United States General Accounting Office

GAO

Report to Congressional Requesters

January 1998

BEST PRACTICES

Elements Critical to Successfully Reducing Unneeded RDT&E Infrastructure

GAO/NSIAD/RCED-98-23

GAO

United States
General Accounting Office
Washington, D.C. 20548

National Security and
International Affairs Division

B-277529

January 8, 1998

The Honorable Sam Brownback
Chairman, Subcommittee on Oversight of Government
Management, Restructuring and the District of Columbia
Committee on Governmental Affairs
United States Senate

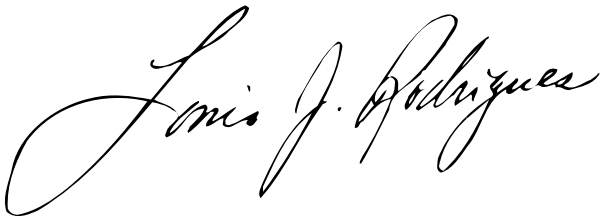
The Honorable John R. Kasich
Chairman, Committee on the Budget
House of Representatives

In response to your request, we reviewed a number of issues related to the federal government's research, development, test, and evaluation (RDT&E) infrastructure. We briefed your staffs previously and this report contains the final results of our review.

This report, in laying out a framework within which changes to the federal RDT&E infrastructure can be accomplished and around which debate about the need for those changes can occur, (1) examines the condition of existing infrastructure, (2) analyzes the approaches used by organizations outside of the federal government to realign RDT&E infrastructure, and (3) compares those approaches to federal agency efforts. This approach, if implemented fully by federal agencies, could help focus agencies' efforts in research and development, reduce unneeded infrastructure governmentwide, and free up resources necessary for scientific programs and related equipment.

We are sending copies of this report to other interested congressional committees and the Secretaries of Agriculture, Commerce, Defense, Education, Energy, Health and Human Services, Interior, Justice, State, Transportation, Treasury, and Veterans' Affairs. We also are sending copies to the Secretaries of the Army, the Navy, and the Air Force; the Director, Office of Management and Budget; the Director, Centers for Disease Control and Prevention; the Director, Drug Enforcement Administration; the Director, Environmental Protection Agency; the Director, Food and Drug Administration; the Administrator, National Aeronautics and Space Administration; the Director, National Institutes of Health; the Director, National Science Foundation; the Director, Nuclear Regulatory Commission; the Director, Office of Personnel Management; the Director, Office of Science and Technology Policy; the Director, Smithsonian Institution; and the Director, Tennessee Valley Authority. We will make copies available to other interested parties upon request.

This report was prepared under the direction of Katherine V. Schinasi, Associate Director, Defense Acquisitions Issues, who may be reached on (202) 512-4841 if you or your staff have any questions. Other major contributors to this report are listed in appendix V.



Louis J. Rodrigues
Director, Defense Acquisitions Issues
National Security and
International Affairs Division

Victor S. Rezendes
Director, Energy, Resources, and Science Issues
Resources, Community, and
Economic Development Division

Executive Summary

Purpose

The federal research, development, test, and evaluation (RDT&E) establishment is in transition. The missions of its research and development (R&D) laboratories and test and evaluation (T&E) centers are being redefined within a changed environment while these agencies compete for scarce federal resources. As future pressures to reduce discretionary spending increase, a greater share is devoted to operating and maintaining an aged, inefficient, and costly infrastructure at the expense of research and development.

In an effort to identify alternatives for achieving cost-saving efficiencies while maintaining high quality research and development, the former and current Chairmen of the Subcommittee on Oversight of Government Management, Restructuring and the District of Columbia, Senate Committee on Governmental Affairs, and the Chairman of the House Committee on the Budget asked the U.S. General Accounting Office (GAO) to review a number of issues related to the federal RDT&E infrastructure. GAO (1) examined the condition of existing infrastructure, (2) analyzed approaches used by organizations outside of the federal government to realign RDT&E infrastructure, and (3) compared those approaches to federal agency efforts.

GAO focused on efforts by the Departments of Energy and Defense and the National Aeronautics and Space Administration (NASA) to streamline their RDT&E infrastructure because they represent about 72 percent of all federal investment in research and development and own most of the RDT&E infrastructure. This report lays out a framework within which changes to the federal RDT&E infrastructure can be accomplished and around which debate about the need for those changes can occur.

Background

For fiscal year 1997, the U.S. Congress appropriated $72 billion for the conduct of federal research and development (including Defense Department test and evaluation), about 14 percent of federal discretionary spending. Although that amount is expected to increase slightly in fiscal year 1998, budget projections indicate a decline in the future.

Twenty-two federal agencies receive R&D funding, and 17 of them own 514 R&D laboratories and T&E centers. These RDT&E facilities support six fundamental research areas: national security, health and safety, energy security, environmental protection and cleanup, industrial competitiveness, and fundamental science. Much of the R&D funding the Congress provides to agencies is passed on to laboratories that other

agencies, universities, or the private sector operate. For example, the Department of Energy carries out over $1 billion in research and development for other agencies each year and its three weapons laboratories receive more than one-half of their R&D funding from the Defense Department as "work for others." Thus, agencies' research activities often are intertwined. The Research and Development in the United States (RaDiUS) database, newly created by The RAND Corporation's Critical Technologies Institute, compiles systematically data on the conduct of federal R&D investments. A review of RaDiUS database activities raises concerns that duplication within and across agencies may be prevalent and identifies opportunities for collaborations that are being missed.

The end of the Cold War and budget constraints led to calls to streamline federal organizations, including the RDT&E establishment, eliminate unneeded infrastructure, and reduce costs. In response, federal agencies have undertaken some actions. For example, the Office of Science and Technology Policy and the Office of Management and Budget have engaged the Departments of Energy and Defense and NASA in internal reviews of RDT&E infrastructure. While the Departments of Energy and Defense and NASA have conducted intra-agency reviews and reduced personnel levels, they have made only limited reductions in RDT&E infrastructure.

Results in Brief

The Departments of Energy and Defense and NASA have attempted to reduce their excess laboratory capacity and associated costs, but could achieve even further reductions in their RDT&E infrastructure. In recent years, more than 150 studies, panels, commissions, task forces, and GAO reports have cited excess capacity, poor maintenance, duplicative activities, and the failure of the federal RDT&E establishment to adapt missions and programs to the changing world environment. For example, according to the 1995 Task Force on Alternative Futures for the Department of Energy National Laboratories (the Galvin Task Force), Energy's laboratory infrastructure was oversized for its existing mission and its productivity was lagging. In addition, even though the Defense Department will have closed 62 RDT&E sites and activities at host sites after implementing fully all four base realignment and closure (BRAC) rounds, a 1995 Defense Department estimate indicates the Department still will have an estimated 35-percent excess capacity in its laboratories and an estimated 52-percent excess capacity in its T&E centers in the air vehicles, electronic combat, and armaments/weapons areas. While NASA closed a

number of individual sites and facilities in recent years, it has yet to consolidate or close any of its major laboratory facilities. All of the individual agency actions were taken independent of one another and, to date, have resulted in limited infrastructure reductions and cost savings. Little success has been achieved in attempts to consolidate federal RDT&E infrastructure across agency boundaries.

The federal sector is not alone in its need to reduce RDT&E infrastructure in response to fiscal constraints and a changing world environment. In recent years, corporate and foreign government organizations have restructured successfully their laboratory operations to achieve cost-saving efficiencies. GAO examined restructuring efforts by two organizations—the Boeing Company Defense & Space Group (recently renamed the Boeing Company Information, Space, & Defense Systems Group) and the Defence Research Agency within the British Ministry of Defence—both of which reduced substantially their laboratories' infrastructure and costs. Officials responsible for those successful efforts identified five critical elements that were key to their success. The elements were (1) a "crisis" that served as a catalyst to spark action; (2) an independent authority to overcome parochialism and political pressures that impede decision-making; (3) core RDT&E missions focused to support the organizations' overall goals and strategies; (4) clear definitions that delineate fully the existing infrastructure needed to support those missions; and (5) accurate, reliable, and comparable data that capture total infrastructure costs and utilization rates for each affected activity. They further asserted that their success depended on the use of all five elements in concert.

Many of the elements that made the Boeing Company Defense & Space Group's and the Defence Research Agency's laboratory consolidations a success generally are lacking in U.S. federal agencies' efforts. In general, budgetary concerns have not, to date, created a catalyst to focus and redefine missions and then reduce the supporting RDT&E infrastructure within the Departments of Energy and Defense and NASA. The missions of R&D laboratories and T&E centers are being redefined as agencies compete for scarce federal resources. Without concurrent reductions in infrastructure, this perpetuates excess capacity and contributes to the retention of old, poorly maintained facilities. Moreover, agencies are not collecting the information they need to assess the full scope and cost of their RDT&E infrastructure. Further, there has been little effort to address mission and infrastructure issues across agencies. According to U.S. officials that direct federal RDT&E activities, in some cases resistance to inter- and intra-agency restructuring of RDT&E activities has stymied the

thrust of recent streamlining efforts. The one exception, noted in this report, is the Defense Department's Vision 21 process, a 5-year plan directed by the Congress to consolidate and restructure the Defense Department's R&D laboratories and T&E centers. The Vision 21 process sought to incorporate an independent authority and comprehensive analyses of full operating costs along with the relatively strong mission focus of its RDT&E infrastructure.

Balancing the federal RDT&E infrastructure with current and future missions is a complex problem that has proven intractable largely because of the limited scope of past efforts. Individual agency initiatives have produced some results and while such efforts to achieve management efficiencies should continue, they also need to proceed within the context of a more complete understanding of governmentwide implications. GAO's review shows that independent agency efforts have not been sufficient to date to accomplish the level of improvements warranted. An independently directed approach to governmentwide restructuring by looking at the RDT&E infrastructure of individual agencies in support of the government's broader strategies and missions has not been attempted.

Principal Findings

Agencies Have Not Reduced Infrastructure in Line With Changing Missions

The energy crisis of the 1970s, the end of the Cold War in the late 1980s, the desire for a smaller and more efficient government, and the agreement to achieve a balanced budget by fiscal year 2002 have provided the impetus to change federal RDT&E missions. More than 150 reports cited the need for the Departments of Energy and Defense and NASA to improve efficiency and effectiveness at their RDT&E facilities. Some studies addressed the need to ensure that changing activities are tied closely to core missions and noted that to do so, in many cases, would result in RDT&E infrastructure reductions.

The President's National Science and Technology Council concluded in its 1995 Interagency Federal Laboratory Review Final Report that, given post-Cold War conditions and fiscal restraints, the Departments of Energy and Defense and NASA must downsize and restructure RDT&E facilities, define laboratory missions more clearly, manage laboratories better, and eliminate needless redundancies. Further,

- The Galvin Task Force reported that Energy's facilities could be restructured productively by eliminating obsolete and redundant missions and supporting infrastructure.
- Although it did not make specific consolidation recommendations for NASA infrastructure, the 1995 NASA Federal Laboratory Review (the Foster Task Force) reported that it found major areas of "duplication of capabilities." NASA, recognizing its excess capacity, developed plans to consolidate and close some of its facilities to reduce its RDT&E infrastructure, setting a "stretch" goal to decrease the current replacement value of its facilities by 25 percent by the end of fiscal year 2000.
- The Defense Department's 1995 Directions for Defense: Report of the Commission on Roles and Missions of the Armed Forces identified many opportunities to integrate activities across service lines rather than RDT&E infrastructure reduction.
- The March 1997 Status of Federal Laboratory Reforms, prepared as an update to the National Science and Technology Council report, recognizes improvements but cites a continued need for reform.

Despite these and other reports citing the need for reductions, the three agencies still maintain excess, aging, and deteriorating RDT&E infrastructure that they find increasingly difficult to maintain and support. As of 1993, more than one-half of federal laboratory floor space was over 30 years old, some of it ill-equipped for today's R&D activities. For example, many of Energy's older R&D laboratories were not designed to meet today's (1) need for precise measurements by considering factors like temperature, humidity, and vibrations and (2) health and safety code requirements. NASA's planned $2.8 billion reduction in the current replacement value of its facilities may only result in about $250 million in operations and maintenance cost reductions through fiscal year 2000. Moreover, the maintenance of excess infrastructure, while at the same time modernizing other infrastructure, may lead to higher operational and repair costs. Long-standing backlogs of the maintenance and repair of Defense Department R&D facilities have reportedly worsened as required upkeep and modernization are deferred. The lack of repair of aged facilities may reflect the realities of recent deficit reduction efforts and associated funding priorities. In addition, excess capacity and aged facilities in Energy, for example, may continue to exist because facilities suffer from toxic contamination that cannot be disposed of currently or is too costly to decontaminate and decommission.

Common Elements Were Used in Successful Downsizing

The Boeing Company Defense & Space Group and the Defence Research Agency restructured successfully their laboratory operations by using five critical elements. According to officials managing these restructurings, their success depended on using all five of the elements in concert.

As a result, the Boeing Company Defense & Space Group reduced the number of its laboratories from 456 to 133 in about 4 years, reduced square footage requirements significantly, and saved about $100 million in operating costs. Similarly, the British Ministry of Defence reorganized its four research establishments into a single agency, reduced the number of laboratories from 54 to 35, and reduced overhead costs by more than $100 million.

In the Boeing Company Defense & Space Group and the Defence Research Agency restructuring efforts, respectively, "crises" that served as catalysts to spark change were a refocused strategic plan for the parent organization and a shift in national economic priorities coupled with the likelihood of severe budget cuts. In each case, an independent authority outside of the organizations' normal decision-making chain-of-command, free from parochial or political pressures, was instrumental in precipitating change and ensuring the efficiency and integrity of data collection and analysis. At the Boeing Company Defense & Space Group, this authority reported directly to the company's president, and at the Defence Research Agency, the authority reported to the Secretary of State for Defence. Additionally, both organizations (1) developed core missions and aligned them with their customers' needs, (2) determined what infrastructure they had and how it supported their missions, and (3) collected accurate, reliable, and comparable data about their facilities across-the-board to reduce confusion, prevent facility officials from claiming they should be exempted from restructuring, and reduce their assertions that the facilities were "unique" or "incomparable."

With this information, both organizations were able to determine how best to restructure their programs and activities and reduce their infrastructure and its costs.

Critical Elements Were Not Present in Recent Attempts to Reduce Federal RDT&E Infrastructure

The Departments of Energy and Defense and NASA have attempted to reduce their excess laboratory capacity and associated costs generally by conducting intra-agency reviews, reducing personnel levels, and making limited reductions in RDT&E infrastructure. However, these agencies generally have not taken the steps necessary to ensure success and few of

the critical elements used in successful consolidations we reviewed have been applied. For example, to date, no catalyst to spur action, such as budgetary constraints imposed on agencies, has proven to be sufficient impetus for a major restructuring of federal RDT&E facilities.

Although the Office of Science and Technology Policy and the Office of Management and Budget have engaged the Departments of Energy and Defense and NASA in internal reviews, no independent authority has undertaken a structured approach for streamlining the overall federal RDT&E infrastructure, that is, looking at the infrastructure of individual agencies in support of the government's broader strategies and missions. In addition, individual agency efforts have been limited. For example, the September 1997 plans submitted by these agencies as mandated by the Government Performance and Results Act of 1993 (the Results Act) did not use cross-agency criteria for assessing missions as required by the Results Act. Further, GAO found that agency officials have few incentives or insufficient authority to make significant and far-reaching changes or to implement the recommendations contained in a number of studies that have addressed this issue.

Structural barriers, along with parochialism, have kept the Energy Department from translating changes in mission to reductions of its existing RDT&E infrastructure. For example, although the Energy Department established a Laboratory Operations Board to streamline its laboratory infrastructure, in its current study, the Board is not evaluating any of the larger, multipurpose laboratories that offer the greatest opportunity to reduce unneeded and duplicative RDT&E infrastructure. The Defense Department achieved only limited results in trying to reduce RDT&E infrastructure through the 1995 BRAC round because, due to service parochialism, the services would not agree on cross-service reviews of the capabilities of R&D laboratories and T&E centers together. In fiscal year 1996, the Defense Department and NASA agreed to form six test facilities alliances in an attempt to work together more efficiently and effectively. However, in one of the few attempts to address interagency redundancies, the Defense Department and NASA excluded certain infrastructure from review and asserted that the existing infrastructure was, in general, the minimum they needed to sustain the technology base. Thus, no significant reductions were achieved.

Since each agency, in essence, operates its RDT&E activities independently, the conditions for overlap and duplication are prevalent. In some cases, agencies' new missions and objectives brought them into competition.

Both NASA and the Air Force have test centers that are competing with each other to test the engines for a space launch system. Also, some Energy Department laboratories are competing with private industry, for example, by building facilities to produce medical isotopes.

Neither the Energy Department nor NASA has conducted a full, rigorous inventory of its RDT&E infrastructure or its costs. In fact, NASA's infrastructure current replacement value increased by about 14 percent between fiscal years 1990 and 1995, indicating that NASA was building new facilities faster than it was consolidating or closing older ones. Although the Defense Department was required to delineate fully the scope of its RDT&E infrastructure during four previous BRAC rounds, it has not yet determined the true costs of operating its RDT&E facilities because available cost data and information on utilization rates are considered inaccurate and unreliable.

Ongoing Approaches in the Restructuring Process

Some individual agencies have developed initiatives that incorporate some of the elements necessary for restructuring successfully their RDT&E infrastructures, but none have implemented them fully. For example:

- The Defense Department developed Vision 21, a 5-year plan directed by the Congress to consolidate and restructure the Defense Department's R&D laboratories and T&E centers. Significantly, the Vision 21 process included a request to the Congress for an independent authority (like that of the defense base closure and realignment commissions) as the key implementing mechanism. However, the Department now asserts that, based on the results of the broader Quadrennial Defense Review, implementation of the Vision 21 plan should be incorporated into future BRAC rounds.
- NASA, which has identified infrastructure cuts as a potential source of cost reductions, recently began an effort designed to improve the reliability of data needed to determine its RDT&E infrastructure costs. It remains to be seen whether this effort will reach fruition.
- NASA and Defense Department alliances are working to better coordinate RDT&E activities in several categories of major test facilities. However, reducing the infrastructure has not been explicitly stated as an expected outcome of better coordination. Further, NASA and Defense Department cooperative activities under the alliances have been limited and several have not yet convened.

- The Office of Science and Technology Policy recently established the National Science and Technology Council Interagency Working Group to review barriers to and broaden federal laboratory reform.

These efforts, although helpful, fall short of the elements found in the models.

Observations

The RDT&E infrastructure problem is long-standing, complex, and controversial. Balancing the federal RDT&E infrastructure with current and future missions is a complex problem that has proven intractable largely because of the limited scope of past efforts. Even in the current climate of pressure to reduce discretionary spending, budget reductions have not served as a catalyst for reductions.

Ongoing individual agency initiatives are helpful but will not likely be sufficient to accomplish significant improvements. Additional efforts across federal agencies would offer a more meaningful solution. The critical elements of the models GAO analyzed, when compared to ongoing efforts in the federal government, suggest approaches that could prove successful if implemented fully.

Consensus must be reached between the Congress and the administration that significant changes in the RDT&E infrastructure would better position the RDT&E complex to support current and future science priorities through a more efficient and rational RDT&E infrastructure. Developing the foundation necessary to support an RDT&E infrastructure restructuring process across the government could begin in the executive branch with two agencies: (1) the Office of Science and Technology Policy, which has technical cognizance across the federal RDT&E arena but no direct means to effect change, and (2) the Office of Management and Budget, which is responsible for helping to maintain effective government by reviewing the organizational structure and management procedures of executive branch agencies and developing efficient coordinating mechanisms to implement government activities and expand interagency cooperation. However, the Office of Management and Budget, in responding to a draft of this report, said that it prefers continuance of the current agency-by-agency approaches until they are completed.

Ultimately, however, many of the structural and other barriers that exist between agencies go beyond those found at the agency level. Initiating a governmentwide process that includes all five model elements in concert

could mitigate virtually all of the parochial concerns that stymied past efforts to restructure. Establishing an independent decision-making authority could ensure that all elements of the process are administered fairly. In implementing the process described in the model, such an authority could benefit from information developed through ongoing initiatives, such as proper implementation of the Results Act, to help coordinate missions and goals of individual agencies that are involved in crosscutting program areas and balancing individual agencies' multiple strategic goals. An independent authority also could benefit from lessons learned during the federal government's past uses of independent authorities, such as the defense base closure and realignment commissions, and from activity and budget details about research and development accumulated in the RaDiUS database.

The need to reduce RDT&E infrastructure in balance with mission requirements is a long-standing and complex issue. Agency efforts to date, while encouraging in some cases, are too narrowly focused and likely will promote or sustain duplication and excess capacity. Further, many of the elements employed as best practices by other organizations are neither integral nor readily available to federal agencies. Thus, a governmentwide approach, which could focus both within and across agencies, may offer a viable alternative and increase the likelihood of successfully reshaping the nation's RDT&E infrastructure to meet current and future needs. While agencies should be encouraged to continue ongoing efforts to improve efficiencies in the management of RDT&E infrastructure, emphasizing interagency approaches could be a significant improvement in this arena.

Matters for Congressional Consideration

To help craft a more efficient structure to support future federal RDT&E efforts, the Congress may wish to begin a process to reduce the federal RDT&E infrastructure that applies collectively the critical elements identified in this report. This process could be designed to look both within and across agencies to eliminate unnecessary mission overlap and duplication and the resulting excess infrastructure capacity. Lessons learned from the federal government's past uses of independent, external authorities could be used to structure this process. Ongoing restructuring efforts of the agencies could be assessed for their potential to contribute to overall RDT&E infrastructure restructuring. The RaDiUS database could provide preliminary inputs indicating possible duplication of effort. The Government Performance and Results Act of 1993 provides an established legislative framework that addresses agencies' missions and performance

and may be useful in focusing specifically on crosscutting agency missions that determine the requirements for RDT&E infrastructure.

Recommendations

GAO is making no recommendations in this report.

Agency Comments and GAO's Evaluation

Specific comments from the Office of Management and Budget, Energy Department, NASA, and the Defense Department and GAO's evaluation of them have been incorporated throughout this report. Office of Management and Budget, Energy Department, NASA, and Defense Department comments are reprinted in appendixes I, II, III, and IV, respectively.

All four agencies indicated that the report did not give sufficient credit for actual, ongoing, and planned infrastructure reductions they have undertaken. To illustrate further the infrastructure reduction steps the agencies have initiated, GAO has added information that recognizes other agency plans and activities.

Although the agencies acknowledge that they need to reduce further their infrastructure, there was no universal view expressed as to how to effect significant change in the federal RDT&E infrastructure. For example, while each of the four agencies recognized the importance of mission focus in their comments, they had varying perspectives regarding the efficacy of the model's other critical elements. For example, the Department of Energy does not believe a "crisis" is needed to spur action, stating that changing missions and budget reductions provide the external pressure needed to get change. NASA agreed with the need for accurate and reliable data about the true cost of operating RDT&E facilities and pointed out that it is developing an integrated financial management system to gather such data. The Department of Defense agreed with GAO's conclusion regarding the need for an independent, BRAC-like authority to effect significant change. The Department of Energy and NASA, on the other hand, believe they can make, or have already made, appropriate changes regarding the future strategies for their RDT&E infrastructure. Lastly, the Office of Management and Budget believes each agency should rationalize individually its infrastructure before a more complex interagency approach is attempted. The Office of Management and Budget agrees, however, that an interagency approach is needed. With respect to defining fully the scope of the RDT&E infrastructure, the agencies comments' largely were silent.

After reviewing carefully the agencies' comments, GAO believes that the comments generally reflect the parochialism and structural and organizational barriers discussed in the report. For example, when the agencies' comments discussed planned RDT&E infrastructure reductions, those plans were limited in scope and focused exclusively on internal reductions. While acknowledging, in some cases, overlapping capability and excess capacity in RDT&E infrastructure, Departments of Energy and Defense and NASA comments generally reflect their belief that (1) their missions and associated infrastructure are unique, (2) they have planned to do enough restructuring and consolidation on their own, and (3) they already coordinate among agencies to the maximum extent practicable.

The Office of Management and Budget states that although additional steps are necessary to ensure that maximum impact is achieved through restructurings, agencies should downsize first before crosscutting analysis is conducted. GAO believes that, to the extent the agencies actively pursue interagency approaches as they restructure their respective RDT&E infrastructures, the potential for success in ongoing efforts may be increased. As GAO has reported previously, decision-making on the size and scope of infrastructure needed by an individual agency in the absence of information and consideration of related missions and activities has resulted in decisions that are not rational nor cost effective when looked at from a broader perspective.[1] GAO and the agencies agree that maintaining more RDT&E infrastructure than warranted by requirements does not well serve the nation's research needs and that successful consolidation and reduction efforts are key ingredients to assuring adequate resourcing of future research in science and technology. GAO's perspective differs from the agencies' in that we believe the best way to achieve this end is through a governmentwide restructuring process.

The Department of Energy also questioned the basic applicability of the best practices model, stating that the scale of the successful consolidations cited by GAO was small in comparison to the Energy Department's RDT&E laboratory system. However, the Department of Defense, which is a much larger organization, already has incorporated many of the elements of the model in its BRAC rounds and is proposing many of the elements for its Vision 21 process. Further, while it is self-evident that differences in scale (and complexity) may make it more difficult to overcome challenges and barriers, these differences do not

[1]See, for example, Electronic Combat: Consolidation Master Plan Does Not Appear to Be Cost-Effective (GAO/NSIAD-97-10, July 10, 1997).

negate the validity of the process for different types of organizations nor of the key elements employed in successful consolidations.

NASA further commented that it was concerned about GAO publishing the report because, in NASA's opinion, the report did not meet GAO's normal standards, largely because NASA believes the report overlooks its accomplishments in reducing RDT&E infrastructure while focusing on governmentwide issues. GAO believes its report does recognize NASA's accomplishments, while also pointing out that NASA's most comprehensive infrastructure study—its 1995 Zero-Base Review—began with the premise that to meet its mission, NASA needed the existing infrastructure. The model presented in this report provides a different approach by suggesting that decisions regarding mission be made first and then infrastructure aligned to support those missions.

Contents

Executive Summary		3
Chapter 1 Introduction		20
	The Federal Government's Role in Research, Development, Test, and Evaluation	20
	Federal R&D Budgets	24
	Objectives, Scope, and Methodology	28
Chapter 2 Condition of the Federal RDT&E Infrastructure		32
	Studies Show That a Reduction of RDT&E Infrastructure Is Needed	32
	Agencies Maintain Large RDT&E Infrastructures	33
	Multiple Agencies Conduct Research in Similar Programs	38
	Repairs of Aging RDT&E Infrastructure Are Backlogged	40
Chapter 3 Approaches Other Organizations Have Taken to Reduce RDT&E Infrastructure Successfully		42
	Consolidation of RDT&E Facilities at the Boeing Company Defense & Space Group and the British Ministry of Defence's Defence Research Agency	42
	Five Elements Critical to the Boeing Company Defense & Space Group and British Ministry of Defence Restructuring	43
Chapter 4 Federal Agencies' Approaches to Reducing RDT&E Infrastructure Lacked Critical Elements		48
	The Department of Energy's Restructuring Efforts	48
	NASA's Restructuring Efforts	51
	The Department of Defense's Restructuring Efforts	55
	Conclusions	60

Chapter 5 Observations and Matters for Congressional Consideration 63
Observations 63
Matters for Congressional Consideration 65
Agency Comments and GAO's Evaluation 65

Appendixes
Appendix I: Comments From the Office of Management and Budget 70
Appendix II: Comments From the Department of Energy 75
Appendix III: Comments From the National Aeronautics and Space Administration 80
Appendix IV: Comments From the Department of Defense 83
Appendix V: Major Contributors to This Report 86

Glossary 87

Related GAO Products 92

Tables
Table 1.1: Type of Federally Owned R&D Laboratory by Agency 21
Table 1.2: Approximate Number of Research and Support Personnel in DOE, NASA, and DOD Laboratories and Centers 24
Table 2.1: Research Topics Involving Multiple Agencies 39

Figures
Figure 1.1: Number of RDT&E Facilities in Each State 23
Figure 1.2: Agency-by-Agency Appropriation for the Conduct of Federal Research and Development for Fiscal Year 1997 26
Figure 1.3: Projected Changes in Federal R&D Funding for Fiscal Years 1997-2002 27
Figure 2.1: Lawrence Livermore National Laboratory, Livermore, California 34
Figure 2.2: NASA Ames Research Center, Moffett Federal Airfield, California 36
Figure 2.3: Wright Laboratory, Wright-Patterson Air Force Base, Ohio 37

Abbreviations

AID	Agency for International Development
AIDS	acquired immune deficiency syndrome
BRAC	base realignment and closure
DDR&E	Director, Defense Research and Engineering
DED	Department of Education
DERA	Defence Evaluation and Research Agency
DHHS	Department of Health and Human Services
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
DOI	Department of the Interior
DOJ	Department of Justice
DOT	Department of Transportation
DRA	Defence Research Agency
DVA	Department of Veterans' Affairs
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
FFRDC	federally funded research and development center
GAO	General Accounting Office
HIV	human immunodeficiency virus
MOD	Ministry of Defence
NASA	National Aeronautics and Space Administration
NSF	National Science Foundation
NSTC	National Science and Technology Council
OMB	Office of Management and Budget
OSTP	Office of Science and Technology Policy
R&D	research and development
RaDiUS	Research and Development in the United States
RDT&E	research, development, test, and evaluation
SSMP	Stockpile Stewardship and Management Program
T&E	test and evaluation
USDA	U.S. Department of Agriculture

Introduction

For fiscal year 1997, the Congress appropriated $72 billion for the conduct of federal research and development (R&D), which included Department of Defense (DOD) test and evaluation (T&E)—only about 4 percent of the federal budget but about 14 percent of the government's discretionary budget. To balance the budget, the government is cutting discretionary spending, and R&D funding is expected to decline by about 14 percent between fiscal years 1997 and 2002. Twenty-two federal departments and agencies receive federal R&D funding, and 17 of the 22 own 514[1] R&D laboratories and T&E centers. Within this vast network, DOD, the Department of Energy (DOE), and the National Aeronautics and Space Administration (NASA) receive about three-quarters of the R&D funding and own most of the research, development, test, and evaluation (RDT&E) infrastructure.

The Federal Government's Role in Research, Development, Test, and Evaluation

Investment in—and performance of—the science mission involves a complex web of government, industrial, and academic organizations. Funds from these three sources were estimated to total more than $184 billion[2] in 1996.[3] While industry contributes a larger share overall, federal research is essential where the risk is too great for private companies to make investments or where the public benefit is large despite small private return. For example, about 60 percent of the basic research[4] performed in the United States is funded by the federal government. U.S. industry also depends heavily on federal research and development for the innovations that drive productivity and new products.

Twenty-two federal departments and independent agencies receive federal R&D funding for projects in six fundamental research areas: national security, health and safety, energy security, environmental protection and cleanup, industrial competitiveness, and fundamental science. As shown in table 1.1, 17[5] of the 22 organizations own 514 RDT&E facilities, 62 of which

[1]See Federal R&D Laboratories (GAO/RCED/NSIAD-96-78R, Feb. 29, 1996). Although this report lists 515 federal R&D laboratories, DOD officials indicated that one DOD R&D laboratory has since closed.

[2]About 62 percent of this total is funded by industry, about 34 percent is funded by the federal government, and the remaining 4 percent is funded by universities and nonprofit organizations.

[3]The National Science Foundation collects these data by different means and represents expenditures during the calendar year; therefore, they do not correlate with the federal budget data reported elsewhere in this report, which are shown in budget authority by fiscal year.

[4]Government-funded basic research, performed mostly by university laboratories, explores the fundamental aspects of science without specific application.

[5]The Departments of Housing and Urban Development and Labor, the U.S. Agency for International Development, the U.S. Postal Service, and the Social Security Administration receive federal funding for research and development but do not own any RDT&E facilities.

are operated by nongovernment entities—for-profit businesses, universities, or other nonprofit organizations under contracts or cooperative agreements with a federal agency, some of which are federally funded research and development centers (FFRDC). Sixty-five of these RDT&E facilities also operate a total of 221 additional satellite locations. Much of the R&D funding the Congress provides to agencies is passed on to laboratories and centers operated by other agencies, universities, or the private sector. For example, DOE carries out over $1 billion in research and development for other agencies each year. Most of the federal government's research and development is conducted under contract with industry and universities—not in government-owned and -operated laboratories.

Table 1.1: Type of Federally Owned R&D Laboratory by Agency[a]

Federal agency	Government-operated laboratories	Nongovernment-operated laboratories
Department of Agriculture[b]	185	0
Department of Commerce	38	0
DOD	51	16
Department of Education	0	10
DOE	7	26
Department of Health and Human Services	18	1
Department of the Interior	20	0
Department of Justice	2	0
Department of Transportation	5	1
Department of the Treasury	0	1
Department of Veterans' Affairs	102	0
Environmental Protection Agency	11	0
NASA	9	1
National Science Foundation	0	5
Nuclear Regulatory Commission	0	1
Smithsonian Institution	2	0
Tennessee Valley Authority	2	0
Total	**452**	**62**

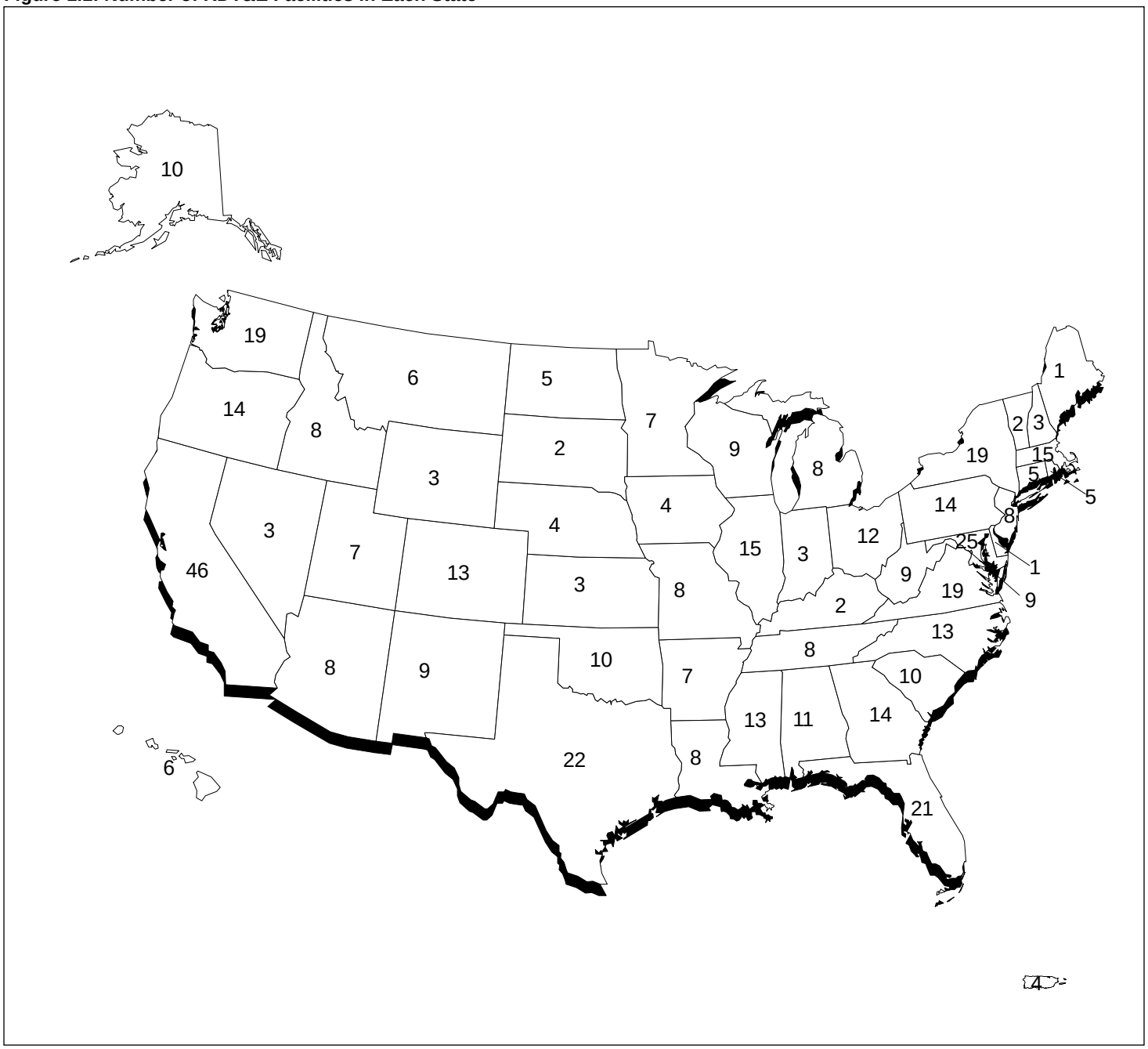
[a]Includes T&E centers.

[b]Although the Department of Agriculture reported owning the most laboratories, its laboratories are among the smallest in size and have relatively small operating budgets.

The federal RDT&E network is complex and definitions of what constitutes RDT&E infrastructure can vary significantly. For example, the number of laboratories counted depends upon the definition used for the term "laboratory." In fact, not all agencies use that term. A NASA "Center of Excellence" is an overall capability that resides within a center or laboratory.[6] Likewise, DOD differentiates strictly its R&D laboratories from its T&E centers. The "infrastructure" associated with these facilities often has varying definitions. (See the glossary for agency definitions of key terms.) Figure 1.1 shows the number of RDT&E facilities located in each of the 50 states (as of February 1996).

[6]A Center of Excellence is a laboratory that specializes in an area of research and development and is sufficiently proficient that other organizations will rely on the Center of Excellence to perform their required work in that research and development area.

Figure 1.1: Number of RDT&E Facilities in Each State



Note: Three Department of Agriculture laboratories are located in Argentina, France, and Panama and two Navy medical research institutes are located in Indonesia and Egypt.

DOD, NASA, and DOE combined own most of the federal RDT&E infrastructure. This infrastructure consists of thousands of buildings and large acreage of government property. More than 180,000 research and support personnel work in these facilities (see table 1.2). Their numbers vary greatly by agency and by facility. DOD facilities may have as few as 18 or as many as 20,000 employees. NASA facilities may have as few as 206 or as many as 6,104 employees. DOE facilities may have as few as 432 or more than 10,000 employees.

Table 1.2: Approximate Number of Research and Support Personnel in DOE, NASA, and DOD Laboratories and Centers

Agency[a]	Research personnel	Support personnel	Total personnel
DOD	39,209	61,272	100,481
NASA	11,150	8,067	19,217
DOE	38,791	22,908	61,699

[a]Technical staff are included in the research category for DOE and the support category for DOD and NASA.

Source: DOD, NASA, and DOE.

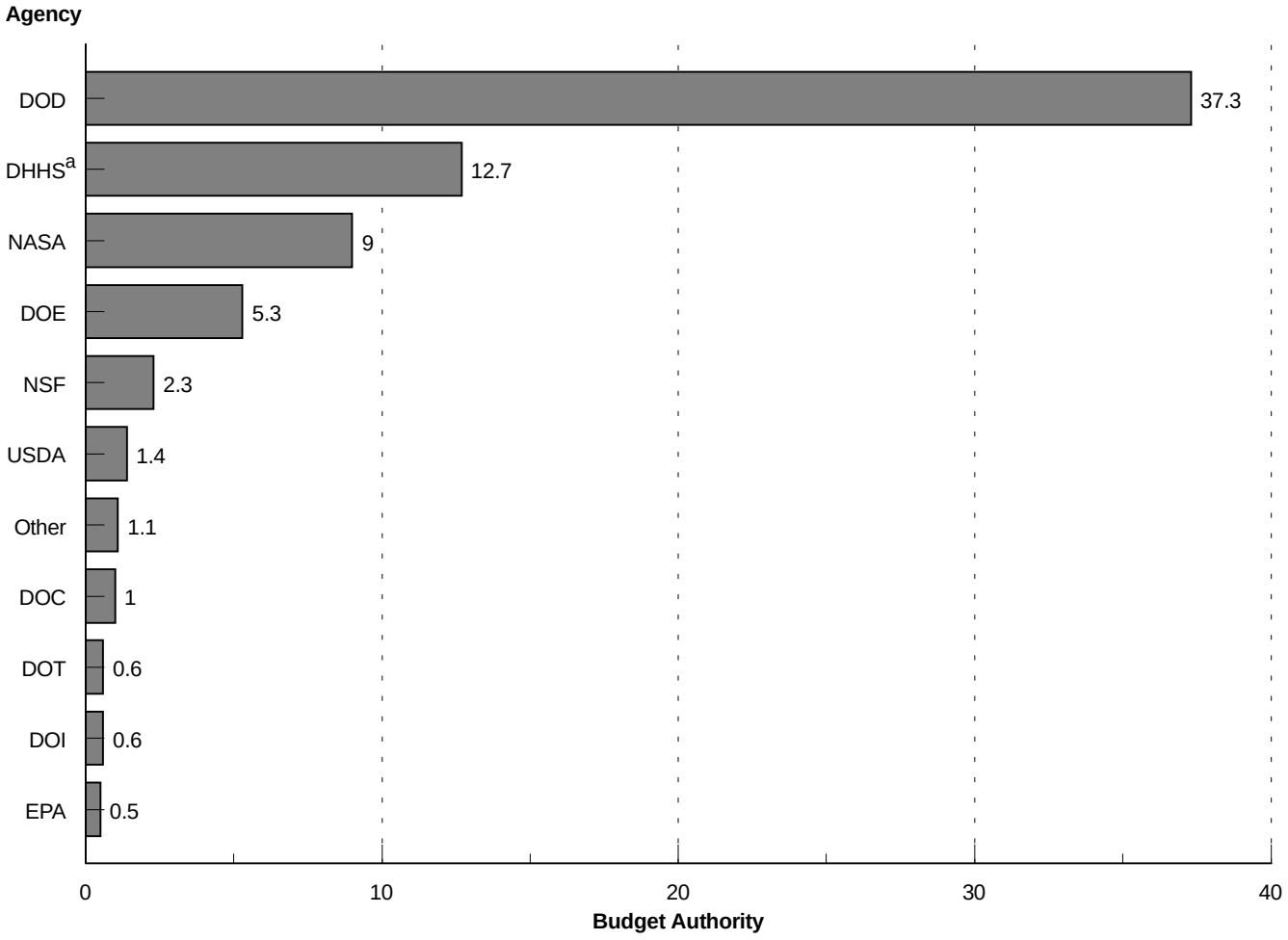
Federal R&D Budgets

Funding for R&D is not identified as a single line item in the federal budget. Instead, it is appropriated by the Congress in 13 different bills and expenditures for programs are included in the budgets of the 22 departments and agencies involved in research, development, test, and evaluation. These organizations report to dozens of congressional committees and subcommittees. Further, each RDT&E facility generally does not receive its funding in a large allocation. For example, each DOE laboratory budget is comprised of individual funding decisions by the Department's senior management and program managers and by other agencies.

The $72 billion appropriation for the conduct of federal R&D in fiscal year 1997 represented only about 4 percent of the total budget but about 14 percent of discretionary funding. About $2.2 billion also was appropriated separately for RDT&E facilities. Of the $72 billion, about 72 percent was to be used by DOD, NASA, and DOE, the three largest laboratory systems. As seen in figure 1.2, DOD received about $37.3 billion, or about 52 percent of the total. In addition to R&D funding, this amount includes funding for T&E facilities and a significant amount of it is spent to support work in DOE's nuclear weapons laboratories and with NASA. In fact, DOE's weapons laboratories receive more than one-half of their R&D funding from DOD.

While most agencies break out R&D into the three categories of basic research, applied research, and development, DOD divides its RDT&E account into seven categories (basic research, exploratory development, advanced technology development, demonstration and validation, engineering and manufacturing development, management and support, and operational systems support). Finally, NASA received about $9 billion and DOE received about $5.3 billion.

Figure 1.2: Agency-by-Agency Appropriation for the Conduct of Federal Research and Development for Fiscal Year 1997 (constant fiscal year 1997 dollars in billions)



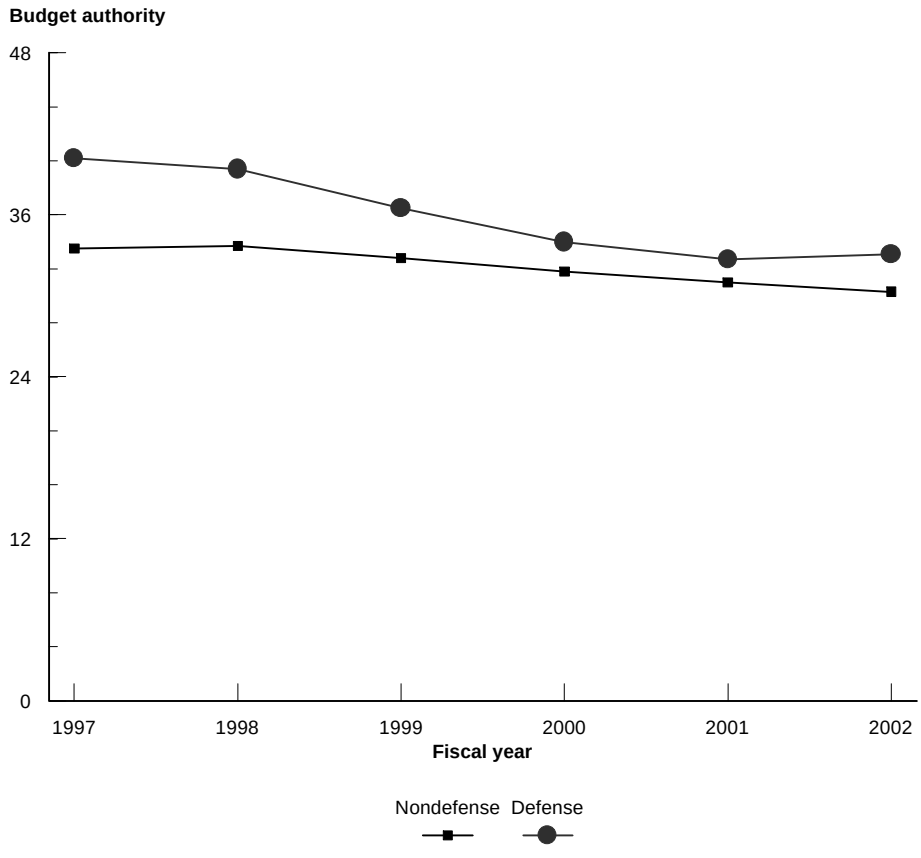
[a]While the Department of Health and Human Services received the second largest amount of R&D funding—about $12.7 billion—it provides primarily grants to other research organizations.

Source: Critical Technologies Institute, The RAND Corporation.

The President's fiscal year 1998 budget projected a significant decline in research and development (see fig. 1.3). Between fiscal years 1997 and 2002, the total R&D budget is projected to decline from about $73.7 billion

(including spending for RDT&E facilities) to about $63.4 billion, or about 14 percent. However, for fiscal year 1998, the Congress approved increases greater than the expected 2.5-percent rate of inflation for every major R&D funding agency except the Departments of Agriculture and Transportation. Moreover, the Congress funded only the fiscal year 1998 installment of the administration's request for almost $1 billion in construction costs of various R&D facilities. As seen in figure 1.3, defense RDT&E, which includes funding for defense programs in DOD and DOE, is projected to decline by about 18 percent and nondefense R&D is projected to decline by about 9 percent.

Figure 1.3: Projected Changes in Federal R&D Funding for Fiscal Years 1997-2002 (constant fiscal year 1997 dollars in billions)



Source: American Association for the Advancement of Science and the Budget of the United States Government for Fiscal Year 1998.

At the agency level, the President's budget for fiscal year 1998 projected that between fiscal years 1997 and 2002, NASA's R&D funding will decrease by about 12 percent and DOE's will decrease by about 16 percent.[7] DOD plans to reduce RDT&E funding every year until fiscal year 2001 and then projects a small increase for fiscal year 2002. In fiscal year 2002, the DOD RDT&E budget request is estimated to be 18 percent less than in fiscal year 1997.

Objectives, Scope, and Methodology

At the request of the former and current Chairmen of the Subcommittee on Oversight of Government Management, Restructuring and the District of Columbia, Senate Committee on Governmental Affairs, and the Chairman of the House Committee on the Budget, we reviewed a number of issues related to the federal RDT&E infrastructure. The purpose of this report is to lay out a framework within which changes to the federal RDT&E infrastructure can be accomplished and around which debate about the need for those changes can occur. To do so, we have (1) examined the condition of existing infrastructure, (2) analyzed the approaches used by organizations outside the federal government to realign RDT&E infrastructure, (3) and compared those approaches to federal agency efforts.

To determine the existing condition of the federal RDT&E infrastructure, we surveyed the 17 cabinet-level departments and independent agencies that own such facilities. We identified and evaluated the restructuring of RDT&E facilities undertaken by the Boeing Company Defense & Space Group (a private company) and the British Ministry of Defence's Defence Research Agency. Further, we reviewed major studies conducted between fiscal years 1987 and 1997 on federal RDT&E facilities. These studies included those conducted by the defense base closure and realignment commissions, the Office of Science and Technology Policy (OSTP), and the National Science and Technology Council (NSTC); departments and agencies; and others outside of the government.

To review the criteria and methodologies used in consolidating successfully RDT&E infrastructure, we reviewed pertinent documents and interviewed appropriate representatives from the Boeing Company Defense & Space Group in Seattle, Washington; officials at the British and Canadian Embassies in Washington, D.C.; the British Ministry of Defence in London, England; the Defence Research Agency and Defence

[7]Targeted investments in large-scale facilities and equipment, such as the $1 billion National Ignition Facility, tend to mask greater declining R&D funding for DOE.

Evaluation and Research Agency (DERA) in Farnborough, England; and the Defence Test and Evaluation Organisation at Boscombe Down in Salisbury, England.

We examined infrastructure restructuring efforts throughout the federal government and, based on our survey results, performed a detailed review of DOE, NASA, and DOD because (1) about 72 percent of federal R&D budget authority flows through these agencies and (2) they own most of the federal RDT&E infrastructure. We discussed RDT&E infrastructure with appropriate officials in the Departments of Agriculture, Commerce, Defense, Education, Energy, Health and Human Services, Interior, Justice, Transportation, and Veterans' Affairs; the Centers for Disease Control and Prevention; the Drug Enforcement Administration; the Environmental Protection Agency; the Food and Drug Administration; NASA; the National Institutes of Health; the National Science Foundation (NSF); the Office of Management and Budget (OMB), and OSTP within the Executive Office of the President.

Within DOE's laboratory system, we visited Lawrence Livermore National Laboratory in Livermore, California; Lawrence Berkeley National Laboratory in Berkeley, California; Sandia National Laboratories in Albuquerque, New Mexico; Los Alamos National Laboratory in Los Alamos, New Mexico; Argonne National Laboratory in Argonne, Illinois; and Brookhaven National Laboratory in Upton, New York. Also, we interviewed officials from DOE headquarters divisions in Washington, D.C., and DOE representatives at the national laboratories we visited.

Within NASA's laboratory system, we visited the Jet Propulsion Laboratory, a FFRDC in Pasadena, California; Ames Research Center at Moffett Federal Airfield, California; Aeroflightdynamics Directorate of the U.S. Army Aviation and Troop Command, a tenant of Ames Research Center, Moffett Federal Airfield, California; and George C. Marshall Space Flight Center, Alabama. Also, we interviewed officials from NASA headquarters in Washington, D.C.

Within DOD's R&D laboratory and T&E center systems, we visited the U.S. Army Research Laboratory in Adelphi, Maryland; U.S. Air Force Wright Laboratory at Wright-Patterson Air Force Base, Ohio; Naval Air Warfare Center, Weapons Division, China Lake, California; Naval Air Warfare Center, Weapons Division, Point Mugu, California; Naval Command, Control and Ocean Surveillance Center, San Diego, California; U.S. Army Missile Command, Redstone Arsenal, Alabama; U.S. Army Missile

Research, Development and Engineering Center, Redstone Arsenal, Alabama; Redstone Technical Test Center, Redstone Arsenal, Alabama; and the U.S. Army Engineer Waterways Experiment Station in Vicksburg, Mississippi. We also interviewed officials from the Office of the Director, Defense Research and Engineering (DDR&E), and its Office of Laboratory Management and Technology Transition; and the Chief Scientist and Technical Director, Office of Naval Research, Europe, in London, England. In addition, we interviewed officials of the Massachusetts Institute of Technology's Center for International Studies and Defense and Arms Control Studies in Cambridge, Massachusetts.

All federal budget data are presented in 1997 constant dollars. We obtained data for fiscal years 1995 to 1997 from The RAND Corporation Critical Technologies Institute's Research and Development in the United States (RaDiUS) database. We also obtained data about research topics performed by multiple agencies in fiscal year 1996, the number of awards/tasks active in fiscal year 1996 for those topics, and their known federal obligations for fiscal year 1996 (see table 2.1) from RaDiUS and The RAND Corporation representatives. The Critical Technologies Institute is a FFRDC supported by OSTP. RaDiUS is the first comprehensive, real-time accounting of federal R&D activities and spending. It allows users to track federal R&D activity from cabinet- and agency-level budgets down to the program, project, and award levels, where budget categories translate into actual R&D work performed for fiscal years 1993 to 1997. RaDiUS allows users to see the total R&D investment by all federal agencies, compare the level of R&D investment in specific areas of science and technology across all federal agencies, or examine the details of research investments within a specific agency. Researchers at the Critical Technologies Institute use the database to analyze federal R&D expenditures and programs in support of OSTP and NSTC. The operational version of the database recently was made available to OSTP and other federal agencies. RaDiUS is accessible to designated users via the Internet through the World Wide Web. The RAND Corporation representatives said that obligational data presented in this report are conservative because obligational data are not available for all awards/tasks. We did not verify the accuracy of the data contained in the RaDiUS database.

Future trend data were obtained from the Budget of the United States Government for Fiscal Year 1998 and the American Association for the Advancement of Science. Data on the amount of R&D investments by industry and academia were obtained from NSF's National Patterns of R&D Resources: 1996. Personnel data for DOD were obtained from the

Department of Defense In-House RDT&E Activities Management Analysis Report for Fiscal Year 1996. Personnel data for NASA were from the end of the second quarter of fiscal year 1997 and were obtained from the NASA Civil Service Workforce Report. Personnel data for DOE were from the end of fiscal year 1996 and were obtained from the Secretary of Energy's Advisory Board. We did not attempt to verify the accuracy of these data.

We performed our review from July 1996 through June 1997 in accordance with generally accepted government auditing standards.

Condition of the Federal RDT&E Infrastructure

Despite numerous studies citing the need for DOE, NASA, and DOD to reduce significantly their RDT&E infrastructures in alignment with agency core missions, these agencies have not responded fully to the studies' recommendations. The energy crisis of the 1970s, the end of the Cold War in the late 1980s, the desire for a smaller and more efficient government, and the agreement to achieve a balanced budget by 2002 caused these three agencies to revise their missions. In some cases, RDT&E facilities have taken on expanded missions beyond agency core requirements in order to employ the existing infrastructure. As a result, they perpetuate excess capacity and retain many old, deteriorating facilities in need of repair. Moreover, DOE, NASA, and DOD—along with many of the other 14 agencies that own RDT&E infrastructure—have programs involving the same areas, thus creating the potential to overlap and duplicate research.

Studies Show That a Reduction of RDT&E Infrastructure Is Needed

Numerous studies, panels, commissions, and task forces, and several GAO reports have addressed the inefficiencies in DOE, NASA, and DOD RDT&E facilities. Many concluded that RDT&E facilities must adapt appropriately their missions and programs to the changing world environment; tie RDT&E closely to agency core missions; and eliminate duplication, excess capacity, and unfunded backlogs in facility maintenance and repair. The President's NSTC reported that given post-Cold War conditions and new fiscal constraints, DOE, NASA, and DOD must reduce and restructure their RDT&E infrastructures, define laboratory missions more clearly, manage laboratories better, and eliminate needless redundancies.[1]

- Since 1982, seven major panels, commissions, and task forces, and six GAO reports have addressed how DOE could achieve operational efficiencies in its RDT&E facilities. Recommendations included focusing unclear missions, aligning laboratory activities with DOE goals, consolidating facilities, and replacing its cumbersome, inefficient management structure. In particular, the 1995 Task Force on Alternative Futures for the Department of Energy National Laboratories (the Galvin Task Force) reported DOE's entire laboratory system could be reduced productively by eliminating obsolete and redundant missions and supporting infrastructure.[2]

[1]See Interagency Federal Laboratory Review Final Report, Executive Office of the President, Office of Science and Technology Policy (May 15, 1995), pp. 1, 7, and 9-13.

[2]See Alternative Futures for the Department of Energy National Laboratories, Secretary of Energy Advisory Board Task Force on Alternative Futures for the Department of Energy National Laboratories (Feb. 1995).

- Although it did not make specific recommendations to consolidate NASA infrastructure, the 1995 Foster Task Force[3] reported that it found overlaps in capabilities at NASA and other agencies and recommended that NASA should reduce redundant capabilities among its centers. NASA, recognizing its excess capacity, developed plans to close and consolidate some of its facilities to reduce its RDT&E infrastructure, setting a "stretch" goal to decrease the current replacement value[4] of its facilities by 25 percent by the end of fiscal year 2000.
- Since 1987, more than 150 studies have addressed the need for DOD to achieve operational efficiencies in its RDT&E infrastructure. Recommendations from these studies focused most on management efficiencies and less on infrastructure reductions. For example, the 1995 Directions for Defense: Report of the Commission on Roles and Missions of the Armed Forces identified many opportunities for DOD to integrate operational activities with duplicative missions in areas such as command, control, communications, computers, and intelligence (C^4I) rather than RDT&E infrastructure reduction.[5]
- The March 1997 Status of Federal Laboratory Reforms, prepared as an update of the NSTC report, recognizes improvements but cites a continued need for reform.

Agencies Maintain Large RDT&E Infrastructures

DOE, NASA, and DOD actions to address inefficiencies in their RDT&E have focused most on management efficiencies and less on reducing infrastructure. When attempted, strategic infrastructure reduction was largely limited to individual facilities within agencies, but it has not been attempted governmentwide. In part, because well-established programs have mobilized political support to resist change, these three agencies still maintain large, relatively unchanged RDT&E infrastructures.

Some DOE reform efforts led to management efficiencies, staff reductions, and the closure of a few facilities directly related to the end of the Cold War. However, DOE's efforts failed to implement large-scale restructuring because either the scope of these efforts was limited, subsequent recommendations were not implemented fully, or the recommending body

[3]See NASA Federal Laboratory Review, NASA Federal Laboratory Review Task Force, NASA Advisory Council (Feb. 27, 1995).

[4]The current replacement value of a facility is its acquisition cost, excluding land, and the cost of collateral equipment and incremental book value changes escalated to the current year using a 20-city average cost index for buildings.

[5]See Directions for Defense: Report of the Commission on Roles and Missions of the Armed Forces (May 24, 1995).

lacked the independent authority necessary to implement recommendations. DOE currently maintains one of the world's largest collections of scientific laboratories—33 such laboratories valued at over $100 billion. Figure 2.1 shows an aerial view of the Lawrence Livermore National Laboratory in Livermore, California.

Figure 2.1: Lawrence Livermore National Laboratory, Livermore, California

Source: DOE.

Although budgetary constraints forced NASA to look for savings, NASA has not consolidated or closed any of its 10 major centers. For example, the 1995 NASA Federal Laboratory Review concluded that NASA saved money by cutting personnel but not by closing facilities. According to NASA officials,

additional reductions in R&D laboratories are unlikely. Although NASA established a "stretch" goal of reducing the current replacement value of its facilities by $2.8 billion by 2000, it may achieve only $250 million in operations and maintenance cost reductions by then. In fact, NASA's infrastructure current replacement value increased by about 14 percent between fiscal years 1990 and 1995, indicating that NASA was building new facilities faster than it was consolidating or closing older ones. NASA's 10 major centers currently include about 3,000 buildings on about 130,000 acres of land. Figure 2.2 shows an aerial view of NASA's Ames Research Center at Moffett Federal Airfield, California.

Figure 2.2: NASA Ames Research Center, Moffett Federal Airfield, California

Source: NASA Ames Research Center.

DOD will have closed 62 RDT&E sites and activities at host sites once it implements the recommendations from the four base realignment and closure (BRAC) rounds (1988, 1991, 1993, and 1995). While this action is laudable, once complete, DOD still will have about 35-percent excess

capacity in its laboratory infrastructure and about 52-percent excess capacity in the air vehicles, electronic combat, and armaments/weapons arenas of its T&E infrastructure, according to DOD's own estimates. DOD currently owns 67 laboratories. Figure 2.3 shows an aerial view of the Air Force's Wright Laboratory, Wright-Patterson Air Force Base, Ohio.

Figure 2.3: Wright Laboratory, Wright-Patterson Air Force Base, Ohio

Source: U.S. Air Force.

There are cases where DOE, NASA, and DOD laboratories coordinate to help ensure that similar research programs are complementary and not overlapping. Although individual agencies have taken limited actions to reduce their own RDT&E infrastructures, they have had little success in

consolidating infrastructure across agency boundaries. Recent attempts by DOD to reduce RDT&E infrastructure excluded analyses of overlap with other agencies. Previously, DOD and NASA established integrated product teams and then alliances to improve coordination between their laboratories. However, interagency rivalries hampered their efforts. Further, some areas either started slowly or have not started at all. More importantly, these teams had no explicit goal to identify ways to reduce their infrastructures through this effort. As a result, their efforts achieved minimal infrastructure reduction to date.

Although agencies say that they assess continuously the infrastructure required to fulfill their mission requirements through their strategic planning processes, in some cases, instead of restructuring their infrastructure to support core missions, agencies have expanded missions to preserve existing infrastructure. Rather than expanding the agency's mission, NASA has focused and redefined its centers' missions. In some cases, this has resulted in competition among agencies that may also extend into their dealings with the private sector. For example, NASA and Air Force test centers are competing with each other to test engines for the Air Force's Evolved Expendable Launch Vehicle. Also, some DOE laboratories are competing with private industry, for example, by building facilities to produce medical isotopes.

Multiple Agencies Conduct Research in Similar Programs

Many RDT&E activities of DOD, DOE, and NASA are inextricably linked. For example, the major thrust of DOD's RDT&E effort is national security and DOE laboratories have been making contributions to national security since the World War II Manhattan Project by designing, developing, and/or maintaining nuclear weapons. NASA also contributes to national security with its work on military aerospace and improved aircraft performance. In addition, environmental issues are a growing part of the three agencies' RDT&E efforts. Both DOD and DOE now have significant responsibilities for finding ways to clean up their own pollution and advance the science and technology of environmental remediation. NASA and DOE have undertaken complementary or coordinated RDT&E programs related to the earth's environmental and climate changes.

Agency mission and RDT&E infrastructure duplication is thought by some to be a governmentwide problem. However, the full extent is not known. DOE, NASA, and DOD, along with many other agencies involved in research, develpment, test, and evaluation, are awarding contracts and directing tasks in programs that involve research on the same or similar subjects.

This research may be different at each agency, but there is potential for overlap or duplication. Until recently, there was no formal system to monitor possible redundancies in research and development. The RaDiUS database, newly created by The RAND Corporation's Critical Technologies Institute to support OSTP and NSTC, compiles systematically data on the conduct of federal R&D investments by agency, bureau, program, project, and award. This database can aggregate individual agencies' total investments, compare the level of investment in specific areas of science and technology across all federal agencies, and provide the details of research investments within a specific agency. Table 2.1 shows examples of agencies' fiscal year 1996 contract awards/tasks for four research topics that we selected at random.

Table 2.1: Research Topics Involving Multiple Agencies (dollars in millions)

Research topic	Agencies supporting research[a]	Number of known awards/tasks	Estimate of amounts spent in fiscal year 1996
Fuel Cell(s)	DOD, DHHS, NASA, DOE, NSF, USDA, DOT, DVA	120+	$160-$175
HIV/AIDS	DOD, DHHS, DOE, NSF, USDA, DOC, AID, DVA, DED	2,800+	$550-$700
Human Genome	DOD, DHHS, DOE, NSF, USDA, DOC, DVA	290+	$110-$125
Aviation Safety	DOD, DHHS, NASA, DOE, NSF, DOC, DOT	160+	$800-$950

[a]AID (Agency for International Development); AIDS (acquired immune deficiency syndrome); DED (Department of Education); DHHS (Department of Health and Human Services); DOC (Department of Commerce); DOI (Department of the Interior); DOJ (Department of Justice); DOT (Department of Transportation); DVA (Department of Veterans' Affairs); and USDA (U.S. Department of Agriculture).

Source: RaDiUS database, Critical Technologies Institute, The RAND Corporation.

A review of activities in the database raises concerns that duplication within and across agencies may be prevalent and identifies opportunities for collaborations that are being missed. The search revealed that many agencies and awards/tasks are involved. However, what appear on the surface to be overlapping projects or surprising locations where particular research is taking place, in fact, may be different. For example, fuel cell research for different vehicles (automobiles, spacecraft, and launch vehicles) may involve distinct technologies with different objectives as well as public and private applications. Without a comprehensive evaluation of the actual details of the various R&D activities, it is difficult to assess whether collaboration is sufficient or if duplication is occurring.

Repairs of Aging RDT&E Infrastructure Are Backlogged

As we and others have reported, backlogs of maintenance and repairs of deteriorating RDT&E facilities have increased significantly. Further, much of the federal laboratory infrastructure is old, in poor operating condition, or rapidly becoming obsolete—in part because maintenance and repairs are underfunded.[6] Some of it is ill-equipped for today's R&D activities. For example, many of DOE's older R&D laboratories were not designed to meet today's (1) need for precise measurements by considering factors like temperature, humidity, and vibrations and (2) health and safety code requirements. The lack of repair of aged facilities may reflect the realities of recent deficit reduction efforts and associated funding priorities. In addition, excess capacity and aged facilities in DOE, for example, may continue to exist because facilities suffer from toxic contamination that cannot be disposed of currently or is too costly to decontaminate and decommission. However, since noncontaminated excess capacity exists, it seems reasonable that restructuring could be used to reduce excess capacity and consolidate some functions in the better maintained facilities, and not waste available resources maintaining and repairing old and underused facilities.

In 1993, we reported that about 54 percent of federal laboratories' space was over 30 years old.[7] DOE's floor space, which accounts for almost 50 percent of the total RDT&E laboratory space for all federal agencies, was the oldest—35 percent of its space was over 40 years old, and 62 percent was over 30 years old. In addition, 29 percent of DOD's laboratory space and 24 percent of NASA's laboratory space was more than 40 years old. In 1991, DOD reported that it had a $850 million backlog in unfunded repairs to research facilities that would take more than 12 years to eliminate.

DOE, NASA, and DOD officials confirm that the RDT&E maintenance and repair backlogs we reported in 1993 still persist today or have been improved only marginally. For example, in 1996, about 41 percent of DOD's laboratory space was over 36 years old and 62 percent was more than 26 years old. DOE officials estimated that the agency would need $1.3 billion to maintain and modernize R&D facilities, but funding for such projects in fiscal year 1995 was only $80 million—about 6 percent of that amount. In fiscal year

[6]See DOE's Laboratory Facilities (GAO/RCED-96-183R, June 26, 1996); Federal Research: Aging Federal Laboratories Need Repairs and Upgrades (GAO/RCED-93-203, Sept. 20, 1993); Federal Buildings: Actions Needed to Prevent Further Deterioration and Obsolescence (GAO/GGD-91-57, May 13, 1991); Long-Term Modernization of Research, Development, Test and Evaluation (RDT&E) Facilities, Institute for Defense Analyses, January 1991; and NASA Maintenance: Stronger Commitment Needed to Curb Facility Deterioration (GAO/NSIAD-91-34, Dec. 14, 1990).

[7]See Federal Research: Aging Federal Laboratories Need Repairs and Upgrades (GAO/RCED-93-203, Sept. 20, 1993).

1997, NASA requested $238 million for routine annual maintenance and repair of its facilities. Although this amount does not reduce its backlog of maintenance and repairs, NASA indicated that some minor amounts of routine maintenance funds may be expended for such projects as painting the exteriors of mothballed buildings or replacing the roofs of facilities considered to be excess capacity.

Approaches Other Organizations Have Taken to Reduce RDT&E Infrastructure Successfully

The need to reduce RDT&E infrastructure in light of fiscal constraints and changing requirements is not unique to the U.S. government. In recent years, several organizations that faced declining resources and a globally competitive business environment have restructured successfully their RDT&E operations, reducing both the size and cost of their RDT&E infrastructures. Our review of how two organizations' restructured their RDT&E facilities shows that five elements, used in concert, were critical to their success. These two restructurings provide useful "lessons learned" for the U.S. government.

Consolidation of RDT&E Facilities at the Boeing Company Defense & Space Group and the British Ministry of Defence's Defence Research Agency

The Boeing Company Defense & Space Group[1] eliminated significant RDT&E infrastructure through its restructuring efforts. Before restructuring, the company had neither focused on the number or size of its facilities nor identified how widespread duplication had hampered its facilities' efficiency. After forecasting reductions in its workload for military electronics and space programs in 1989, however, the Boeing Company Defense & Space Group realigned its laboratory infrastructure to support the company's new strategic business plan.

In roughly 4 years, the Boeing Company Defense & Space Group reduced its 456 laboratories to 133, cutting its square footage requirements significantly. As a result of this consolidation, labor and other facility-based operating costs were reduced by about $100 million. Despite the consolidation, the company's business base suffered no losses, and there was little need to contract out for services. With a successful restructuring methodology in place, the Boeing Company Defense & Space Group began to review the possible consolidation of additional laboratories gained through the acquisition of Rockwell International's space and defense units, including The Rocketdyne Corporation. An official from the Boeing Company Defense & Space Group estimated that this consolidation may take as few as 12 months.

Similarly, the British Ministry of Defence consolidated its four research establishments into a single agency for laboratories, the Defence Research Agency, which serves all three military services. The Ministry created the agency when operating and planning problems revealed that its laboratories and T&E sites were unresponsive to customers' needs, culturally antiquated, and unaffordable. The laboratories and test centers were widely dispersed, laid out inefficiently, and in poor repair. These

[1]In August 1997, the Boeing Company Defense & Space Group was renamed the Boeing Company Information, Space, & Defense Systems Group.

inefficiencies were compounded by a likely reduction in future defense spending and a Ministry staff relocation that left two major sites only half utilized and a heavy burden to operate and maintain.

To respond to these problems, from 1991 to 1995 the Defence Research Agency reduced its 54 laboratories to 35 and combined the Ministry's four principal nonnuclear research establishments into one coherent and highly efficient single organization. The agency reduced its overhead costs by more than $100 million, yet the military-science program maintained nearly the same level of funding. The agency later expanded to include T&E centers and is now called DERA.

Five Elements Critical to the Boeing Company Defense & Space Group and British Ministry of Defence Restructuring

According to the Boeing Company Defense & Space Group and British Defence Research Agency officials, the restructuring process included five elements that were critical to ensuring prompt and complete success. According to officials managing these restructurings, their success depended on using all five elements together. These elements were either in place when the consolidation began or were added to complete the process.

- A "crisis" that served as a catalyst to spark action.
- An independent authority to overcome parochialism and political interest.
- Core missions focused to support the organization's goals and strategies.
- The full scope of supporting infrastructure clearly delineated.
- Accurate, reliable, and comparable data that capture total infrastructure cost and utilization rates for each affected entity and can be collected and evaluated systematically.

A "Crisis" as a Catalyst to Spark Action

At both the Boeing Company Defense & Space Group and the Defence Research Agency, the overriding catalyst that forced action to preserve the organizations' options and maintain the quality of their work was a shift in national economic priorities. Organization executives at the Boeing Company Defense & Space Group and the Ministry of Defence foresaw imminent and severe budget cuts, which created the impetus to restructure their RDT&E facilities.

During the U.S. defense buildup in the 1980s, the Boeing Company Defense & Space Group operated two separate military aircraft divisions, which competed with one another for designs. However, when the Cold

War ended and defense budgets declined, the company realized that it could no longer afford the luxury of internal competition.

The Defence Research Agency, on the other hand, created its own "crisis" that served as a catalyst to effect the restructuring of its RDT&E facilities. Originally, the Ministry of Defence was slow to respond both organizationally and culturally to post-Cold War changes. The executive in charge of restructuring the Defence Research Agency forced the facilities to become financially self-sufficient by making them independent contractors to the government, thus creating an environment of "crisis" for both the Defence Research Agency and its new military customers.

An Independent Authority to Direct Restructuring

According to representatives of the Boeing Company Defense & Space Group and the Defence Research Agency, their RDT&E consolidation efforts succeeded primarily because an independent authority provided leadership from outside the organizations' normal decision-making chain-of-command. Being free from parochial or political pressures, the authority could effect change, ensure that data collection and analysis were efficient and objective, and implement recommendations quickly. In the Boeing Company Defense & Space Group, the authority reported directly to the company president, and in the Defence Research Agency, the authority reported directly to the Secretary of State for Defence. Facility personnel were told that the independent authority would direct the restructuring with or without their cooperation and that it would therefore be in their best interests to represent their facilities completely and candidly.

Core Missions That Support Organizational Goals and Strategies

As part of larger organizations, the Boeing Company Defense & Space Group and the Defence Research Agency were expected to support overall goals and strategies as efficiently as possible. Both the Boeing Company Defense & Space Group and the Defence Research Agency realigned their missions to meet existing and anticipated conditions. They achieved this by asking several basic questions:

- What are the organizations' core missions?
- What research areas are the organizations involved in?
- Does existing research at a facility support the core missions?
- Can someone else do the research?
- What are the costs and consequences of not doing the research?

The Boeing Company Defense & Space Group's RDT&E facility capacity (and any consolidation or streamlining) had to conform to the Boeing Company's strategic business plan. The Defence Research Agency began operating on a "trading fund" basis and aligned its missions along functional lines that were linked directly to the needs of its customer, the Ministry of Defence. In both organizations, when the plans required a particular capability, the executive responsible for the laboratories had to choose either to maintain the applicable research and development or to contract for it (if the capability was reasonably available by outside contract). The Boeing Company Defense & Space Group and the Defence Research Agency documented their decisions to ensure that laboratory missions and functions were linked directly to the missions and functions of the greater organization.

The Full Scope of Supporting Infrastructure Clearly Delineated

Before determining whether their capabilities and functions supported their parent organizations' missions, the Boeing Company Defense & Space Group and the Defence Research Agency had to complete an inventory of all their RDT&E facilities, without exception, to determine what to cut. For example, although its High Technology Center was only 3 years old and cost $40 million to build, it was included in the inventory and dismantled because it failed to support the company's strategic business plan. According to a Boeing Company Defense & Space Group official, if the company had exempted certain facilities from its inventory, new ones like the Center would likely not have been cut.

Because of political sensitivities, the Defence Research Agency restructured its RDT&E infrastructure in two phases. The R&D laboratories were restructured first, then the T&E centers. The R&D laboratories were easier to restructure because they were all in England, and so only one constituent country was involved. The T&E centers, on the other hand, were located in England, Scotland, and Wales. The agency thus had to face three separate legislative bodies in two constituent countries (England and Scotland) and one principality (Wales) with its politically sensitive restructuring decisions. However, the successful restructuring of the laboratories eased the way for the restructuring of the T&E centers.

Accurate, Reliable, and Comparable Data on Infrastructure Costs and Utilization Rates

The Boeing Company Defense & Space Group and the Defence Research Agency discovered that their financial management systems could not capture or evaluate either the total costs of operating their laboratories or the facility utilization rates. Because accurate, reliable, and comparable data were critical to success in restructuring their RDT&E facilities, both organizations developed standardized data collection instruments to capture necessary details about their infrastructure. These details included each laboratory's geographic location, original and current purpose, present and future projects, unique capabilities, product areas, equipment values, utilization rates, maintenance costs, personnel costs and capabilities, anticipated capability requirements, and potential consolidation/closing requirements.

To validate and analyze the data collected, the Boeing Company Defense & Space Group created multidisciplinary review teams that included scientists, strategic planners, financial experts, accountants, engineers, and laboratory operations specialists. For each site visit, corresponding individuals were added to the team to ensure that accurate and comparable data were being obtained and to allow laboratory personnel to participate in the data collection process. A neutral party unified the overall data collection process. Once the data was collected and its accuracy verified, the teams analyzed the data by function and, if needed, by geographical area. Data on functional categories tied each laboratory's activities to its primary mission, and data on geographical area helped the teams discern differences in facility use rates in that area. Brainstorming sessions listed 45 to 50 functions, which were winnowed to 15 prime functions. Team decisions were reached by consensus.

Senior scientists from the Defence Research Agency analyzed data about each other's facilities. The agency's Director of Rationalisation worked with the Director of Support Services and Director of Personnel to restructure facilities and determine human resource needs. The final results from these data covered over 50 individual options for sites in detail and revealed common elements. In fact, the level of overlap was so great that the restructuring plan could only be assembled as a complete package after all the studies were completed.

Both organizations collected accurate, reliable, and comparable data about their facilities across-the-board to reduce confusion, prevent facility officials from claiming they should be exempted from restructuring, and reduce their assertions that the facilities were "unique" or "incomparable." Also, both organizations' recommendations encompassed a wide variety of

restructuring options: closure, consolidation, relocation, downsizing, expanding, transferring responsibility, mothballing, or no change. Once approved, recommendations were implemented quickly.

Federal Agencies' Approaches to Reducing RDT&E Infrastructure Lacked Critical Elements

When the Boeing Company Defense & Space Group and the Defence Research Agency applied elements critical to their restructuring efforts, they achieved cost savings and operational efficiencies. However, not all of these critical elements were present in DOE, NASA, and DOD attempts to restructure their RDT&E facilities. Reduced agency budgets have not served as a catalyst for major reductions or restructurings. Although individual agencies have taken steps to realign their missions, these steps have been taken independently and not within the context of a rational, governmentwide approach. In fact, when agencies did refocus their missions, the goal sometimes was to maintain existing infrastructure or to limit infrastructure reduction. Furthermore, agencies have made decisions using the various definitions of R&D infrastructure without considering fully the scope of existing infrastructure and lacking information on the cost to operate it and the way to assess its value. The five critical elements used in concert by the Boeing Company Defense & Space Group and the Defence Research Agency are broadly applicable to laboratory infrastructure within and across federal agencies.

The Department of Energy's Restructuring Efforts

DOE has attempted in limited and isolated ways to consolidate its RDT&E infrastructure. For example, DOE began a restructuring of RDT&E facilities in 1987 at the Nevada Test Site, which is used by DOE's three defense weapons laboratories to meet unique requirements with specific technical and operational capabilities. At that time, DOE initiated a comprehensive effort to reengineer its support operations and facilities at the site; created joint experimental facilities and consolidated its construction camp, dormitories, and other logistical services; and consolidated several personnel support functions, such as the support contractor and drilling crew. According to DOE officials, this effort resulted in a test site budget about 2.5 times smaller than the 1987 budget of nearly $1 billion. Overall however, DOE's attempts to restructure its RDT&E facilities yielded only modest budget savings and little or no significant restructuring. Further, none of the five critical elements used in the successful consolidations by the Boeing Company Defense & Space Group and the Defence Research Agency were part of DOE's process. Institutional barriers, along with parochialism and other pressures, prevented DOE from reducing much of its existing infrastructure.

During the Cold War, more than one-half of the total work of the major DOE laboratories was directed toward defense-related research, development, testing, and environmental management. The DOE multiprogram laboratories and the DOE weapons laboratories have

diversified their missions during the past decade, including, for example, more emphasis on industrial competitiveness. Also, environmental cleanup and restoration and nonproliferation projects that were funded primarily by the Defense Program budget were transferred to the Environmental Restoration and Non-Proliferation Program budgets. Thus, the total Defense Program's work in 1993 dipped below 50 percent of the total laboratory complex budget.

In 1994, the Secretary of Energy announced DOE's strategic plan, which included a plan to reduce its budget by $14.1 billion over the next 5 years. This goal was later revised to $10.5 billion, with savings to be achieved by reducing management expenses in the environmental area and energy programs and by implementing recommendations from two DOE commissions created to improve its defense laboratories and applied research programs.[1] In May 1995, DOE began a strategic alignment and downsizing initiative, as part of its strategic plan, attempting to save $1.7 billion in its laboratories over 5 fiscal years.

More recently, DOE has changed its mission focus to respond to the changed world environment, but without a reduction in infrastructure. In August 1995, U.S. efforts toward ratification of the Comprehensive Test Ban Treaty required DOE to create the Stockpile Stewardship and Management Program (SSMP) to replace research and production of new nuclear weapons with the maintenance and testing of the existing nuclear stockpile. The SSMP is a 10-year initiative that has cost about $4 billion per year and is expected to cost $4.5 billion per year beginning in 1999—$400 million a year more than the Department's annual weapons budget during the Cold War. If funding for weapons production in Cold War budgets is included, then the program's budgets are substantially less than Cold War budgets. However, current budgets do contain an increase in annual funding for weapons research programs. Through the program, DOE reduced some overlap and duplication at its three weapons laboratories and made major reductions in the production complex. Nevertheless, no major laboratory facilities will be consolidated or closed because of the program. For fiscal year 1998, DOE laboratories are again devoting more than one-half of their workload to defense.

Other than nuclear weapons work, DOE has expanded its RDT&E mission to include research on, for example, the human genome, chemical/biological warfare agents, and the expansion of fusion energy research at five

[1]See Energy Downsizing: While DOE Is Achieving Budget Cuts, It Is Too Soon to Gauge Effects (GAO/RCED-96-154, May 13, 1996).

laboratories. Studies have been expanded at one laboratory on ways to counter all weapons of mass destruction. Often, research on weapons of mass destruction was mandated either within the executive branch or in legislation.

DOE has never conducted the rigorous inventory of its RDT&E programs, personnel, and facilities like that done by the Boeing Company Defense & Space Group and the Defence Research Agency. As part of a recent DOE effort to capture total research costs, all laboratories were asked to submit personnel and cost data to enable DOE to evaluate ratios of research to support staff, determine percent technical labor on research, and average operating costs per research full-time employee. Laboratory directors criticize this effort for overlooking the many unique capabilities and local accounting methods that make DOE laboratories so diverse. They also widely criticize DOE's more recent requirement to collect functional cost data, saying that it has no value. One laboratory estimated that it took one-half of a staff year to collect the data, while at another an official said the data cost the laboratory millions of dollars to obtain.

Except for the data now being collected, DOE has made no other effort to validate and evaluate data about the cost or utilization of its R&D laboratories—one of the five critical elements applied in the Boeing Company Defense & Space Group's and the Defence Research Agency's restructurings. In 1995, DOE established a Laboratory Operations Board to guide the Department's effort to improve the management of its laboratories and reduce their costs, but the Board has a limited mandate and little autonomy. In July 1996, the Board produced the Strategic Laboratories Mission Plan, which inventoried laboratory programs and capabilities but not their operating costs or facility utilization rates. The latest report of the Board's external members said that the laboratories have made progress and have cut costs, but they note that inefficiencies in each mission continue because of DOE's complicated management structure and that progress over the last year has been much slower than is desirable.

Their main findings state that DOE program plans need improvement. The Board reports that each program needs a plan that articulates a compelling mission, identifies the technical paths to accomplish the mission, and defines the roles of different R&D performers to accomplish the missions. The Board notes that this has been accomplished in DOE's Defense Program, but to a much lesser extent in the other parts of the Department.

In many programs, the Board finds that plans are not worked out in sufficient detail to allow the laboratories to plan their roles.

The report also states that some programs are using a larger number of performers than appears optimum; there are opportunities to improve performance and reduce costs through better focusing; and better planning is needed, for example, to set priorities for the energy mission, to develop a road map for future major scientific facilities, and to develop greater integration across R&D programs. The Board is surveying currently some of DOE's small, single-purpose laboratories to validate roles or determine if they are candidates for privatization, alternative contracting mechanisms, consolidation, or closure, but it is not performing the same review of the large, multiprogram laboratories where opportunities for overlap and duplication are most prevalent.

Directors at three of the multiprogram laboratories told us that an independent authority was needed to reduce RDT&E infrastructure. However, the directors at DOE's three weapons laboratories or their representatives disagreed; they contended that the SSMP already had focused their missions and consolidated their funding for the next decade.

NASA's Restructuring Efforts

Several elements we identified in the Boeing Company Defense & Space Group and the Defence Research Agency models were evident in NASA's response to what it perceived as a serious budgetary crisis. In response to successive budgetary reductions, NASA readjusted missions at individual locations and closed some facilities that were no longer needed. Most recently, the Administrator introduced an initiative, which is scheduled to be implemented fully in fiscal year 1999, to capture more fully the cost of supporting NASA's missions.

NASA officials note that the elimination of unnecessary infrastructure is a continuous, ongoing objective of the agency's strategic planning. Despite this plan, it remains to be seen whether NASA can meet its internal infrastructure reduction goals and, through its cooperative efforts with DOD, reduce unnecessary duplication in aerospace RDT&E facilities.

NASA Has Applied Several of the Critical Elements in Its Restructuring and Achieved Some Reductions

NASA's future years' budget requests for fiscal years 1995 to 2000 were reduced from $122 billion in fiscal year 1993 to $82 billion in fiscal year 1996. To manage this major reduction, beginning in fiscal year 1994, NASA adjusted or terminated several major programs. The agency also began to

reduce the number of support contractors and decrease its workforce from about 25,000 in fiscal year 1993 to a projected 17,500 in fiscal year 2000—a 30-percent reduction. In fiscal year 1996, NASA decided to absorb funding decreases by consolidation and closure of smaller facilities in conjunction with personnel reductions. NASA officials said they made a conscious decision not to close any of NASA's 10 major centers based on the agency's workload, customer requirements, and statutory responsibilities.

NASA officials believe NASA still is in a budgetary crisis. However, parochial and cultural barriers have prevented a more substantial reduction in its facilities infrastructure to help deal with the crisis. These barriers include concerns about the effect that closing facilities, relocating activities, and consolidating operations will have on missions, personnel, and local communities. As we reported in 1996, NASA will not meet its initial goal of decreasing the current replacement value of its facilities by $4 billion.[2] Instead, NASA now plans a $2.8 billion reduction in the current replacement value of its facilities, or approximately 16 percent of the facilities identified in the 1994 baseline. This reduction is estimated to yield only about $250 million in operations and maintenance cost reductions through fiscal year 2000. The agency will not meet its goal partially because it has had problems evaluating some cost-reduction opportunities and its efforts with DOD to coordinate the joint use of facilities are progressing slowly.

Like the Boeing Company Defense & Space Group and the Defence Research Agency, NASA's Zero-Base Review[3] redefined roles and program management structures and better focused its centers' missions. However, the review began with the premise that to meet its mission, NASA needed the existing infrastructure. Therefore, NASA purposefully did not consolidate or close any of its 10 major R&D centers. Rather, NASA made laboratory infrastructure reductions within each center by deactivating 25 wind tunnels and aeropropulsion facilities and closing some of its smaller sites. For example, in 1995, (1) the Jet Propulsion Laboratory closed its Edwards Test Station at Edwards Air Force Base, California; (2) Ames Research Center closed Crows Landing in Stanislaus County, California[4];

[2]See NASA Infrastructure: Challenges to Achieving Reductions and Efficiencies (GAO/NSIAD-96-187, Sept. 9, 1996).

[3]The Zero-Base Review was a NASA-wide effort completed in June 1995 to allocate reductions in the fiscal year 1996 budget, establish center role assignments, provide suitable guidance for the fiscal year 1997 budget, and change the way NASA conducts business. However, of the review's 50 recommendations, only two applied to specific facilities.

[4]Crows Landing was a former Navy airfield that Ames Research Center acquired as a result of becoming landlord of Moffett Federal Airfield following the 1991 BRAC round.

and (3) Marshall Space Flight Center, Alabama, closed the Slidell Computer Facility in Slidell, Louisiana, and the Yellow Creek Facility in Iuka, Mississippi, which was to have built the Advanced Solid Rocket Motor for the Space Shuttle. According to NASA officials, additional reductions are unlikely in NASA's centers.

NASA attempted to define clearly its supporting infrastructure in considerable detail. Using the National Facility Study that was performed in 1993 to 1994 as a starting point, and, in cooperation with DOD, NASA created the Major Facilities Inventory, which provided a database of 1,494 NASA and DOD facilities. However, this database is not being used to make decisions regarding reductions in infrastructure because it contains errors and does not use consistent metrics and credible variables that could be applied across NASA or DOD.

While the two agencies have not found opportunities to eliminate physical infrastructure from their inventories, they have found modest ways to avoid costs. For example, the two agencies can avoid spending (1) $60 million by combining spacecraft technology demonstrations and sharing the results of their experiments; (2) $14 million by sharing a C-17 aircraft hangar at Edwards Air Force Base/Dryden Flight Research Center, California; (3) $445,000 through joint use of an alternative fueling facility at Langley Air Force Base/Langley Research Center, Virginia; and (4) $200,000 annually through the Army's use of the Marshall Space Flight Center's photography laboratory at Redstone Arsenal, Alabama.

NASA does not have an integrated financial system. Also, NASA officials do not know the true costs of operating and maintaining the agency's laboratory infrastructure. Each of the 10 major centers maintains its own accounting system. NASA's nonstandard, decentralized accounting systems do not capture information on overhead rates in a consistent, rigorous, reliable, or useable manner. According to a NASA official, the agency has a poor cost-accounting analysis capacity, poor cost-accounting systems, and cannot determine the laboratories' actual costs. In 1995, NASA introduced an initiative, which it is implementing incrementally, to integrate full-cost accounting, budgeting, and management practices. The initiative was begun to provide complete cost information with which to make more fully informed decisions and improve mission performance. Full implementation of the initiative requires that NASA's financial systems be improved significantly to accommodate detailed cost data, practices, and processes. NASA has indicated that it plans to integrate the full-cost accounting system in its fiscal year 1999 budget. However, according to a

NASA official, the resulting cost data still will not provide the level of detail needed for infrastructure reduction processes like those used by the Boeing Defense & Space Group and the Defence Research Agency.

NASA and DOD Efforts to Work Together

In April 1996, NASA and DOD agreed to form alliances to work together more efficiently and effectively in six categories of major test facilities, including wind tunnels, air-breathing propulsion, rocket propulsion, space environmental, hypervelocity ballistic range/impact, and arc-heated facilities. The agreement was the result of a joint study, Final Report on the 1995-1996 DOD/NASA Cooperation Initiative, which concluded that, because a number of major test facilities were deactivated since 1993, the existing major facilities "very nearly represent the minimum necessary" to conduct current and planned civil and defense-related aerospace research, development, test, and evaluation. However, the study also concluded that NASA and DOD do not coordinate adequately major test facilities' investments, upgrades, and operations, and there was excess capacity in rocket engine test facilities.

NASA officials note that the starting point for determining infrastructure needs are NASA and DOD's missions and programs. Nonetheless, the agencies have not directly sought infrastructure reduction as part of the alliances' goals. Also, NASA and DOD cooperative activities under the alliances have been limited since their agreement in April 1996. Beyond the Rocket Propulsion Alliance, only two of the five new alliances actually convened.[5]

In part because NASA and DOD have not been directed specifically to consider jointly RDT&E infrastructure reductions during such restructurings, these agencies are not adequately coordinating with one another about infrastructure investment decisions and infrastructure consolidations. For example, according to DOD officials, DOD's 1996 Vision 21, a 5-year plan directed by the Congress to consolidate and restructure DOD's R&D laboratories and T&E centers for the 21st century, does not provide for coordination with or participation by NASA. Moreover, the plan does not call for involvement by DOE.

The National Defense Authorization Act for Fiscal Year 1997 (sec. 211) directed NASA and DOD to prepare a joint plan, by the end of 1996, for coordinating and eliminating unnecessary duplication in the operation and

[5]For a further discussion of the alliances, see our forthcoming report on Aerospace Testing: Promise of Closer NASA/DOD Cooperation Remains Largely Unfulfilled (GAO/NSIAD-98-52).

planned improvements of the rocket engine and rocket engine component test facilities managed by the Air Force and NASA and for developing commonly funded and operated facilities. The agencies did not meet the deadline but indicated that they had efforts underway to form the basis for such a plan.[6] However, the outcome of these efforts is uncertain or excludes NASA.

It remains to be seen whether the two agencies' cooperative efforts will reduce their investments, excess capacity, and unnecessary duplication in aerospace RDT&E facilities. NASA center officials generally agreed that an independent, external authority may be necessary to optimize restructuring activities, but they believe that NASA already has focused successfully its centers' roles and missions.

The Department of Defense's Restructuring Efforts

Although DOD has been through four BRAC rounds, it has not made the reductions and realignments of RDT&E infrastructure it deems necessary. Its Vision 21 initiative incorporates several of the elements critical to success, but it is on hold pending resolution of related BRAC issues.

The end of the Cold War, combined with the increasing need to reduce and eventually eliminate the federal budget deficit, altered fundamentally DOD's requirements for RDT&E infrastructure. DOD officials recognized the need to (1) reduce excess capacity, (2) avoid unnecessary overlap and duplication in missions and capabilities, (3) reduce costs, and (4) maximize operational efficiency and effectiveness. According to the former Secretary of Defense, future increases in spending for readiness and weapons modernization will have to come, in part, from infrastructure reduction savings. Further, DOD officials recognized that to fund weapons modernization and modernization of required RDT&E infrastructure, DOD must reduce current infrastructure costs by eliminating old, high-maintenance, and inefficient RDT&E facilities while retaining critical capabilities to meet future requirements.

Since 1989, DOD has missed three opportunities for interservice consolidations to reduce RDT&E infrastructure and maintained the status quo of separate RDT&E facilities for each military service instead. These opportunities were (1) the RDT&E restructuring that occurred at the end of Cold War, (2) the 1995 BRAC round, and (3) Vision 21.

[6]These efforts include DOD's Vision 21 and Quadrennial Defense Review and a joint draft rocket propulsion test alliance.

The end of the Cold War afforded DOD its first opportunity. In 1989, the President directed the Secretary of Defense to develop a plan to implement fully the Packard Commission recommendations[7] and to review DOD's management. The Secretary of Defense formed a task force to provide specific plans on how suggested guidance on cutbacks would be implemented. One of the task force's recommendations was to consolidate RDT&E activities into a single agency.

In response to the recommended consolidation, the services offered a counter-proposal that ultimately established Project Reliance, which was intended to improve coordination and reduce overlap and duplication in the services' RDT&E programs and facilities. While Project Reliance has improved communications and increased cooperation between the military services' RDT&E activities, it was not conceived as a mechanism for infrastructure reductions and thus maintains the status quo. DOD also did studies that focused on interservice rather than intraservice consolidations, in which the three services were already engaged. DOD's first opportunity was lost because the services implemented RDT&E restructuring with little interservice consolidation.

DOD officials did not—and still do not—have a sense of "crisis" because RDT&E funding long has been a national security priority and has been relatively flat or decreasing only slightly. The closest DOD came to facing a "crisis" similar to that of the British Ministry of Defence was a 1990 task force recommendation to consolidate all RDT&E organizations into a single agency.[8] In referring to this recommendation, an official in the Office of the Secretary of Defense stated that "nothing could bring the services together in agreement like a threat."

Overall, the roles and missions of DOD's RDT&E facilities are aligned closely with the services and responsive to their requirements. They are integral components of the military departments' acquisition and combat support infrastructure. The basic mission of DOD's laboratories is "to provide the technical expertise to enable the Services to be smart buyers and users of

[7]The recommendations addressed defense management structural problems in the areas of national security planning and budgeting, military organization and command, acquisition organization and procedures, and government-industry accountability. The recommendations included (1) presenting the defense budget to the Congress based on national priorities and operational concepts rather than line items; (2) changing current law to designate the Chairman of the Joint Chiefs of Staff as the principal uniformed military advisor to the President, the National Security Council, and the Secretary of Defense; (3) creating the new position of Under Secretary of Defense (Acquisition); and (4) providing precise criteria for applying contractor sanctions.

[8]See Defense Management Report: RDT&E Consolidation, Office of the Under Secretary of Defense for Acquisition Defense Management Report Task Force (Oct. 9, 1990).

new and improved weapons systems and support capabilities."[9] While DOD's laboratories act as interpreters and integrators of technology, industry produces the products—weapons systems—that the laboratories' customers, the warfighters, ultimately use. Although each service aligns its laboratories along core product lines (such as ships, aircraft, tanks, weapons, and communications) and assigns its laboratories full life-cycle R&D responsibility, DOD laboratories help support each of the six areas of national need outlined in chapter 1.

It has been long recognized that the services have had many crosscutting opportunities for more direct use of resources so that duplicative and overlapping capacity and capabilities could be reduced or eliminated. However, service parochialism and controversies successfully thwarted any such restructuring. Although DOD officials recognize that any lasting solution to reducing RDT&E infrastructure requires breaking down long-standing cultural barriers involving service parochialism, DOD to date has been unable to achieve that goal even with an independent, external authority (the BRAC process), which focused primarily on the closure of military bases.

Since 1988, the BRAC process also has been the primary vehicle within DOD for RDT&E infrastructure reductions. In 1996, we reported that despite four BRAC rounds in 1988, 1991, 1993, and 1995, DOD's infrastructure reductions had not kept pace with reductions in funding, personnel, and force structure.[10] When the last round has been implemented fully by 2001, DOD will have closed 62 RDT&E sites and activities at host sites,[11] but significant excess capacity will remain in DOD's RDT&E infrastructure. According to officials from the BRAC 1995 Laboratory Joint Cross-Service Group, after all current BRAC actions have been completed, DOD's laboratory infrastructure still will have an excess capacity of about 35 percent. Similarly, according to officials from the BRAC 1995 Test and Evaluation Joint Cross-Service Group, DOD's T&E infrastructure will have an excess capacity of about 52 percent in the areas of air vehicles, electronic combat, and armaments/weapons.

[9]See Federal Advisory Commission on Consolidation and Conversion of Defense Research Laboratories, 1992.

[10]See Defense Acquisition Infrastructure: Changes in RDT&E Laboratories and Centers (GAO/NSIAD-96-221BR, Sept. 13, 1996).

[11]During the four BRAC rounds, the Army closed only three sites and 11 activities at sites located on other installations. The Navy closed 13 sites and 27 activities at host sites. The Air Force closed only three sites and five activities at host sites.

DOD has been forced through four BRAC rounds[12] to clearly define and delineate in detail the full scope of its supporting RDT&E infrastructure. Also, during the BRAC process, DOD attempted to develop and use accurate, comparable cost data to overcome concerns regarding the lack of consistency and reliability of data used in the process, but was unsuccessful. DOD did not capture the total costs associated with operating and maintaining its RDT&E infrastructure in previous BRAC rounds either—and still does not know the true costs of operating its RDT&E facilities. DOD officials found it particularly difficult to compare laboratories across the services due to insufficient cost and equipment use data. In some cases, according to BRAC 1995 participants, data were collected and compiled by those most affected by the outcome of the analysis, and prior knowledge about how the data was to be evaluated led to modifications of the data in a way that made an accurate analysis impossible.

During the first three BRAC rounds, each of the service's processes and recommendations focused almost exclusively on its own activities without considering the potential for consolidating work across service lines. Therefore, joint cross-service groups for RDT&E facilities, among others, were established for BRAC 1995. The Vice Chairman of the Joint Chiefs of Staff advocated a strong role for the joint cross-service groups and recommended that the services be required to incorporate their alternatives in the final recommendations,[13] thus affording DOD the second opportunity for interservice consolidations. However, the services asserted that they had to retain the final decision on realignments and closures to meet their individual responsibilities to ensure, for example, a ready and controlled source of technical competence and the resources necessary to ensure timely responses.

DOD also lost opportunities in the BRAC 1995 process to reduce its RDT&E infrastructure.[14] For example, DOD's decision to split its analysis of R&D laboratories and T&E centers into two groups created artificial barriers around the functions and facilities that each could consider. R&D laboratories and T&E centers later were reviewed independently using

[12]See Base Realignment and Closures: Report of the Defense Secretary's Commission (Dec. 29, 1988); 1991 Report to the President, Defense Base Closure and Realignment Commission (July 1, 1991); 1993 Report to the President, Defense Base Closure and Realignment Commission (July 1, 1993); and 1995 Report to the President, Defense Base Closure and Realignment Commission (July 1, 1995).

[13]See Military Bases: Analysis of DOD's 1995 Process and Recommendations for Closure and Realignment (GAO/NSIAD-95-133, Apr. 14, 1995).

[14]See Defense Acquisition Infrastructure: Changes in RDT&E Laboratories and Centers (GAO/NSIAD-96-221BR, Sept. 13, 1996).

different methodologies. Also, the services protected their own facilities, which undermined the BRAC process. The services did not adopt scenarios that could have eliminated excess T&E infrastructure and could not agree on comparable definitions of laboratories and centers or potential realignments or closures, since they were unwilling to collocate or rely on each other. Thus, BRAC 1995 resulted in little joint cross-servicing.

Upon expiration of BRAC legislation and full implementation of previous BRAC recommendations, DOD and the Congress realized that RDT&E infrastructure needed to be reduced further. Because DOD was unable to do it on its own, the Congress directed the Secretary of Defense, in the National Defense Authorization Act for Fiscal Year 1996 (sec. 277), to develop a 5-year plan to consolidate and restructure DOD's RDT&E facilities for the 21st century. The Secretary of Defense was to specify the administrative and legislative actions needed to consolidate RDT&E facilities into as few as practical and possible by October 1, 2005.[15] The Secretary of Defense responded with a plan and developed a legislative package entitled Defense Research, Development, Test and Evaluation, Vision 21, Reduction, Restructuring and Revitalization Act of 1997 (commonly referred to as Vision 21). DOD initially sought unilateral authority to reduce its RDT&E infrastructure. However, while the legislative package was being reviewed for interagency coordination, officials from OMB told DOD that it must include an independent commission in the Vision 21 process, since DOD has historically been unable to reduce significantly its RDT&E infrastructure.

DOD officials consider Vision 21 the equivalent of a BRAC round for RDT&E facilities. DOD officials structured Vision 21 to incorporate the lessons learned from BRAC 1995 concerning the decision-making process, which had resided solely with the services. Thus, Vision 21 became another DOD opportunity for interservice consolidations. Moreover, DOD's plan incorporated most of the critical elements used by the Boeing Company Defense & Space Group and the Defence Research Agency, such as the collection of accurate, reliable, and comparable data that captured the total cost associated with RDT&E operations and an analysis of the data along functional lines and related directly to the agency's overall mission. The legislative package was modified to include a provision for an independent commission outside of DOD to make the final realignment and closure recommendations to the Congress.

[15]Section 265 of the act requires the Secretary to conduct a related comprehensive review of the aeronautical research and test facilities and capabilities to assess their current condition.

Vision 21 did not contain any provision to review related or duplicative facilities in other agencies, however, because the Congress, in section 277, did not direct DOD to seek interagency cooperation. Moreover, DDR&E officials want to rationalize DOD's RDT&E facilities before addressing issues inherent in analyzing NASA and DOE facilities as well.

More recently, the Quadrennial Defense Review called for two additional BRAC rounds for fiscal years 1999 and 2001. DOD decided not to submit its legislative package for Vision 21 and instead opted to include RDT&E infrastructure in any future BRAC round, again rejecting efforts that would result in interservice consolidation and delaying this opportunity to implement the critical elements used in the Boeing Company Defense & Space Group's and the Defence Research Agency's restructuring. Since the Congress has not accepted DOD's BRAC legislative package and DOD's recommendation for two new BRAC rounds in 1999 and 2001, it remains unclear whether DOD will attempt to consolidate and restructure its RDT&E infrastructure and how it might proceed.

Conclusions

Although there are no easy solutions for how a successful consolidation process can be used to restructure and reduce RDT&E infrastructure throughout the federal system, our review indicates that lessons from the Boeing Company Defense & Space Group and British Ministry of Defence models could be applied successfully to federal agencies.

- A Catalyst to Spark Action. Catalysts that precipitated successful laboratory consolidations by the Boeing Company Defense & Space Group and the British Ministry of Defence (i.e., severe fiscal constraints, structural changes that shift significantly control of budgets, mission failures, etc.) are not affecting federal agencies in ways that effect bold actions. In an enterprise as broad and diverse as the federal laboratory system, the potential effects of catalysts such as "budget crises" may be averted for years because the impacts of funding reductions and mission shifts can often be delayed indefinitely. It is well understood by many laboratory managers and budgeteers, however, that a federal budget "crunch" precipitated, in part by continued decreases in federal discretionary spending, is "right around the corner." Considering conditions that exist in the federal laboratory systems, now is the time to act.
- An Independent Authority to Direct Restructuring. Many government officials responsible for directing federal RDT&E activities, as well as academic and industry representatives, have said that significant barriers

impede successful infrastructure reduction efforts. Further, many of them agree that, while a more rational R&D infrastructure is needed, agencies have been unable to achieve significant infrastructure reductions alone because they face intractable barriers. They further conclude that an independent, external panel or commission would be crucial to making significant reductions. At various times, some members of Congress, the GAO, and others, having reached similar conclusions, have called for consideration of this option for DOE, NASA, and DOD laboratories or T&E centers.

However, there is little agreement on how to structure an independent authority to focus on governmentwide reductions of RDT&E infrastructure, and no agreement exists on the scope of the restructuring to be attempted. Such an approach could only succeed if both the Congress and the administration agree that change is necessary and openly demonstrate the willingness to scale the federal RDT&E infrastructure to better meet national needs.

- Core Missions That Support Organizational Goals and Strategies. Although federal laboratories acknowledge the need to focus their core missions better, they have been incapable of doing so on their own. However, it is taken for granted that missions must be refocused around agency core functions if they are to meet impending fiscal constraints. Existing legislative frameworks, such as the Government Performance and Results Act of 1993 (the Results Act), could be used to determine and establish appropriate core missions for each laboratory in the federal RDT&E system. The Results Act already engages agencies and the Congress in a dialogue about missions and performance. In addition, alternative approaches to reducing infrastructure, but also requiring legislative action, include the following:

  - Establish an independent commission with the authority to (1) review and evaluate the agencies' R&D laboratory and T&E center missions, (2) conduct comparative analyses of the RDT&E capabilities and capacities, and (3) make recommendations regarding mission focus and infrastructure reductions to the Congress and the administration.
  - Prepare for a comprehensive RDT&E infrastructure reduction effort by having an independent authority begin a "pilot program" to focus on one or two lines of research or documented areas of duplication, redundancy, or excess capacity. Potential areas or commodities include chemical and biological warfare agents, solar power, nuclear nonproliferation, or energetics.

- Amend current mandates, such as section 277 of the National Defense Authorization Act for Fiscal Year 1996, to require interagency analyses in decision-making regarding reductions of RDT&E infrastructure.

- The Full Scope of Infrastructure Clearly Delineated. Agency efforts to identify and disclose the scope and capabilities of their RDT&E infrastructure, which have only recently emerged, have not yet been used for infrastructure reductions. The computerized Major Facilities Inventory, which includes more than 1,494 RDT&E facilities operated by DOE, NASA, and DOD, as well as R&D facilities owned by the National Ocean and Atmospheric Administration, is a first step and could provide data to set the stage for reductions. Interagency agreement not to take anything "off the table" before discussion begin also is necessary.
- Accurate, Reliable, and Comparable Data on Infrastructure Cost and Utilization Rates. Accurate and reliable data about the true cost of operating federal RDT&E facilities are not available, thus making meaningful comparisons of relative efficiency difficult.

Observations and Matters for Congressional Consideration

Observations

The RDT&E establishment is in transition. The missions of R&D laboratories and T&E centers are being redefined within a changed global environment as agencies compete for scarce federal resources. Future pressures to reduce discretionary spending governmentwide suggest that, without changes now, a greater share of science funding will be devoted to operating and maintaining an aged, inefficient, and costly infrastructure at the expense of research and development. The current condition, although unsettled, provides an opportunity to shape the future in a way that ensures an efficient and rational RDT&E infrastructure is in place to support current and future science priorities.

Adjusting the federal infrastructure to meet the most important current and future RDT&E requirements is an enormous task that has, to date, proven to be intractable. Cultural and parochial barriers have, in large part, been responsible for federal agencies' inability to achieve a major restructuring of RDT&E facilities within and across the agencies. As is apparent in reviewing the restructuring process of the Boeing Company's Defense & Space Group and the British Defence Research Agency, the use of an independent authority to direct the process was key to achieving streamlined RDT&E operations and infrastructure. The approaches taken by individual agencies have not been sufficient to balance the federal RDT&E infrastructure with focused core missions and has resulted in concerns about mission overlap and duplication and the retention of excess capacity. For example, the September 1997 plans submitted by these agencies as mandated by the Results Act did not use cross-agency criteria for assessing missions as required by the Results Act.

The critical elements of the best practices model we analyzed, when compared to ongoing efforts in the federal government, suggest approaches that could prove successful. However, consensus must be reached that significant changes in the RDT&E infrastructure would better position federal agencies to support current and future science priorities through a more efficient and rational RDT&E infrastructure possible.

First, we encourage the federal departments and independent agencies to continue their individual efforts to achieve management efficiencies in their respective RDT&E infrastructure restructuring efforts, but with an increased focus on interagency approaches. Cross-agency efforts to support an RDT&E infrastructure restructuring process could begin in the executive branch with two agencies: (1) OSTP, which has technical cognizance across the federal RDT&E arena, but no direct means to effect change and (2) OMB, which is responsible for helping to maintain effective

government by reviewing the organizational structure and management procedures of executive branch agencies and developing efficient coordinating mechanisms to implement government activities and expand interagency cooperation.

Although these agencies have engaged DOE, NASA, and DOD in internal reviews, such as OSTP's recently established NSTC Interagency Working Group, no independent mechanism exists to undertake a structured approach for streamlining the overall federal RDT&E infrastructure, that is, looking at the infrastructure of individual agencies in support of the government's broader strategies and missions. OMB, in responding to a draft of this report, said that it prefers to see federal RDT&E infrastructure examined as a whole only after reductions using the current agency-by-agency approaches are completed.

Ultimately, however, many of the structural and other barriers that exist between agencies go beyond those found at the agency level. Initiating a governmentwide process that includes all five elements discussed in this report could mitigate virtually all of the parochial concerns that stymied past efforts to restructure.

Establishing an independent decision-making authority could ensure that all elements of the process are administered fairly. In implementing the process described in this report, such an authority could benefit from information developed through ongoing initiatives, such as proper implementation of the Results Act, to help coordinate missions and goals of individual agencies that are involved in crosscutting program areas and balancing individual agencies' multiple strategic goals. It also could benefit from lessons learned from the government's past uses of independent authorities, such as the defense base closure and realignment commissions, and from activity and budget details about research and development accumulated in the RaDiUS database that is used to compile systematically data on federal R&D investments.

The need to reduce RDT&E infrastructure in balance with mission requirements is a long-standing and complex issue. Agency efforts to date, while encouraging in some cases, are too narrowly focused and likely will promote or sustain duplication and excess capacity. Further, many of the elements employed as best practices by other organizations are neither integral to nor readily available to federal agencies. Thus, a governmentwide approach, which could focus both within and across agencies may offer a viable alternative and increase the likelihood of

successfully reshaping the nation's RDT&E infrastructure to meet current and future needs. While agencies should be encouraged to continue ongoing efforts to improve efficiencies in the management of RDT&E infrastructure, emphasizing interagency approaches could be a significant improvement in this arena.

Matters for Congressional Consideration

To help craft a more efficient structure to support future federal RDT&E efforts, the Congress may wish to begin a process to reduce the federal RDT&E infrastructure that applies collectively the critical elements identified in this report. This process could be designed to look both within and across agencies to eliminate unnecessary mission overlap and duplication and the resulting excess infrastructure capacity. Lessons learned from the federal government's past uses of independent, external authorities could be used to provide structure to this process. Ongoing restructuring efforts of the agencies could be assessed for their potential to contribute to overall RDT&E infrastructure streamlining. The RaDiUS database could provide preliminary inputs indicating possible duplication of effort. The Government Performance and Results Act of 1993 provides an established legislative framework, which addresses agencies' missions and performance, and may be useful in focusing specifically on crosscutting agency missions that determine the requirements for RDT&E infrastructure.

Agency Comments and GAO's Evaluation

In commenting on a draft of our report, the Departments of Energy and Defense, NASA, and OMB generally indicated that the report did not give sufficient credit for actual, ongoing, and planned infrastructure reductions they have undertaken. To illustrate further the infrastructure reduction steps the agencies have initiated, we have added information that recognizes other agency plans and activities.

Although the agencies acknowledge that they need to reduce further their infrastructure, there was no universal view expressed as to how to effect significant change in the federal RDT&E infrastructure. For example, while each of the four agencies recognized the importance of mission focus in their comments, they had varying perspectives regarding the efficacy of the model's other critical elements. DOE, for example, does not believe a "crisis" is needed to spur action, stating that changing missions and budget reductions provide the external pressure needed to get change. However, as the report points out, DOE's new missions are being developed from the inside and decreases in budgets have been addressed largely through plans

to improve management efficiencies. Conversely, NASA agreed with the need for accurate and reliable data about the true cost of operating RDT&E facilities and pointed out that it is developing an integrated financial management system to gather such data. DOD agreed with our conclusion regarding the need for an independent, BRAC-like authority to effect significant change. DOE and NASA, on the other hand, believe they can make, or have already made, appropriate changes regarding the future strategies for their RDT&E infrastructure. OMB's strategy blends the two. OMB believes each agency should rationalize individually its infrastructure before a more complex interagency approach is attempted. OMB agrees with GAO, however, that an interagency approach is needed. With respect to defining fully the scope RDT&E infrastructure, the agencies comments largely were silent.

After reviewing carefully the agencies' comments, we believe that the comments generally reflect the parochialism and structural and organizational barriers discussed in the report. For example, when the agencies' comments discussed planned RDT&E infrastructure reductions, those plans were limited in scope and focused exclusively on internal reductions. While acknowledging, in some cases, overlapping capability and excess capacity in RDT&E infrastructure, Departments of Energy and Defense and NASA comments generally reflect their belief that (1) their missions and associated infrastructure are unique, (2) they have planned to do enough restructuring and consolidation on their own, and (3) they already coordinate among agencies to the maximum extent practicable.

OMB states that although additional steps are necessary to ensure success, agencies should downsize first before crosscutting analysis is conducted. We believe that, to the extent the agencies actively pursue interagency approaches as they restructure their respective RDT&E infrastructures, the potential for success in ongoing efforts may be increased. Decision-making on the size and scope of infrastructure needed by an individual agency in the absence of information and consideration of related missions and activities has resulted in decisions that are neither rational nor cost effective when looked at from a broader perspective.[1] We and the agencies agree that maintaining more RDT&E infrastructure than warranted by requirements does not well serve the nation's research needs and that successful consolidation and reduction efforts are key ingredients to assuring adequate resourcing of future research in science and technology.

[1]See, for example, Electronic Combat: Consolidation Master Plan Does Not Appear to Be Cost-Effective (GAO/NSIAD-97-10, July 10, 1997).

Our perspective differs from the agencies' in that we believe the best way to achieve this end is through a governmentwide restructuring process.

DOD generally supported the findings in our report. For example, DOD said that a significant reduction in infrastructure can only be achieved under BRAC-like authority. However, DOD responded that (1) we did not give appropriate weight to the role of the Congress in reducing infrastructure by the BRAC process and to the reductions in RDT&E infrastructure prior to the 1995 BRAC round, (2) the Vision 21 effort should not be listed as a lost opportunity because it is expected to continue under existing authority, (3) excess capacity expressed in work years may not necessarily match up to excess physical facilities, (4) the personnel component of the RDT&E infrastructure has been declining steadily by 4 to 5 percent annually since 1993, and (5) the supporting mission of the DOD laboratories and T&E facilities in providing superior warfighting technology has never been challenged. We agree fully with DOD on the need for an independent, BRAC-like authority and recognize that the Congress has an important role to play, as it has on prior occasions. We believe the extent DOD's Vision 21 effort proceeds under existing authority may be largely dependent on continuing congressional support for reductions. We acknowledge fully that personnel reductions of the magnitude suggested by DOD have occurred and continue under congressional mandates. However, we have reported that, overall, defense civilian acquisition workforce costs are about the same as they were in 1980 as measured in constant dollars.

DOE questioned the basic applicability of the best practices model, stating that the scale and complexity of its R&D enterprise presents a much bigger challenge than that faced by the Boeing Company Defense & Space Group and the Ministry of Defence. We do not imply that the model could be transplanted exactly to any organization or situation, but indicate that the basic underlying principles and processes are key. For example, we report that DOD's Vision 21 process, which contains provisions for an independent authority, inclusion of full operating costs, and strong mission focus incorporated many of the same critical elements described in the model. Further, while it is self-evident that differences in scale (and complexity) may make it more difficult to overcome challenges and barriers, these differences do not negate the validity of the process for different types of organizations nor of the key elements employed in successful consolidations. DOE also commented that (1) the end of the Cold War has had a major direct effect on its mission and the mission of its laboratories, (2) DOE's Offices of Defense Programs, Nuclear Energy, and Energy Research will declare excess an estimated 1,000 facilities over the 5-year

period from 1996 to 2000, (3) DOE laboratories have unique facilities and capabilities that also serve other federal agencies, and (4) the agency's Laboratory Operations Board has developed a "Strategic Laboratories Mission Plan." We have reported that much of DOE's "evolved mission" is not unique, but is shared, at a minimum, with the NSF and the Department of Commerce.

NASA said that (1) it has experienced upheaval, restructuring, downsizing, and streamlining and has been reinventing itself since well before the 1995 National Performance Review, (2) it does not have an integrated financial system, (3) a major objective of its strategic planning process is proper sizing of its infrastructure, and (4) based on its Zero-Base Review, it has made appropriate plans to implement closure of unnecessary facilities. NASA also believed that by addressing the three major agencies in the same report, we had overly generalized conclusions and overlooked its accomplishments. We acknowledge fully the goals of NASA's completed Zero-Base Review in our report, but we conclude that it is unlikely that NASA's planned reductions will meet its own internal objectives.

NASA further commented that it was concerned about our publishing the report because, in NASA's opinion, the report did not meet our normal standards, largely because NASA believes the report overlooks its accomplishments in reducing RDT&E infrastructure while focusing on governmentwide issues. While we recognize NASA's accomplishments, we also note that NASA has not closed any of its major facilities, as supported by its own comments on this report.

Comments From the Office of Management and Budget

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

OCT 9 1997

Henry L. Hinton, Jr.
Assistant Comptroller General
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Hinton:

Thank you for the opportunity to comment on the draft GAO report "BEST PRACTICES: Elements Critical to Successfully Reducing Unneeded Research and Testing Facilities."

In this reply, I will concentrate primarily on the aspects of the report dealing with OMB's role in the review and evaluation of potentially unneeded research and testing facilities and highlight specific examples of OMB involvement in agency efforts to reduce RDT&E facilities with overlapping capabilities.

Now on p. 9.
See comment 1.

Now on p. 4.
See comment 2.

There are two key areas where we take exception to your report. We do not agree that "No independent authority--such as the Director of the Office of Management and Budget--has undertaken a structured approach for streamlining the overall federal RDT&E infrastructure, that is, looking at the infrastructure of individual agencies in support of the government's broader strategies and missions" (pages 10-11). Nor do we agree that "The Departments of Energy and Defense and NASA have done little to reduce their excess laboratory capacity and costs" (e.g., on page 5). DoD, DoE, NASA and OMB *have* undertaken various actions that we expect will lead to reductions in excess capacity but additional steps are necessary to ensure success, and thus the process is in too early a phase to have large reductions *in hand.*

See comment 3.

See comment 4.

The reduction of the Federal RDT&E infrastructure is an exceedingly complex task and will take many years to accomplish. We believe that the restructuring processes will best proceed in phases, with restructuring of individual agency facilities being the first phase. Only after we deal with the first phase can we go on to the more difficult inter-agency phase with reasonable expectations of success. As GAO is aware, there are numerous statutory, organizational and external interests, many of which are agency-unique, that will have to be addressed in any significant restructuring of the Federal laboratory system. Although the Federal RDT&E infrastructure should be examined as a whole after individual agency reductions have been made, the scope of an all-purpose multi-agency infrastructure review would be simply too large at this time to be likely to lead to success. We have to break the process into tractable elements.

Now on p. 61.
See comment 5.

Now on p. 62.
See comment 6.

Now on p. 60.
See comment 7.

In the case of NASA, OMB has initiated several facility downsizing reviews and assisted NASA with its on-going infrastructure assessment over the past few years. At the urging of OMB, NASA took aggressive actions to determine its appropriate facility infrastructure in NASA's Zero Based Review (ZBR), an agency-wide evaluation of NASA's RDT&E and other facilities that was not mentioned in the draft report. One conclusion in the draft report (page 69) suggests that "existing legislative frameworks, such as the Government Performance and Results Act of 1993, could be used to determine and establish appropriate core missions for each laboratory." For NASA and OMB, this process is currently ongoing, and each NASA center has been identified as a "Center of Excellence" for a critical R&D area within NASA. Through the ZBR, GPA strategic planning exercises with OMB and other mechanisms, NASA closed 30 facilities. However, the implementation of these agency efforts is just beginning. Another draft conclusion (page 70) states that "accurate and reliable data about the true cost of operating RDT&E facilities are not available, thus making meaningful comparisons of relative efficiency difficult." At OMB's direction, NASA is working to obtain an integrated financial management system to further address major issues of cost, programs and staffing.

The experience with DOD has been somewhat different. As GAO notes, previous BRAC rounds have not produced major downsizings in the DoD lab and test center infrastructure. Therefore, to find a way to reduce the infrastructure burden and to respond to Section 211 of the FY 1996 Defense Authorization Bill, DoD produced a draft plan to reduce, restructure and revitalize its laboratory and test center system: Vision 21.

During the spring of this year, OMB worked closely with the Department of Defense to mold Vision 21 legislation that could achieve the aims of that plan. When the Quadrennial Defense Review recommended a wider-scale round of base closures, the lab and test center closure process was folded into legislation for that purpose--we would like to be able to consider more restructuring than just that possible from the labs and test centers. This was not a case of DoD--or any other Executive Branch organization--"rejecting efforts that would result in interservice consolidation and eliminating this opportunity to implement the critical elements" of lab restructuring (page 67). The BRAC process would in fact have included the same type of independent commission that is envisioned by GAO and that we also believe has merit. If that proposal had been adopted in the FY 1998 Authorization Bill, the first stage of our efforts on DoD facilities could be on the way to implementation. With the rejection of that legislation, we will have to review our prospects for success with RDT&E facilities combined with other facilities. However, neither OMB nor DoD intend to stop efforts to achieve a more efficient and effective lab and test center system.

2

See comment 8.

While we agree with the basic thrust of the draft report that certain factors or elements (e.g., an independent assessment authority, a focus on core missions, accurate data, etc.) are useful in achieving reductions, we believe that the Executive Branch agencies and OMB have produced reasonable processes for achieving reductions and have achieved more in some of those areas than the draft report acknowledges.

We appreciate the opportunity to review the draft report. If we can be of further assistance, please let us know.

Sincerely,

Gordon Adams
Associate Director
National Security and
International Affairs

T.J. Glauthier
Associate Director
Natural Resources,
Energy, and Science

3

The following are GAO's comments on the Office of Management and Budget's letter dated October 9, 1997.

GAO Comments

1. Our report states that, among the agencies we reviewed, only the Department of Defense (DOD) has been assessed by an independent authority charged with reducing infrastructure significantly, and those reviews did not look across related agencies having significant research, development, test, and evaluation (RDT&E) infrastructure such as the Department of Energy (DOE) and the National Aeronautics and Space Administration (NASA). The Office of Management and Budget (OMB) stated in its comments that such a review has not been done and "...would be simply too large at this time ...." We also changed the wording in the report to better reflect OMB's views concerning agencies' progress in rationalizing their RDT&E infrastructure.

2. We reported in detail the major actions taken by agencies in recent years to reduce RDT&E infrastructure. We noted, however, that these actions were almost exclusively intra-agency in nature and, with the exception of base realignment and closure (BRAC) actions, generally did not reduce significantly the number of major facilities.

3. We agree with OMB that making RDT&E infrastructure reductions may be a difficult task. However, we disagree with OMB's preferred strategy of first restructuring the infrastructure of each individual agency before examining them on an interagency basis. Pursuing such an approach that has agencies individually conducting "stovepiped" reviews that ignore similar and complementary infrastructure in other agencies may result in unintended consequences (i.e., additional investments may be made in the wrong areas or the wrong facilities may be closed or realigned).

4. We agree with OMB's conclusion that the federal RDT&E infrastructure should be examined as a whole. However, we believe the barriers to reducing such infrastructure may best be attacked by conducting such analyses before each agency completes individual infrastructure reviews.

5. The report discusses our analysis of NASA's Zero-Base Review and gives significant coverage of its objectives and results to date. It is encouraging to note that OMB and NASA are using the Government Performance and Results Act of 1993 (the Results Act) as a framework in their discussions of RDT&E infrastructure.

6. Although NASA is implementing an integrated financial management system to improve the quality of data used for decision-making, NASA officials have acknowledged that such a system will not likely provide overall summary data in sufficient detail to provide comparative efficiencies in the different facilities and installations that comprise the RDT&E infrastructure.

7. DOD's Vision 21 effort is currently at a standstill in its implementation. However, it is encouraging that OMB and DOD have stated their intent to resume the Vision 21 process at some time in the future, with or without implementing BRAC legislation.

8. We have addressed all the relevant agency initiatives that deal with the issues considered in this report and that were described as being fully implemented at the time our review was performed.

Comments From the Department of Energy

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

Department of Energy
Washington, DC 20585

October 1, 1997

Mr. Henry L. Hinton, Jr.
Assistant Comptroller General
U. S. General Accounting Office
National Security and International
Affairs Division
441 G. Street, N.W., Room 4035
Washington, D.C. 20548

Dear Mr. Hinton:

Thank you for the opportunity to review and comment on your draft report, "Best Practices: Elements Critical to Successfully Reducing Unneeded Research and Testing Facilities," concerning issues related to the Federal Government's research, development, test, and evaluation (RDT&E) infrastructure, Government Accounting Office (GAO) job code 707179. We have had the opportunity on two occasions to discuss several concerns regarding the draft report with your staff who expressed their intent to address them in the final report. A copy of our detailed comments on the draft report is enclosed for your review.

See comment 1.

The parts of the report applying to DOE seem premised on the following assumptions: (1) the laboratories are seeking to "expand or redirect their RDT&E missions to justify the existing infrastructure, while retaining old, poorly maintained, facilities;" (2) there is duplication of capabilities among the facilities of various agencies; and (3) restructuring processes used by Boeing and the British Defense Research Agency are a valuable model for reducing costs and consolidating our efforts.

See comment 2.

- The end of the Cold War has had a major effect on the DOE mission and the mission of the laboratories. The Department has developed the Science Based Stockpile Stewardship Management Program, which is both a necessary component of our national defense and a complex and difficult R&D program being executed at our laboratories. If compared to the total cost of nuclear weapons readiness in the past, one could argue that the Stockpile Stewardship Management Program takes the place of large portions of the production complex and significantly reduces the total cost of maintaining the nuclear deterrent and thereby significantly reduces its related infrastructure.

See comment 3.

- The statement in the GAO report that "no major facilities will be consolidated or closed because of the program" leaves out recognition of the major weapons production facilities that are no longer required. An estimated 1,000 facilities currently managed by the Offices of Defense Programs; Nuclear Energy, and Energy Research will be declared excess in

Printed with soy ink on recycled paper

the five-year period from 1996 to 2000. We are now in the early stages of a major effort to deactivate, shut down, and remove these facilities from the Department's inventory, but the clean up cost of these facilities affects the pace at which we can complete this task.

See comment 4.

- Rather than being duplicative, the DOE laboratories have unique facilities and capabilities which also serve other Federal mission agencies (e.g., National Aeronautics and Space Administration (NASA), Department of Defense (DOD), National Institutes of Health (NIH), and the Environmental Protection Agency (EPA). Our laboratories carry out research and development for these agencies at a level of over $1 billion. This work also supports the Department's programs and effectively utilizes the science and technology infrastructure at our laboratories for the benefit of the Nation.

See comment 5.

- We question the applicability of the restructuring models cited in the report. The scale of the restructuring was very small when compared to the DOE laboratory complex, and driven by different considerations. As noted, one of the most important elements common to these models was, "...a crisis that served as a catalyst to seek action." We believe that it is unwise to precipitate a crisis, and that the Department is being responsive to both changing mission needs and the recommendations of the various reviews which

See comment 6.

have addressed laboratory management. Further, changing missions and budget reductions provide a significant external forcing function.

See comment 7.

The Department has undertaken a major effort over the past few years to improve the management of its laboratories and reduce their costs. Our goal is to develop a DOE laboratory system that is respected not only for the outstanding quality of its R&D, but also for its management and efficiency in addressing the Department's vital national missions of national security, energy, environment and science. To that end, the Department has underway or has already completed significant restructuring, downsizing, and streamlining of DOE's organization and of its government-owned, contractor-operated laboratories. A major challenge of the Department's strategic management process is the appropriate sizing of our infrastructure and our responsibility to continue to provide the scientific user facilities needed to stay on the cutting edge in all of our research mission areas.

See comment 8.

The Department established a Laboratory Operations Board in 1995 to guide DOE in this effort. To date, the Board has overseen reforms that enabled the laboratories to reengineer processes to which should result in cost savings exceeding $2.5 billion over five years. During the past two years, the Board has developed the Strategic Laboratories Mission Plan and recommended improvements in the institutional, strategic, and program planning processes for the Department's major laboratories to help ensure that they have the right capabilities to meet mission needs and have appropriately focused mission roles. The laboratory institutional plans have been streamlined and refocused on strategic and institutional issues including infrastructure. They contain a statement of each laboratory's mission, roles (i.e., principal, major contributing and specialized) and R&D activities. Annual on-site reviews focus on operations and infrastructure issues. The Board will review the plans for each laboratory on an annual basis. The Board has recently

See comment 9.

completed a review of the multi-program laboratories and is now undertaking a review of five of the Department's small, mission-specific laboratories to validate their roles or determine if they are candidates for privatization, consolidation, closure, or alternative contracting mechanisms.

I would be glad to discuss any of the comments contained in the enclosure with you at your convenience.

Sincerely,

Martha A. Krebs
Director
Office of Energy Research

Enclosure

The following are GAO's comments on the Department of Energy's letter dated October 1, 1997.

GAO Comments

1. Our review was conducted to address several objectives that are clearly stated in the report. Nowhere among the objectives were there "assumptions regarding the Department of Energy...." DOE incorrectly characterizes as assumptions our findings regarding critical elements and processes used by other organizations to consolidate successfully and their applicability to DOE. Further, we have reported on (and continue to report) DOE's lack of mission focus and that some mission areas and capabilities overlap with other federal agencies (i.e., the National Science Foundation, the Department of Commerce, and the Environmental Protection Agency, to name a few). Further, we note that managerial imperatives such as (1) focused missions (through the Results Act processes, strategic planning, or otherwise), (2) recognition of fiscal constraints in decision-making, (3) an understanding of the full implications of operating costs, and (4) strategies to overcome the effects of cultural and structural barriers are (or should be) as broadly applicable to federal managers as they are to managers applying "best practices" in other organizations.

2. Our report reflects the emergence of the Stockpile Stewardship and Management Program and its approach to assuring the viability of our nuclear deterrent stockpile. We agree that the program's success could allow DOE to reduce significantly related infrastructure. However, during our review, this had not yet been done.

3. DOE's statement that over 1,000 facilities will be declared excess over the 5-year period (1996 to 2000) is an example of the magnitude and scope of the federal RDT&E infrastructure that requires consolidation. We agree that cleanup costs affect significantly the pace of closing such facilities.

4. Although some laboratories have some unique facilities and capabilities, there are myriad areas of duplicative and overlapping capabilities in federal agencies' laboratories, both within and among agencies. The extent of mission overlap between agencies must be addressed as part of the Results Act process. Further, the extent of overlap and duplication of capabilities, facilities, and research has been suggested by others as an area that needs to be assessed.

5. As stated in the report, the cited model was applied in the successful consolidations by dissimilar organizations. It is self-evident that differences in scale and complexity may make it more difficult to overcome challenges and barriers. These differences, however, do not negate the validity of the process for different types of organizations nor of the key elements employed in successful consolidations. For example, both DOD's Vision 21 process and past BRAC rounds incorporated many of the same critical elements described in the model.

6. To date, budget reductions have not been a sufficient catalyst for change. Agencies have been able to defer effectively, if not indefinitely, impacts of budget reductions by anticipating that funding will improve.

7. The report discusses DOE's efforts to reform DOE laboratory management processes and cites many other reports that also address this issue. Most recently, we testified that DOE has failed to rationalize sufficiently its laboratory infrastructure and has not reformed its burdensome management structure. The Secretary of Energy's Advisory Board recently criticized the fact that individual DOE programs spread research dollars to more laboratories than necessary, thus involving too many of them in too many mission areas.

8. These plans are basically inventories of capabilities and ongoing efforts rather than sources of vision and focus for future research. Further, the House Committee on Government Reform and Oversight gave low marks to DOE's strategic planning in the area of identifying and addressing overlapping/crosscutting functions during its Results Act assessment.

9. Although it is necessary to review small, mission-specific laboratories to validate their roles and determine if there are alternatives, a process with similar objectives focused on reducing governmentwide infrastructure also appears warranted.

Comments From the National Aeronautics and Space Administration

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

National Aeronautics and
Space Administration
Office of the Administrator
Washington, DC 20546-0001

SEP 8 1997

Mr. Henry L. Hinton, Jr.
Assistant Comptroller General
National Security and International Affairs Division
United States General Accounting Office
Washington, DC 20548

Dear Mr. Hinton:

We appreciate the opportunity to review and comment on the draft of the September 1997 GAO report, "Best Practices: Elements Critical to Successfully Reducing Unneeded Research & Testing Facilities," that you provided August 22, 1997, covering issues related to the Federal Government's research, development, test, and evaluation (RDT&E) infrastructure (GAO Code 707179). We recognized the importance of these issues 5 years ago when we began reengineering NASA for the future. The infrastructure is large and complex, and we undertook a number of activities in NASA to systematically deal with these issues. The starting point for our reviews, as it must be for any review of the infrastructure, was mission requirements.

I am sure that you are well aware that NASA has been reinventing itself since well before the National Performance Review. Two major accomplishments in this process were (1) the NASA Strategic Plan that sets the direction for our Agency to meet our customers' needs, and (2) the NASA Strategic Management Handbook that documents our commitment to plan and manage strategically the future of our Nation's civil aeronautics and space program. Our goal in revolutionizing the Agency is to respond to the needs of our customers, the American people, industry, the science and academic communities, and other Government agencies. A NASA facility base, structured with the capabilities to meet our mission requirements, is absolutely vital to delivering our science and technology products to the Nation.

NASA has experienced upheaval, restructuring, downsizing, and streamlining. We have included, as enclosure 1, a copy of the testimony of the NASA Administrator before the Senate Committee on Commerce, Science, and Transportation, on July 24, 1997, which describes the actions taken by the Agency. It clearly indicates that NASA has refocused on programs that make the most sense for the Nation. The technology we are developing is cutting edge and is linked directly to accomplishment of our scientific goals. Our strategic planning and management process fully integrates planning, budgeting, executing, and assessing activities. This process is dynamic, with continual updating of our Strategic Plan of features that address the major issues of cost, programs and staffing. We recognize that we do not have an integrated financial system. We are aggressively working to correct this situation with our Integrated Financial Management Project, and we are now considered the Government's lead in this area. This new system will permit us to have greater insight into the cost issues identified.

See comment 1.

A major objective of our strategic management process is the proper sizing and administration of the NASA infrastructure. We have made a conscious decision not to propose to the Congress closing a Center. Our judgment was based on workload, customer

See comment 2.

requirements, and statutory responsibilities. Additionally, we have completed a number of studies, including the Zero-Based Review, to properly size and configure the NASA infrastructure for its mission. We have made the appropriate plans and are implementing not only closure of unnecessary facilities but also construction of special new capabilities that are essential to our mission.

See comment 3.

The draft report attempts to address the broad issue of the RDT&E infrastructure of the DOD, DOE, and NASA as an entity. An unfortunate result of this breadth is that the report makes generalized and misleading statements and reaches broad overall conclusions that we believe overlook NASA's significant accomplishments in strategic planning, strategic management, reinvention, and infrastructure resizing. We are deeply concerned about GAO's publishing this report, because we believe it falls below GAO's normal standards for such analyses. Addressing three Government agencies in one report is a significant and complex task, and the difficulty GAO had is apparent in this draft. Our specific detailed comments on the draft report are provided in enclosure 2 for your review.

See comment 4.

NASA remains committed to working aggressively with the aerospace community, both the public and private sectors, in sizing its infrastructure to meet the Agency's mission. Thank you for the opportunity to review this draft report.

Sincerely,

J. R. Dailey
Acting Deputy Administrator

2 Enclosures

The following are GAO's comments on the National Aeronautics and Space Administration's letter dated September 8, 1997.

GAO Comments

1. Although an integrated financial system can play an important role in providing greater insight into cost issues for decision-making, NASA officials have acknowledged that even full implementation of NASA's integrated financial system will not likely provide the level of detailed information necessary for successful infrastructure consolidation.

2. Our report recognizes that NASA has made a conscious decision not to propose to the Congress the closing of a major center. The report also discusses the objectives and results of NASA's Zero-Base Review with respect to infrastructure.

3. Nowhere in our report did we treat DOD, NASA, and DOE as a single "entity." We examined the agencies' processes and infrastructure reductions separately and have presented fact-based, agency-by-agency evaluations of what has been achieved by agencies and what remains to be done to date. We discuss the results of NASA's Zero-Base Review with respect to infrastructure and NASA's accomplishments in infrastructure resizing to date. Moreover, we would note that OMB, in commenting on our draft report, indicated that implementation of NASA's efforts to close a number of facilities was just a beginning.

4. NASA expressed concern about our publishing this report because, in its view, the report addresses the broad issue of RDT&E infrastructure of the Departments of Defense and Energy and NASA as a single entity. NASA believes this approach results in generalized and misleading statements and broad, overall conclusions that overlook NASA's individual accomplishments in strategic planning, strategic management, reinvention, and infrastructure resizing. We believe our report does recognize NASA's accomplishments. We updated and added examples of individual agency infrastructure consolidation and reduction-related actions. The report also notes that NASA's most comprehensive infrastructure study—its 1995 Zero-Base Review—began with the premise that to meet its mission, NASA needed the existing infrastructure. The model presented in this report provides a different approach by suggesting that decisions regarding mission be made first and then infrastructure aligned to support those missions.

Comments From the Department of Defense

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
3030 DEFENSE PENTAGON
WASHINGTON, D.C. 20301-3030

OCT 1

Mr. Henry L. Hinton, Jr.
Assistant Comptroller General
National Security and International Affairs Division
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Hinton:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "BEST PRACTICES: Elements Critical to Successfully Reducing Unneeded Research & Testing Facilities," dated August 22, 1997 (GAO Code 707179 / OSD Case 1445). The Department generally supports the comments and conclusions reached in the GAO draft report. However, to achieve clarity, balance and accuracy, we believe there are a number of issues that need to be raised. These are presented below:

See comment 1.

a) The report basically ignores the dominant role played by Congress in the Department's ability to reduce infrastructure by closing unneeded facilities. Several months ago DoD requested authority for two more rounds of Base Realignment and Closure (BRAC), which would enable additional closures of labs and test and evaluation (T&E) facilities, and was denied.

See comment 2.

b) While the DoD acknowledges that the 1995 BRAC round identified significant lab/T&E overcapacity and yet yielded little additional results, the report seriously underplays the sizable reductions to lab and T&E facilities and manpower that occurred in BRAC rounds prior to 1995. These reductions are summarized in detail in the "Vision 21" Report submitted to Congress on April 30, 1996.

See comment 3.

c) Pre-1995 lab and T&E BRAC reductions are clear evidence that the DoD is best positioned to rationalize its own Research, Development, Test and Evaluation (RDT&E) infrastructure. Attempts to find cross-Service opportunities for reduction of infrastructure were weak in BRAC '95, but Vision 21, the Department's lab/T&E Reduction, Restructuring and Revitalization process, was set up specifically to address that weakness. It is counter productive to suggest that another Federal agency or some independent committee could design a better DoD RDT&E infrastructure. The DoD recognizes the value of an independent BRAC commission to, among other things, insure the integrity of the process. Whereas the DoD recommended solutions to such commissions, the report appears to suggest that the agencies should play no role in redesigning their R&D infrastructures. We believe this represents a subtle misreading of

the experiences of Boeing Company's Space and Defense Group and Britain's Defence Research Agency (DRA), cited in the report. In fact, both redesigned their R&D infrastructures from within.

d) The Vision 21 effort should not be listed as a "lost opportunity". The DoD is not "again rejecting efforts that would result in interservice consolidation". The Vision 21 process has been on hold because of uncertainty regarding new BRAC legislation, but it is still active. We expect Vision 21 will proceed under existing authorities to look at possible avenues to reduce costs. It must be emphasized again, however, that significant reductions of infrastructure can only be achieved under BRAC-like authority.

See comment 4.

e) Estimates of excess capacity must be viewed with caution. Those cited in the report were developed in 1993/1994. Workyears were used as a surrogate for capacity and do not necessarily match with excess physical facilities. Insofar as personnel are concerned, there has been a steady decline of four- to five-percent annually since 1993. Vision 21 will address the issue of just how much physical capacity is required.

See comment 5.

f) The report notes that federal laboratories "need to better focus their core missions", but "they so far have been incapable of doing so on their own". This statement is inapplicable to the DoD. The DoD mission is clear and it has never been challenged that the supporting mission of the DoD labs and T&E facilities is to provide superior warfighting technology to our nation's warfighters.

See comment 6.

Additional technical corrections were provided separately to the GAO Staff. The DoD appreciates the opportunity to comment on the draft GAO report.

Sincerely,

George T. Singley, III
Acting

The following are GAO's comments on the Department of Defense's letter dated October 1, 1997.

GAO Comments

1. Our report does discuss the role of congressionally directed BRAC rounds in reductions of DOD infrastructure, and while it is true that the Congress did not approve DOD's latest request for additional BRAC rounds, DOD in its Vision 21 process still can affect changes.

2. The report indicates that BRAC rounds led to the closure of over 60 RDT&E facilities as well as related realignments. In DOD's own estimate, it has not reduced sufficiently its RDT&E infrastructure.

3. Although DOD asserts that it is in the best position to rationalize its own RDT&E infrastructure, it was also the one federal agency asking for another BRAC-like independent authority to oversee reductions in its RDT&E infrastructure. We have not suggested that the agencies should play no role in the design of their infrastructures. Moreover, the Boeing Company Defense & Space Group and the Defence Research Agency largely attributed the success of their efforts to the establishment of independent authorities to implement change.

4. We agree with DOD that the likelihood of significant reductions in infrastructure is enhanced immensely under BRAC-like authority. We note in our report that the Vision 21 process is on hold and that its future course had not been determined at the time we completed our review.

5. We agree with DOD that there has been a steady decline in acquisition personnel levels associated with its laboratories and test and evaluation (T&E) centers. Also, we recognize, and we have reported on, the difficulty of measuring excess capacity in RDT&E infrastructure. However, the report uses DOD's own estimates of its excess capacity throughout.

6. The report already noted the relative clarity of missions and close ties between DOD laboratories and T&E centers and their military customers, the warfighters.

Major Contributors to This Report

National Security and International Affairs Division, Washington, D.C.

Katherine V. Schinasi, Project Director
Clifton E. Spruill, Project Manager
Mark A. Pross, Deputy Project Manager
James L. Morrison, Deputy Project Manager
Leslie E. Schafer, Senior Evaluator
Stacy Edwards, Evaluator
Nancy L. Ragsdale, Evaluator (Communications Analyst)

Resources, Community, and Economic Development Division, Washington, D.C.

William J. Lanouette, Senior Evaluator

Glossary

Applied Research	The National Science Foundation (NSF) and the Office of Management and Budget (OMB) define applied research as "research directed toward the acquisition of knowledge or understanding necessary for determining the means by which a recognized and specific need may be met." The Department of Defense (DOD) defines applied research as "research concerned with the practical application of knowledge, material, and/or techniques directed toward a solution to an existent or anticipated military requirement."
Basic Research	NSF and OMB define basic research as "research directed toward increases in knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific application toward processes or products in mind." DOD defines basic research as "efforts typically performed in laboratories as experiments to explore the basic laws of science and their potential application to DOD weapon systems or technology development."
Current Replacement Value	DOD uses "plant replacement value" as an estimate of what it would cost to replace all of the buildings, pavements, and utilities at its bases using today's building standards. The Department of Energy (DOE) uses "replacement plant value" as the current cost to replace an existing building with a new building. This value does not include the cost of the underlying land. The estimate is based on assigning dollar values to usage categories. DOE also uses "other structures and facilities replacement plant value," which is the cost to replace the existing structure with a new structure of comparable size using current technology, codes, standards, and materials. The National Aeronautics and Space Administration (NASA) uses "current replacement value" to mean the acquisition cost of facilities, excluding land, plus the cost of collateral equipment and incremental book value charges escalated to the current year using a 20-city average cost index for buildings.
Infrastructure	DOD generally defines infrastructure as "all fixed and permanent installations, fabrications, or facilities for the support and control of military forces." It consists of mission supporting property, plant, equipment, and personnel, including contractor manpower. DOD excludes the equipment and personnel necessary to perform directly critical technical and acquisition functions. DOE defines infrastructure as "all real property and installed equipment and personal property that is not solely

supporting a single program mission." NASA defines infrastructure as "the underlying foundation for NASA operations, including its people, facilities, equipment, business systems, institutional information systems, and technical infrastructure." Facilities are the land, buildings, structures, permanently located trailers, and other real property improvements, including utility systems and collateral equipment that essentially is integrated into the facility. Business systems are business processes and business tools. Institutional information systems include NASA computers, networks, and general purpose application software. Technical infrastructure includes mission/project/technology/science implementation tools and processes, such as equipment and instrumentation, processes and procedures, and software tools.

Laboratory

DOD defines laboratory as "an activity (an aggregate of personnel and facilities located at one base, under the same command) owned and operated by a DOD component, that performs predominantly science and technology, engineering development, systems engineering, engineering support of deployed materiel and its modernization, and/or in-service engineering work." DOE defines laboratories functionally by the research discipline housed in the particular building. DOE maintains laboratories for the following functions: research and development (R&D) support, meteorology and calibration, calibration, computation, applied science, other support, chemistry, nonnuclear chemistry, nuclear chemistry, other chemistry, optics, physics, applied physics, nuclear physics, other physics, electrical/electronics, other electrical/electronics, communications, biomedical research, biological research, medical research, human factors, animal research, materials, environmental, radiation effects, research reactor, general, non-nuclear general, nuclear general, and multi-function research. NASA defines laboratory as "all of the activities and facilities at a NASA center and subordinate organizational units that perform or support the performance of research and development."

Research, Development, Test, and Evaluation

Research, development test, and evaluation (RDT&E) can be subdivided as (1) science and technology (i.e., activities that produce or expand the use of new knowledge and new or enabling technologies) and (2) systems development (i.e., weapons systems in DOD, product demonstration, testing, and evaluation such as nuclear work in DOE, and missions operations and demonstrations in NASA). DOD, unlike other federal agencies, subdivides its RDT&E funding into seven program element categories, each with a numerical code: Basic Research (6.1), Exploratory

Development (6.2), Advanced Technology Development (6.3), Demonstration and Validation (6.4), Engineering and Manufacturing Development (6.5), Management and Support (6.6), and Operational Systems Support (6.7). The first three categories are comparable strictly to the research and development reported by other agencies.

Science and Technology

DOD defines science and technology as the first three program elements of the seven RDT&E categories. The first three are Basic Research (6.1), Exploratory Development (6.2), and Advanced Technology Development (6.3). (Systems development corresponds to the other four DOD RDT&E categories.)

Test and Evaluation

DOD defines test and evaluation as "any project or program designed to obtain, verify, and provide data for the evaluation of research and development other than laboratory experiments for the purpose of determining if the minimum operational performance requirements as specified in the Operational Requirements Document have been satisfied."

Related GAO Products

Aerospace Testing: Promise of Closer NASA/DOD Cooperation Remains Largely Unfulfilled (GAO/NSIAD-98-52).

Department of Energy: Clearer Missions and Better Management Are Needed at the National Laboratories (GAO/T-RCED-98-25, Oct. 9, 1997).

Military Bases: Lessons Learned From Prior Base Closure Rounds (GAO/NSIAD-97-151, July 25, 1997).

Results Act: Observations on the Department of Energy's Draft Strategic Plan (GAO/RCED-97-199R, July 11, 1997).

Defense Acquisition Infrastructure: Changes in RDT&E Laboratories and Centers (GAO/NSIAD-96-221BR, Sept. 13, 1996).

NASA Facilities: Challenges to Achieving Reductions and Efficiencies (GAO/T-NSIAD-96-238, Sept. 11, 1996).

NASA Infrastructure: Challenges to Achieving Reductions and Efficiencies (GAO/NSIAD-96-187, Sept. 9, 1996).

Department of Energy: Observations on the Future of the Department (GAO/T-RCED-96-224, Sept. 4, 1996).

DOE's Laboratory Facilities (GAO/RCED-96-183R, June 26, 1996).

Energy Downsizing: While DOE Is Achieving Budget Cuts, It Is Too Soon to Gauge Effects (GAO/RCED-96-154, May 13, 1996).

FDA Laboratories: Magnitude of Benefits Associated With Consolidations Is Questionable (GAO/HEHS-96-30, Mar. 19, 1996).

Federal R&D Laboratories (GAO/RCED/NSIAD-96-78R, Feb. 29, 1996).

Department of Energy: A Framework for Restructuring DOE and Its Missions (GAO/RCED-95-197, Aug. 21, 1995).

Department of Energy: Need to Reevaluate Its Role and Missions (GAO/T-RCED-95-85, Jan. 18, 1995).

Department of Energy: National Laboratories Need Clearer Missions and Better Management (GAO/RCED-95-10, Jan. 27, 1995).

DOE's National Laboratories: Adopting New Missions and Managing Effectively Pose Significant Challenges (GAO/T-RCED-94-113, Feb. 3, 1994).

Federal Research: Aging Federal Laboratories Need Repairs and Upgrades (GAO/RCED-93-203, Sept. 20, 1993).

Department of Energy: Management Problems Require a Long-Term Commitment to Change (GAO/RCED-93-72, Aug. 31, 1993).

Federal Buildings: Actions Needed to Prevent Further Deterioration and Obsolescence (GAO/GGD-91-57, May 13, 1991).

Ordering Information

The first copy of each GAO report and testimony is free. Additional copies are $2 each. Orders should be sent to the following address, accompanied by a check or money order made out to the Superintendent of Documents, when necessary. VISA and MasterCard credit cards are accepted, also. Orders for 100 or more copies to be mailed to a single address are discounted 25 percent.

Orders by mail:

U.S. General Accounting Office
P.O. Box 37050
Washington, DC 20013

or visit:

Room 1100
700 4th St. NW (corner of 4th and G Sts. NW)
U.S. General Accounting Office
Washington, DC

Orders may also be placed by calling (202) 512-6000 or by using fax number (202) 512-6061, or TDD (202) 512-2537.

Each day, GAO issues a list of newly available reports and testimony. To receive facsimile copies of the daily list or any list from the past 30 days, please call (202) 512-6000 using a touchtone phone. A recorded menu will provide information on how to obtain these lists.

For information on how to access GAO reports on the INTERNET, send an e-mail message with "info" in the body to:

info@www.gao.gov

or visit GAO's World Wide Web Home Page at:

http://www.gao.gov

United States
General Accounting Office
Washington, D.C. 20548-0001

Bulk Rate
Postage & Fees Paid
GAO
Permit No. G100

Official Business
Penalty for Private Use $300

Address Correction Requested