. He found two things: first, that there hasn’t been nearly as much change as people think, and the change that has occurred has been slow. And second, the change that has occurred is much more profound than people realize.

Now, you can’t figure out the new policy by listening to people talk about it and give it names. You have to look at the institutional structures of the government that have arisen and look at what they do. Guston studied NIH and found institutional structures that Congress has challenged. Members say, especially during budget discussions, “We no longer take the scientific community’s word for it, that if we just fund enough science, it will all produce benefits. We insist that the government begin to tell us how these benefits will arise, and what they will be.” So OSTP, OMB, and the whole science community have got to start making the connection between science investments and what our constituents—especially Congressional Members—expect us to be accountable for in terms of public benefits.

Guston’s basic point is that we are now in an era, irreversibly so, in which the body politic is saying, in a perfectly reasonable voice, “Our nation is dependent on science and people want scientific research funded, but only in a managed environment. We understand the purposes, the objectives,” they say, “but there has got to be some attempt to assess effectiveness and to get more efficiency into the system.”

If that, indeed, is the case, then I believe we have an incentive and an opportunity—an obligation—to do considerably more long-range research than we are doing now. Most of the short-term problem solving should be done by the private sector, except when the government itself is the customer, as in defense. Our thinking should be more strategic and longer term. And a good bit should be quite basic—creative, competitive, and academically oriented. That is what I mean by basic—that it should be creative. And there is basic technology research, too.

So I believe a much larger fraction of federally funded research should be long term. It should be more creative in its mode of performance and more diverse in the exploration of promising opportunities than is now the case. This means that such activities need to address major national issues, work side-by-side with programs already in existence, and preserve the intellectually driven science—the investments in

intellectual infrastructure and education—upon which everything else rests.

### Scientific Leadership and Benchmarking

**BRANSCOMB:** If we are going to start measuring more closely whether goal-oriented research (whether basic or applied), is effective, we also are going to need to measure whether our intellectual investments are paying off. Ralph Gomory, a former Director of Research at IBM and now head of the Sloan Foundation, has some good ideas on this. He has been involved with the President’s Committee of Advisors for Science and Technology and has argued that we should use benchmarking—and this gets back a little bit to the Frank Press report—to test whether or not our science investments are achieving their objectives. Ralph says our overall goal is scientific leadership. By this he means putting the United States in a leadership position or at least in a comparable position in strategic areas. He has identified some nice techniques for doing this, including ways to enhance an agency’s ability to respond to the Government Performance and Results Act.

In short, I firmly believe that with Congress in the mood to be generous to science, now is precisely the time for the scientific community to come forward and say, “We appreciate this support. We think it is important. And by the way, we have got a way to think about how a larger part of this scientific effort in fact contributes to definable goals.”

Senators Barbara Mikulski and Kit Bond recently said that federal science policy lacks vision, and I think they are right. We can do better.

**KIRLIN:** Peter, you had a comment.

**ROONEY:** The one thing I would add is that federal and private research dollars are completely different animals. With the possible exception of the pharmaceutical sector, the federal government is the monopoly financier of new knowledge creation in our society. Government plays such a critical role. It has that role by default because in the early stages of knowledge creation, results cannot be appropriated and the private sector simply will not do it. In fact, during the past 10 years the private sector has moved closer to the market, which is a good thing because it greatly increases the efficiency and speed at which new knowledge enters the marketplace. This approach also leverages the knowledge that is created.

But what we haven’t done an adequate job of lately is in funding new knowledge creation at a level commensurate with its return to society. And I think we have to work with Congress to change this situation.

### Personalizing Congressional Relations

**WELLS:** Anybody who wants to work with Congress has to know its idiosyncratic features, its individual Members, and individual committees. No two are alike, so you have to take the time to learn what drives each individual and each committee. And you’d better not walk in to see either a Staff Director, a staff member, or a Congressional Member without knowing what is important. That is why, several years ago, I wrote a

little book called *Working with Congress*. The American Association for the Advancement of Science published it and we expected to sell maybe 500 copies, but it turned into a kind of stunner. The first printing of 6,000 copies went quickly and now a second printing of 6,000 is going out the door.

Now, I am going to embarrass Allan. One afternoon he called me at the university and said, "Would you consider coming over to be my Chief of Staff?" I said, "Allan, I am a damn Democrat." And he said he didn't care. I think that was a very positive beginning because Allan was more interested in who could do the job than in their politics. It drove the Presidential Personnel Office crazy that several of Allan's Associate Directors were Democrats. But if you have talented staff, then other White House Directors are not going to take away your jurisdiction. But if you don't have good staff, missions start being stolen because people are sized up very rapidly in terms of whether or not they know what they are doing.

So, a strong White House staff is important, regardless of party affiliation. As I said, the President's science advisor must be willing to talk to Congressional staff. It is not a matter of dealing with Senators, Representatives, and committee chairmen who make some of the decisions. It is the staff who make most of the decisions, or at least do the work that leads to particular decisions. And I remember times that Allan and I sat for half an hour in a waiting room to talk to some subcommittee Staff Director.

This attention to Congressional staff paid off. For example, all we needed was a few thousand dollars to run PCAST. But Dick Darman, who was OMB Director, said he wasn't going to give us the money. He didn't think that we could get it from the Hill, so he said, "Go up and try to get it yourself."

So Allan and I went to Senator Barbara Mikulski and her chief guy on the Senate Appropriations Committee and made the pitch that we needed three quarters of a million dollars to run PCAST. Barbara said, "You've got it." Now, you don't go to the Hill only when you have a problem. You cultivate a relationship first. And you also use your White House base to build that relationship. I remember dealing with a chief staff member on the House Appropriations Committee who seldom talked to lobbyists and felt that he knew all he needed to know. So one afternoon Allan and I were talking about this and I said, "Allan, you need to invite him to the White House mess hall." And in all the 22 to 23 years he had been on the Hill in that position, no one from OSTP or the White House had ever invited him to the White House. This guy was a hard case and was flattered that he was invited to the White House mess hall.

This brings me to the issue of sizing up your opportunities to advance an agenda. To be effective, you need a lot of intelligence. Unfortunately, most legislative liaison guys don't know the issues or the proper people to contact. In effect, OSTP has to develop its own Congressional relationships. This means sizing up the 12 to 20 Members of the House and Senate that you really need to spend your time on so that you can focus these people on your priorities. You also need to do the same with committees and subcommittee chairmen. Unfortunately, White House staff don't often make this effort.

Another thing we did was to invite 12 or 15 key staff members to the White House every two or three months for an "inside" briefing. Now it wasn't really inside. There was nothing that was really secret. And we didn't just invite the relevant Members of Congress, we invited the senior staff to the White House as well. So when you did have a problem, you didn't have to wait three days for someone to return your phone call.

In short, relations between the White House and Congress have to be personalized, highly personalized. Far too many people, including people in the science community, start with the idea that they have a problem that their relevant Member of Congress should fix. But they haven't done any intelligence work, and some may even assume that the Member owes them a solution to their problem.

**KIRLIN:** Elizabeth Prostic, you work for Senator John McCain, who chairs the Commerce Committee, and Senator Bill Frist, who chairs the Science and Space Subcommittee. What do you think?

**PROSTIC:** I chuckled as Bill spoke because he is so right. I want to make two points. The first is that the Director of OSTP and his Associate Directors need to develop personal relationships with key Members of Congress and their staffs. You need these relationships so that Congress doesn't just see you when you testify, which puts you on the opposite side of the table anyway. Speaking of tables, OSTP needs to be at the negotiating table, and often they are not. They need to be there, however, because we regularly negotiate important issues with the House Science Committee, the House Commerce Committee, or other committees.

My second point is that, as staff, we meet 50 to 60 people a week. Everybody wants attention or a favor or whatever. But if you develop a trusting relationship with someone, you always take that call and you always read what they suggest because they may have a larger perspective than you do.

### Congressional Reform

**KIRLIN:** Refining our national research agenda and linking that agenda to economic activities and national security are a first step toward enhancing our research and innovation capacity. A second step, it seems to me, is integrating both the advisory structure and the budget process. We are now talking about a third step, improving Congressional, OMB, and White House interactions. How can this be done?

**BROMLEY:** The Congressional committee structure presents a real challenge. No matter how carefully the President crafts his initiatives, or the agencies work to present a unified budget, Congress immediately tears it apart and ships it to a dozen subcommittees and committees, all of whom have their own way of handling things. You end taking all the bits and pieces that fall out of this process and put them together into some kind of coherent final product that can be funded and perhaps utilized.

That doesn't make much sense. So, on several occasions, we called the Hill leaders and their key staff to the White House and sat them down around the table in the Roosevelt Room. We said, "Look, it is just insane for a developed country like ours, which is supposed to be smart and a world leader, to divide responsibility in Congress in this way. We need to reorganize the responsibility in the various committees and subcommittees, and perhaps change some of them so that at least there is a better match between what we are trying to do in the Administration and what you in the Congress want us to do."

And everyone would always agree, "Oh, absolutely. That is exactly what we need to

do,” until the question was asked, “How much turf are you going to give up?” Then the answer was, zilch, none, and forget the whole thing. They would go back to Capitol Hill and nothing would change.

In short, I don't think the Congress is about to help any President restructure committees and subcommittees. But perhaps the President and Congress could create a joint commission to examine, in a bipartisan way, how Congress responds to Executive proposals. We do have a sick structure.

**BRANSCOMB:** Congressional reform is extremely difficult. I went to see Tom Foley when he was Speaker of the House and I said to him, “If the Executive Branch restructured its science and technology activities to make them more rational, what might you be able to do to restructure the committees to match?” He leaned back in his chair and he said, “Let me tell you a story. A year ago I called in one of my dearest friends in Congress, a person I have known for many, many years and with whom I have a very close relationship. And I said, ‘Look, I have to ask you to do something for me, and I know it is going to be a little painful but would you please consider moving from this subcommittee to that subcommittee?’” Foley's friend said, “Tom, if you do that, I will hate you for the rest of your life and in every action you take in this House, I will vote against everything you want to do.” Foley ended our meeting by saying, “Forget it. There is no way that Congress is going to reorganize its committee structure to meet this requirement.”

However, the 104th Congress did in fact do a fair amount of committee restructuring. This happened when Speaker Newt Gingrich momentarily had the power to do so, and was willing to exercise that power. It was also a time when Congress was trying to slash its own budget by 30 percent, and this gave them an additional incentive to reorganize. But boy, Congressional reform is an uphill fight.

**WATKINS:** I think we need to tell the President-Elect that a very strong base for bipartisan action on science policy exists in the Congress. Almost no other subject in the Congress enjoys this. Just look at the petition in the Senate for doubling the NSF budget, which is supported by an equal number of Democrats and Republicans. The Science Caucus also started with a very carefully balanced group of sponsors. I think this whole effort should be called to the attention of the new President and a real political effort ought to be made to sustain long-range funding of programs that focus on basic research and the development of human skills.

**NICHOLS:** A few years ago I wrote a little monograph for the Carnegie Corporation. And in order to write it, I compiled a list of all of the executive agencies and Congressional committees that have some budgetary responsibility in that area where science and technology intersect with international affairs. Some of the agencies are very big, like the Department of Defense. Some of them are fairly big but not likely to get discussed today like Agriculture and the National Institutes of Health, which has a small center with a \$20 million budget. The Department of Energy also does a lot of research, mostly in the United States, but its efforts are broadly relevant.

So if someone is going to do the kind of staff work that Bill Wells has wisely and shrewdly talked about, as well as the higher level of work required to create liaisons that

provide advanced warning on key issues, you have to talk to a lot of committee and subcommittees chairs and staffers. Bill said OSTP needs to spend a quarter of its staff time interacting with Congressional committees, which I think is a pretty reasonable estimate if you want OSTP to be an effective performer.

### Creating An Ongoing Dialogue

**CARNES:** I want to propose a way to manage the multiplicity of committees on the Hill and in the agencies in the Executive Branch. The next President might propose a procedure that is outside the normal appropriations process. Right now, most interactions between the Executive Branch and Congress have to do with specific appropriations, even if a single agency's appropriation is in the context of a larger Administration-wide initiative. What is needed is the equivalent of an ongoing dialogue. And as we begin the new century, it makes sense to look closely at the federal government's entire R&D portfolio. The group to do this probably should include representatives from all of the federal agencies and all of the key Congressional committees. This group would listen to presentations by subject matter experts in health, engineering, defense, energy, and other research areas. This approach would generate a better portfolio sense of what the government currently is doing, and provide lawmakers and policy experts with a sense of the direction and pace of how research should be moving.

Naturally, we have to look at the federal portfolio in the context of what industry is doing and what is going on in other countries in the science and technology arena. Again, the goal is to remove ourselves from the appropriations process so that we can establish an independent dialogue that may help the President's science advisor to identify priorities and, along the way, build relationships of trust and understanding across committee and agency lines.

### Should Congress Revive the Office of Technology Assessment?

**ABSHIRE:** I want to ask a question. Can the Office of Technology Assessment (OTA) be restored, in a better form, and would a reinvigorated OTA help the policy process?

**BRANSCOMB:** OTA was killed because House Speaker Newt Gingrich was committed to cutting a third of the budget from the Congressional agencies, and OTA was the weakest of the Congressional agencies. The fact that Senator Ted Kennedy was strongly associated with the creation of OTA probably didn't help either.

But it could have been saved. In the final hours, a compromise was reached whereby it would have kept going at about half of its size within the Library of Congress. But the head of the Library refused to go along with the deal for fear that he would have to eat some of the budget—at least I think that was his reason. And if it had survived, it could have grown back and then become independent again, but that has not happened. OTA's statutory basis still exists, it simply doesn't have the appropriation.

**BROMLEY:** The political aspects were important, of course, but there were operational issues as well. For example, OTA typically took two years to issue a report. By then we had a totally new set of problems. Unless something can be done to speed up the process, I don't think it is worth setting it up again.

**NICHOLS:** I agree with all of this. Just before OTA was eliminated, a clear feeling emerged that OTA could do some things much quicker. And I think part of the secret of any new design of an OTA-like entity is to say that a third of our effort or a half of our effort is just going to be to respond in 60 days or 90 days. That is longer than the Library of Congress takes, but much shorter than the National Academy of Sciences. Frankly, I think a revamped OTA could be a winner, and that there could be bipartisan support to re-fund it.

## 8. International Issues and Opportunities

**NICHOLS:** I would like to turn to international activities. As many of you know, Secretaries of State tend to discover how important science and technology is to diplomacy just before or after they leave office. For example, Henry Kissinger said, “Technology daily outstrips the ability of our institutions to cope with its fruits. Our political imagination must catch up with our scientific vision.” Cyrus Vance said, “For some time it has been clear that advances in science and technology are out-distancing the capacity of existing international organizations to deal with them.”

Unfortunately, the State Department is resource poor, but let me pose four questions relating to innovation and international issues.

Question one, should the State Department just abandon its science and technology roles? Stated differently, will the new science advisor to the Secretary of State make any difference?

As many of you know, for years I have advocated more science and technology in the State Department. But, reluctantly, recently I have come to the opposite view, that we ought to go through the Executive Office of the President, and give OSTP, the National Science Foundation, and the mission agencies much more international responsibility, and State fewer responsibilities.

Question two, should the Agency for International Development (AID) rebuild its science and technology capabilities?

A generation ago, AID built up its science and technology staffs because developing countries, and developed countries for that matter, came to our embassies for help with science and technology issues. Today, we are not equipped to provide that assistance. We have taken away all of our field staff in science and technology and centralized them in Washington. This is the wrong approach, as President Carter and I argued in the Carnegie report eight years ago.

One alternative would be to manage all of the international S&T assistance to countries, especially developing countries, through an overarching political guidance system operated by the OSTP and the State Department, with program management by the mission agencies themselves. We ought to talk further about this.

Question three, does it really matter whether we improve the science and technology-dependent functions of the United Nations?

Many people say it doesn't matter. After all, the United States is pretty strong and we can do more or less what we want, including engage in an alliance with any country we wish. But I am not so sure that is true. In fact, I think it isn't true. I recommend

that we pick one or two major UN agencies—the Food and Agricultural Organization, the International Telecommunications Union, the UN Health Organization, or UN development programs—and create an entirely new framework focused on making these organizations first rate in science and technology. And then we should concentrate on U.S. relations and influence over what they do.

Question four, should we pay almost equal attention to every developing country in our science and technology relationships, or should we focus on a handful, such as India, China, Brazil, and Mexico?

I think the latter approach makes much more sense. Whether these resources are inside the State Department or distributed across the mission agencies, which is more sensible, we really need to set priorities. At the moment, we are skimming too much ground.

**WELLS:** I think we ought to try to reinvigorate interest in and the capabilities of both the State Department and the Agency for International Development. However, we have to recognize that science attachés have no status. It is the political advisors who have status, and that is a very practical fact of life. Unless we begin to change the status of science and technology people, we are not ever going to have the kind of recognition or capabilities that State and AID ought to have.

**SOLOMON:** I, too, feel that the authority of the State Department to coordinate international science and technology relationships is exactly right. I don't know, Rod, do you want it moved out of State because you have just thrown up your hands and given up on State?

**NICHOLS:** There is a job that needs to be done that State is not doing.

**SOLOMON:** Absolutely. But if you look at U.S. relationships with countries around the world, science and technology are basically aligned with economic policy, with a whole range of political issues. And these are the things that the State Department and the regional bureaus know best. So any science and technology coordination in other countries has to be done with a basic understanding of economic policy and political relationships.

The question, once again, as it has been for decades, is—how do we fix the State Department? I expressed my view about a year ago in an op-ed article in *Science*, where I argued that the S&T function should be aligned in the State Department with economic policy and be supervised by the Under Secretary for Economic Affairs. I think it would get a lot more attention there and be understood. And we could coordinate a number of fundamental policy issues, like intellectual property rights, in one place at State.

**BRANSCOMB:** Our relationships in the developing world are changing rapidly. In fact, the largest purchasers of U.S. exports are countries in the developing world, not in Europe and Japan. Most people don't realize this. We have a lot of trade with developed countries, but the developing world is our market. We really ought to be doing more for them in our own self-interest, as well as in our humanitarian interest.

**ABSHIRE:** It seems to me that the key question is whether the new Secretary of State is going to give this issue top priority or not. We could dramatically raise the possibility of rejuvenating the State Department, knowing that it clearly takes not only a commitment by the new Secretary but also by the Office of Management and Budget. If State is not willing to make this commitment, we ought to say that they might lose their current responsibilities with respect to science and technology issues.

**CARNES:** We need to rethink the role of the State Department in the whole S&T area. Right now, a President tends to throw in a science and technology partnership whenever he does a handshake with a foreign leader, without thinking about the potential commercial benefits or burdens to the United States. I don't know whether decisions like this should stay with the State Department or go to the mission agencies, but that needs to be addressed.

**BROMLEY:** International S&T policy always seems to provide a special challenge. During my tenure in the White House, I thought that all of the Federal Coordinating Council for Science, Engineering and Technology (FCCSET) committees were quite successful, except for the one on international affairs. Looking back, I believe the reason can be found in the fact that the international FCCSET committee had no budgetary responsibility. We put together budgets for all of the other agencies and they had to stick with them. But State refused to have anything to do with the international FCCSET committee's recommendations. No money was involved, so nobody really felt a sense of ownership of the committee. And even though we had some remarkably able people, it never produced anything comparable to the other FCCSET committees.

**NICHOLS:** Well, the Mega Science Forum is still around, even though it doesn't have a budget either. This organizational innovation sprung up out of frustration and provided people who wanted a forum to discuss big science projects on an international basis to at least start those discussions. Eventually, the topic of funding would come up. If another country was interested, you could sit down and talk design. But if you were the only country interested, you had to fund it.

**BROMLEY:** Yes, it came down very much to what Jim Watkins was talking about when he spoke about the Superconducting Supercollider project. The United States did its thing and then sent top officials around the globe to ask for support. I spent a week in Japan talking to everybody and saying, essentially, "We would like you to help us pay for our machine."

I didn't literally say that, but the Japanese translated it beautifully into that.

#### Challenges in International Policy

**BOND:** I see the problems, but it is really important to look at U.S. research and innovation policy in an international context. We can't have an effective U.S. innovation policy unless it includes a significant international component.

**BRANSCOMB:** I absolutely agree. That is why I mentioned the apparent conflict between trade policy and research policy that needs to be resolved.

For example, direct foreign investment and trade are probably our most effective tools internationally. The U.S. government should work with other countries to develop an indigenous capability. However, Congress is never going to provide money for that purpose except via the World Bank and other institutions, which probably is the right way to do it. But we shouldn't stop trying to convince Congress to provide resources for technical advice, human resources, and development training.

Moreover, governments can work with the private sector on key issues. In point of fact, the pharmaceutical companies are working with the United States and African governments to get the AIDS drugs to Africa.

#### Immigration and Education

**NICHOLS:** I want to make two quick points about potentially incendiary issues relating to science and technology in the international arena. One is immigration. We have major shortages of technical people at several different levels. It has been an important and controversial issue on the Hill. And the incoming science advisor is going to have to make a decision about whether we should continue to have a really open immigration system for technically trained people who are not U.S. citizens. I tend to favor having an open system and lifting those immigration caps because I think it is good for our economy and it is a good symbol of helping democracy.

**BRANSCOMB:** The immigration issue really is an education issue, viewed from a different angle. And I would offer three comments on the issue of science and math education. First, a huge amount of attention is being given to distance learning and Web-based learning, which already is very important at the college and graduate school level. And although these forms of learning don't address the fundamental problems we have in education, they are creating a market for education in a very subtle and effective way, at least in the long term. Take the most rapidly growing piece of K-12 education, which is home instruction. Here, you can imagine distance learning having a significant affect.

My second comment concerns a real disaster, namely, our failure to connect our fabulously vital university research in cognitive science with the applied research done in schools of education. Most university scientists are not connected either to those folks doing the learning science or to the educators engaged in educational practices. We simply aren't getting what we know about learning into the school systems. And the government has to figure out how to break this cycle.

My third point concerns foundations. Right now the MacArthur Foundation is working with the National Research Council and the new dean of the Stanford School of Education to develop for the private foundation world a research and practice agenda for reforming K-12 education. I think the applied notion behind it, although not stated explicitly anywhere, is that the private foundation world is close to saying, "To hell with the National Science Foundation and the Department of Education. Neither one is solving the problem of inadequate math and science education. We are just going to do it in the foundation world and in the universities and in the private sector."

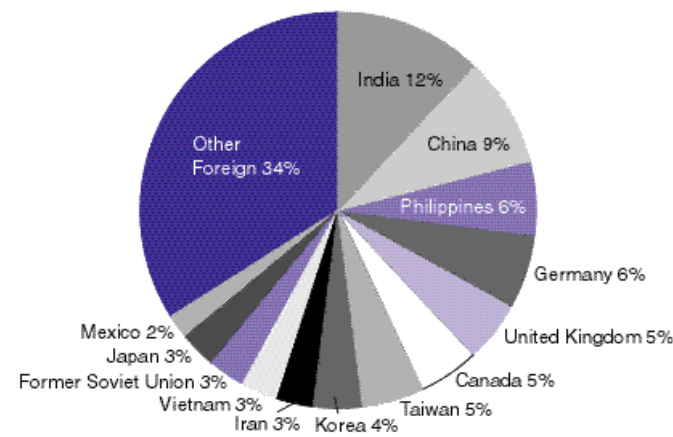
So if I were President and I thought voters really cared about education, I would seriously consider telling the foundations to get in there and try to fix this problem, and tell me how to fix the federal agencies so they can help.

**Direct Foreign Investment**

**NICHOLS:** The second issue I want to comment on is foreign direct investment, which goes in both directions. There was a scare a few years ago that U.S. companies were investing so much in R&D facilities abroad, that we were creating big competitors to our own industries. And most of the assessments have shown that that argument doesn't make any sense because the net flow is more in the United States' direction. For example, data show that something like \$15 billion is invested in the United States by so-called foreign firms, while American firms invest about \$12 or \$13 billion abroad annually. But that will come back again once there is another flap about some product or service in which we are losing a little competitive edge. Again, my tendency is to vote for a rather open system of this kind of foreign direct investment. I think that generally is better for the United States.

But the science advisor sometimes has been cut out of both of those issues. In my judgment, it is a good idea to have the science advisor advise on these issues of technical personnel and trade-related investments.

**Place of Birth for Foreign-Born S&E Degree Holders, 1997**



**WEISS:** I teach science, technology and international affairs at Georgetown University, and I agree that international trade and development issues are going to be increasingly important in the next 10 years. These issues cut across all kinds of jurisdictional lines and mandates of the scientific agencies. But the fact is that there is a lot more money in the science agencies than in the foreign policy agencies—the State Department budget has been cut drastically while the science budget is rising dramatically. Is there some way,

consistent with domestic priorities and Congressional jurisdictions, to shift some money to the State Department so that science and technology can be applied to development issues?

For example, a number of small-scale programs show that the monies would be well spent. The malaria initiative at NIH is a good example of traditional research. Other examples include venture capital investments in developing countries, AID's cooperative agreement with the pharmaceutical industries and a host of both old and new mechanisms involving private resources (such as technical assistance) and public resources, as appropriate, to solve problems. If more funds were available, I know a lot of good projects could be funded.

**ABSHIRE:** I don't know about the wisdom of shifting funds, but the Center supports revitalizing the State Department so that diplomacy is an integral part of a forward-looking national security system.

**A Case Study in Integrated Oceans Research**

**WATKINS:** I will give you an example of doing things in an integrated way. The National Oceanographic Research Leadership Council, which is chaired by the Secretary of the Navy, was started six years ago. Each month an interagency working group meets, and twice a year Council members meet. We also have an Ocean Research Advisory Panel, which draws on experts from a number of federal agencies.

We are talking about one small section of science and how to integrate it across nine federal agencies, but, more than that, we are now setting up a program office to connect and integrate international oceanographic operations. This project is important to the United States, and we need to engage the G-7 nations because a great number of resources will be necessary to put together an integrated ocean observing system capable of predictive modeling. Right now we try to do the same thing with computers that come off the shelf and are not integrated.

The best way to build an ocean observation system is by integrating the various science advisory panels. I set up one at the Department of Energy called the Secretary of Energy Advisory Board, which the president of Cal Tech chaired. Our members included four Nobel Laureates from four different disciplines. And I wouldn't let them leave the table until they told me how I could balance my budget among the various scientific disciplines. And that should be done in every department. Advisory boards become very important. So does the way they interact with each other because if I have an advisory board in the defense sciences, the National Science Board in the NSF, the Secretary of Energy Advisory Board, and NASA's Advisory Board—is there ever any connectivity?

If you are going to integrate in major areas of science, such as I am talking about here, then you have to connect the advisory boards so that there is mutual support at very high levels. For example, the State Department representative has to have international stature and be willing to tell the Secretary, "You get this on the G-7 agenda. This is what we want to get on that agenda. And this is how we are going to integrate our programs and activities." That's the way to make things work.

**9. Summary**

**KIRLIN:** Al Teich, are you ready to summarize today's discussion? Others can add a point or two if you wish after his summary remarks.

**TEICH:** Thanks, Tom. I think this would be a good time to recall the quote that we heard at the beginning of this session from Thomas Jefferson, "No more good must be attempted than the people can bear." So I will try to be brief.

I won't attempt to summarize all of the wise counsel we've heard today, but let me pick a few highlights that struck me.

Our goal was to discuss ways to improve the research and innovation policy process, and we managed to do that. Our core message is that we need Presidential leadership to improve the advisory structure and policy process. That is really what this is all about.



When you talk about Presidential leadership, you very quickly begin talking about the Office of the Science Advisor and the Office of Science and Technology Policy. OSTP has a dual role. Some phrase it as keeping in mind the distinction between policy for science and science for policy. I prefer to talk about advising the President on issues that involve science and technology, wherever those issues might arise. The other function involves overseeing and coordinating—“managing” if you will—the nation’s, particularly the federal government’s, science and technology enterprise. This means setting the tone and keeping an eye on the bureaucracy. It means looking for weak spots and working with Congress, mission agencies, industry, the scientific community, the national labs, and academic research groups to keep the science and technology enterprise healthy.

To do this effectively, the science advisor has to tread carefully. The role is symbolic and at times people tend to regard the science advisor as the science community’s ambassador to the White House. People in other government branches sometimes also slip into thinking that OSTP is an advocacy group. When either of these attitudes takes root, both OSTP and the science advisor lose credibility in the White House and, therefore, the ability to carry out their real functions.

Having said this, it seems to me that the next President needs to know how important an effective science advisor and a well-staffed OSTP are to his Administration. This point needs to be reiterated and personally delivered because even though these offices exist by law, no President is forced to take advice from the science advisor or OSTP if he doesn’t want to. On the other hand, science and technology are increasingly a key part of our society, so incorporating them into the policy process clearly makes good sense.

We talked about the need for OSTP to work within the White House structure, which means working with OMB, the National Economic Council, and the National Security Council. A lot of interesting ideas were floated in terms of shared staff, joint appointments, and structural ways of addressing the fact that so often now it is difficult to distinguish between what is science and technology policy, what is foreign policy, what is economic policy, and what is trade policy. All of these things overlap and they don’t belong in any single bailiwick. But they have to be integrated and one way to do that is through people. In fact, that is probably the only way to effectively integrate all of these activities.

Almost everyone pointed out the importance of OSTP working with Congress, not just in a formal way, but through personal relations. I think a lot of very important things were said here. We also need to stress the importance of working with the mission agencies, with outside experts in the science community, and with experts from industry. Clearly, we have not been using the people on the President’s Committee of Advisors for Science and Technology, as effectively as we should. The private sector funds more than two-thirds of the R&D in this country, and is closing in on three-quarters, so the federal government can no longer really call the shots. Government must form partnerships with the private sector.

At several points during the day we discussed the problems of science and technology in various Executive Branch agencies, including the State Department. State always seems to come up in these discussions, and either current attempts are made successful and permanent, or we give up, as Rod Nichols suggested, and start over.

Also, we talked about the Commerce Department, which has an important role in

research and innovation, but also has some problems, as do the Department of Energy, the Environmental Protection Agency, and the Agency for International Development. I found it interesting that we did not talk much about the National Science Foundation or the National Institutes of Health, which are the two bastions of basic research. I take this to mean that people here think that these agencies are running rather well. That’s good news. The only point that participants seemed to mention is that there appears to be a growing imbalance among agencies in funding, an imbalance that may either be a result of Congressional fascination with medical research or a sign of support for the internal administration of these two key agencies.

Finally, we talked several times about the importance of the appointments process and how vital Presidential leadership has become. The President may not do much personally, but the people he appoints run the government agencies that do so many things in the areas of basic research, innovation, and education. So appointing—early—his Assistant for Science and Technology and making certain that OSTP is well staffed are particularly important. The President and his science advisor also need to take very seriously appointments to other science and technology positions and to the advisory boards. It would be a mistake to use these positions simply as rewards for political contributors and old friends.

More was said, but these were the points that I found especially important.

**WATKINS:** I see two themes emerging. One is the absolute need for better integration, coordination, and communication at all levels within the White House, within the Executive Branch, between the White House and Congress, and within the S&T community.

The second theme is something that came through loud and clear in what Lew Branscomb said—the need for greater anticipatory capability in all units. We need to set up an organizational structure to do exactly that, whether it is through the joint advisory bodies you were talking about or whether it is rebuilding the Office of Technology Assessment or something similar. These two themes, I think, came up repeatedly throughout the day.

**KIRLIN:** Everyone here has contributed enormously to our discussion, and Dave Abshire and I thank you. As he said, we intend to use today’s discussion to make a difference in the next Administration. We will publish a selection of these remarks and, more importantly, draw on today’s comments as we prepare presentations to the new President, his transition team, and Congressional leader.

## APPENDIX

**Science, Technology, and Innovation Policymaking****An Evolving Process**

Invited by President Franklin D. Roosevelt in 1940 to outline ways in which cutting-edge science could help win World War II, Vannevar Bush, president of the Carnegie Institution of Washington, linked science and technology policymaking to the President's Constitutional role as Commander in Chief. Both institutions advanced together during the next 40 years, in large part because "flexibly drawn contractual [agreements]"<sup>1</sup> helped ensure the independence of civilian scientists who worked in university laboratories.

Two Cold War events strengthened the linkage between government and innovation—the Soviet Union's ability to create an H-bomb and their dramatic launch of a manned Sputnik rocket before the United States had developed comparable expertise.

Sputnik signaled a new political and scientific reality, namely, that Soviet scientists had moved beyond espionage to the mastery of advanced scientific concepts and technologies—enough so that they could pursue dominance in space. Spurred on by Senate Armed Services Committee hearings led by Senator Lyndon B. Johnson, President Dwight D. Eisenhower created the National Aeronautics and Space Administration (NASA) in 1958.<sup>2</sup> President John F. Kennedy later charged NASA with sending "a man to the moon" and returning him safely to earth. For his part, President Richard M. Nixon expanded the link between government and science policy by declaring a "War on Cancer" in 1971 that focused attention on the research mission of the National Institutes of Health. In short, well before the Cold War ended, "government" science, innovation, and technology had moved from the covert world of Pentagon planners and generals into the daily lives—and aspirations—of millions of Americans.

Innovations in science and technology drive America's global economy—and make more diffuse and secular our policymaking process. Changes can be traced to the 1980s when U.S. business leaders realized that Japan's highly successful Ministry of International Trade and Industry (MITI) was the equivalent of an "economic Sputnik." MITI cut across a broad array of industrial sectors, including basic industries, machinery and information, and consumer goods, and helped build Japan into a formidable economic power. U.S. industrial leaders were reluctant to allow their government officials the power to "pick winners and losers," so they trimmed payrolls, merged operations, retrained managers, invested in new equipment, and applied emerging information technologies—notably, the Internet (which originated in the military services)—to regain a competitive edge in the global marketplace. This transformation has been so successful that policymakers in and out of government view science, technology, and innovation as economic drivers, advanced by an army of entrepreneurial companies—Cisco, Intel, Microsoft, and America Online—whose CEOs believe that they have created a new economy, not only for the United States but for the world.

**The Current System**

Certainly the Cold War policymaking paradigm in the United States—organized around national security interests and implemented through contracts with large manufacturers such as Boeing—has faded. Although the Department of Defense maintains its Defense Advanced Research Projects Agency (DARPA) as a central research and development (R&D) organization, most advanced research now occurs at research universities and industry centers not affiliated with government contracts or national projects.

Members of Congress, too, have made budget and other decisions that have affected the quality of the science, technology, and innovation policymaking process. For example, in 1995 Congress abolished the Office of Technology Assessment (OTA), an independent agency noted for its nonpartisan assessment of the public costs and social benefits of new technologies. Prior to the abolition of OTA, President Bill Clinton named Dr. Jack Gibbons, its head, as his new National Science Advisor. Gibbons created a "virtual" National Science and Technology Council within the White House to coordinate science, space, and technology policies across the federal government.

Although Congress has trimmed the U.S. budget, it has not reorganized the policymaking process to take full advantage of the advances—and challenges—in science, technology, and innovation. For better or worse, funding decisions that affect NASA, the National Science Foundation, Department of Energy, Department of Defense, the National Institutes of Health, and other mission agencies remain scattered among 13 Congressional committees and subcommittees. Committee jurisdictions are the product of an embedded, decentralized R&D system that grew piecemeal during the Cold War. These artificial constraints are hard pressed to meet the changing demands of long-term basic research in a post-Cold War environment—or the rapid pace of the new economy.

The Congressional budget process is fractured, but, so far, its failings have not proven lethal. Some take comfort in the fact that the current system allows the private sector to pursue commercial returns without government subsidies or restrictions. Proponents of this laissez-faire approach also correctly point out that the current R&D process avoids the costly mistake of a government bureaucracy backing the wrong technology at the wrong time.

It is equally true, however, that an out-of-date Congressional appropriations process creates unnecessary competition between scientific and non-scientific groups (the committee that oversees housing issues, for example, also sets the level of NASA funding). In addition, the current system pits NASA, the National Institutes of Health, the National Science Foundation, and other science-based mission agencies against one another. Worse, it delays policy decisions on long-range research projects and poorly prepares policymakers to deal with emerging legal, financial, ethical, and security issues raised by advances in science, technology, and innovation.

**The Challenges Ahead**

The impact of these advances on existing governance structures is readily apparent. The Carnegie Commission, the RAND Corporation, and a recent White House "Summit on Innovation: Federal Policy for the New Millennium" have noted that as power shifts from nations to individuals—and from producers to consumers—current top-down policymaking and regulatory systems falter. Such systems cannot adequately track inno-

vation, protect national security, stop (or even define) illegal activities, collect e-commerce taxes, secure individual privacy, enforce intellectual property rights across international borders, or educate and train U.S. citizens for the increasingly competitive global economy.

And many industry experts argue that ongoing revolutions in telecommunications and the Internet pale in comparison to the governance issues posed by advances now on the horizon—in biotechnology, robotics, agriculture, warfare, and pharmacology.

The Center for the Study of the Presidency believes that the next President and his key staff can improve the science, technology, and innovation policy process if they:

- ▶ Strengthen the link between national security issues and basic science and technology R&D;
- ▶ Improve policymaking and funding relations with Congress;
- ▶ Help build international governance structures; and
- ▶ Educate the American public about emerging ethical issues and social choices, and the nation's growing dependence on a technically literate workforce.

These challenges are unlike the strategic reform needed in national security matters. There, the first step should be a comprehensive assessment of U.S. strengths and vulnerabilities in the 21st century. As for upgrading science and technology policy, the next President has several options. He can appoint a National Science Advisor with credibility on Capitol Hill who also has ready access to the Oval Office. And he can reaffirm the direct link between advanced scientific and technological R&D and national security interests.

He can improve funding and policymaking relations with Congress by helping to create coalitions with Members of Congress in support of long-term research that builds the nation's innovative capacity. He can work with Congress to improve the regulatory system. And he can encourage Congress to set up a Joint Committee on Science, Technology, and Innovation that serves as a joint advisory body. During the appropriations process, a fine line must be drawn between "pork barrel politics" and projects that are good for both the national and local economies. However, gaining Congressional support and drawing this line are both essential to building bipartisan support for sustained projects at the frontiers of knowledge.

Building international governance structures is an equally difficult task. Political and military allies quickly can become economic competitors. Moreover, neither the White House nor Congress can stop assaults on U.S. intellectual property rights with the same force (and certainty) as we can manage geo-political events or threats to our national security.

Finally, advances in science and technology have produced vulnerabilities in the U.S. social fabric. At least three major challenges exist: security (cyber-terrorism, bio-weapons), education (American companies must import foreign nationals to meet the growing technology demands), and privacy (even government Web sites are not secure). Here, a Presidential initiative could produce significant insights into how best to proceed, with an eye toward protecting citizens' rights and enhancing our national security.

As a nation, the United States has never been more capable or vulnerable, in large part because of advances in science, technology, and innovation. An improved

policymaking process—led by the next President and working with Congress—could help secure our current technology lead in intelligence, surveillance, communications, and the use of precision force. An improved policy process could help build an "Information Umbrella" that would be as effective as the "Nuclear Umbrella" in deterring conflict and improving the quality of life as we enter the 21<sup>st</sup> century.

<sup>1</sup> Daniel S. Greenberg, *The Politics of Pure Science* (Chicago: The University of Chicago Press, 1967, 1999), p. 79.

<sup>2</sup> *The Birth of NASA: The Diary of T. Keith Glennan*, edited by J.D. Hunley (Washington, DC: NASAHistory Office, 1993), pp. xix-xx.

## LIST OF PARTICIPANTS

*September 22, 2000 Dialogue*

**David Abshire**, President  
Center for the Study of the Presidency

**Jennifer Bond**  
Office of Senator Joseph I. Lieberman

**Lewis Branscomb**, Professor Emeritus  
Public Policy and Corporate Management, John F. Kennedy School of Government  
Harvard University and former Chief Scientist, IBM

**D. Allan Bromley**, Dean of Engineering  
Yale University and former Assistant to the President For Science and Technology

**Kelly Carnes**, Assistant Secretary for Technology Policy  
Department of Commerce

**William Happer**, Professor of Physics  
Princeton University and former Director of Energy Research, Department of Energy

**Thomas M. Kirlin**, Program Director  
Center for the Study of the Presidency

**Kei Koizumi**, Director, R&D Budget and Policy Program  
American Association for the Advancement of Science

**Robert D. Kramer**, Senior Advisor  
Coalition of Service Industries

**Bruce McHenry**, Director  
Richard Lounsbery Foundation, Inc.

**Michael G. Maibach**, Vice President  
Government Affairs, Intel Research Corporation

**Homer A. Neal**  
Department of Physics, University of Michigan

**Stephen Nelson**, Associate Director of the Directorate  
American Association for the Advancement of Science

**Rodney W. Nichols**, President and CEO  
New York Academy of Sciences

**Elizabeth Prostic**, Legislative Aide to Senator John McCain,  
Commerce Committee, and Senator William Frist,  
Subcommittee on Science, Technology & Space

**Gilbert A. Robinson**, National Director  
Center for the Study of the Presidency

**Peter W. Rooney**, Executive Director  
Forum on Technology & Innovation, Council on Competitiveness

**Anne G. K. Solomon**, Senior Associate  
Center for Strategic & International Studies and former Deputy Assistant  
Secretary of State For Science, Technology and Health

**Albert H. Teich**, Director  
Science and Policy Programs, American Association for the Advancement of Science

**James D. Watkins**, U.S. Admiral (Ret.), President  
Consortium for Oceanographic Research and Education and former Chief of Naval  
Operations and former Secretary of Energy

**Charles Weiss**, Distinguished Professor and Director  
Program in Science, Technology and International Affairs, Georgetown University

**William Wells**, Special Assistant to the Chancellor  
University of California-Santa Cruz and former Chief of Staff  
Office of Science and Technology Policy

*Participants in Other Informal Sessions*

**William Bonvillian**, Legislative Director  
Senator Joseph I. Lieberman

**Carl Cannon**, White House Correspondent  
*The National Journal*

**Fred Downey**, National Security Analyst  
Senator Joseph I. Lieberman

**Kimberly Jenkins**, President  
Internet Policy Institute

**Kerri Ann Jones**, former Assistant Director  
Office of Science and Technology Policy

**Thomas Kalil**, Senior Director for Science & Technology  
National Economic Council

**Carl Lingenfelter**, Senior Director  
Kissinger McLarty Associates, Inc.

**Paul Margie**, Legislative Aide on Science & Technology  
Senator John D. Rockefeller IV

**Thomas Ratchford**, former Assistant Director  
Office of Science and Technology Policy

**Stephen Rattien**, Director of Science and Technology Policy  
RAND Corporation

**Jonathan Sallet**, former Director  
Office of Policy and Strategic Planning, Department of Commerce

**James Turner**, Minority Chief Counsel  
House Science Committee

**Deborah L. Wince-Smith**, Senior Fellow  
Council on Competitiveness and former Assistant Secretary for Technology Policy,  
Department of Commerce

**John Yochelson**, President  
Council on Competitiveness

## ACKNOWLEDGEMENTS

The Center for the Study of the Presidency wishes to thank:

- ▶ D. Allan Bromley and Lewis Branscomb for serving on our Council of Scholars;
- ▶ Albert Teich and Steve Nelson for opening the doors of the American Association for the Advancement of Science for this gathering;
- ▶ Anne Solomon, former Deputy Assistant Secretary of State for Science, Technology and Health, for helping us identify key participants in this discussion; and
- ▶ The Richard Lounsbery Foundation, Inc. for funding this effort.





CENTER FOR THE STUDY OF THE PRESIDENCY  
1020 Nineteenth Street, NW · Suite 250  
Washington, DC 20036  
202-872-9800  
[www.thePresidency.org](http://www.thePresidency.org)

