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STATEMENT OF

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COMPTROLLER GENERAL OF THE UNITED STATES

BEFORE THE

HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY

ON

THE FEDERAL R&D BUDGET

Mr. Chairman and Members of the Committee:

Of all the congressional committees, this Committee has the broadest oversight of U.S. science and technology and I especially appreciate this opportunity to share my views with you on the Federal budget for R&D and related policy issues.

On June 17, 1975, I appeared before this Committee in support of H.R. 4461 in hearings which lead to the passage of the National Science and Technology, Policy, and Priorities Act of 1976. During that hearing, I stressed the importance of a better system for examining national priorities in research and development and a better system for assessing such needs for both specific programs and the overall levels of Federal and private support for research and development. In my statement, I indicated that:

"* * * however great the difficulty of formulating a comprehensive national policy and strategy, I believe that an attempt should be made to provide a national policy for planning and resource allocation for science and technology programs. There are certainly common objectives, such as support of basic research and supplying adequate investment in training, which go beyond the needs of a single agency to meet its program objectives. This is more true now than ever before. * * * In addition to mission-oriented R&D supported by the various Federal agencies and the private sector, we need to establish a long-term investment policy for Federal support of basic research and graduate education."

The 1976 legislation contained a landmark statement of national policy that provides guidance for the Nation by recognizing the tremendous importance of science and technology to the economy and the interrelationship of science and technology to other policies and programs of the Federal Government. I found particularly important the statement in Section 101(a)(4):

"Federal funding for science and technology represents an investment in the future which is indispensable to sustained national progress and human betterment, and there should be a continuing national

investment in science, engineering, and technology which is commensurate with national needs and opportunities and the prevalent economic situation;

* * *."

Elsewhere in the statute--in the Declaration of Policy as well as in Section 101--it is abundantly clear that the Congress was concerned about the condition, health, and vitality of funding for science and technology and the importance of science and technology to changing national goals and priorities. The statute is a clear refutation of the arguments that science and technology programs could and should be looked at only in the context of priorities for individual programs in the budget.

In this context, there are three major concerns that I wish to address. First, how are the Federal Government and the private sector interrelated in supporting R&D to achieve national goals? Second, under what circumstances and to what extent should the Federal Government subsidize R&D or use alternative incentives to stimulate commercial/industrial technological innovation? Third, what are the major limitations in the present structure and analysis of the "Federal R&D budget" as currently presented to the Congress, and how can this presentation be improved? This is discussed in detail in an attachment to my statement. Before discussing these specific concerns, I should like to present some

background on the nature and importance of R&D. This is to provide context and perspective which I believe are essential to oversight review of "the R&D budget."

BACKGROUND AND PERSPECTIVE

Economists and other scholars generally agree that there is a high positive correlation between R&D investment and economic growth. Indeed, in his Message on Science and Technology to the Congress, President Carter emphasized the importance of a strong national commitment to R&D to assist in attaining appropriate levels of economic growth and satisfying other societal needs.

According to data reported by the National Science Foundation (NSF), total national expenditures for R&D in 1979 are estimated to be $51.6 billion, of which about 50 percent is by the Federal Government. Because of the large share of Federal R&D support and the manner in which Federal policies and regulations increasingly affect private investment in R&D, the dominance of the Federal Government and its impact on the elements of the infrastructure of our science and technology enterprise is greater than ever before.

A common misconception is that total Federal investments in R&D are centrally planned in a total analytic framework which relates scientific and technological opportunities to national objectives. In reality, this is not so. What emerges as "the R&D budget" is currently pieced together from the numerous independent entities in the executive

branch. R&D expenditures become means to achieve larger ends and, as such, compete with other strategies for the departmental dollar. In fiscal year 1980, each of 12 agencies with disparate missions is expected to sponsor R&D in excess of $100 million. Furthermore, the R&D efforts supported by each agency may range from basic and applied research to design, development, and testing of new devices and systems. Many disciplines and a variety of performers are involved.

This diversity of sponsors and performers of R&D is a direct outgrowth of our national philosophy of pluralism. In this context, the essence of pluralism is that more than one agency, rather than one central authority, support R&D to serve their own purposes and consider the ideas and proposals of individual scientists and institutions. A highly decentralized review system is used to judge the merits of R&D proposals.

Although there is no centrally planned "Federal R&D budget" per se, OMB annually publishes a "Special Analysis of R&D" as part of the total budget package. This supplement presents an overview and highlight summary of proposed Federal R&D expenditures. OMB also prepares an R&D display by agency missions, this year's version of which is due out shortly.

Oversight of "the Federal R&D Budget"

This is the context in which the Congress faces its oversight, authorization, budget allocation, and appropriations

responsibilities. The Congress, in exercising its responsibility to establish policy and oversee its execution, needs to examine not only the vertical mission-oriented R&D supported by the particular agencies under its jurisdiction, but also horizontal interagency comparisons in related R&D programs whose missions or technologies are similar. Individual committees in both Houses conduct hearings on particular agencies, programs, or special oversight for selected facets of the proposed Federal R&D expenditures. But this Committee is the only one charged with the full scope of Congress' responsibility for oversight of R&D policy.

In my view, a major function of the Federal budget is to serve as a policy document which discloses the Administration's plans and strategy for implementing priority decisions emerging from major policy considerations. To facilitate oversight of R&D expenditures, the budget should include information to disclose specific mission- or program-related R&D and to permit broad oversight of total Federal R&D expenditures in relation to the transcending issues, interagency-related programs, and similar technologies. For the broad oversight, reports (such as the Special Analysis of R&D and the Science and Technology Annual Report) are needed to present the Administration's view of how the total amount and distribution of Federal R&D expenditures relate to transcending issues and national goals, and to identify and disclose

the rationale for major increases and decreases in existing programs, new initiatives, and analysis of issues associated with multiagency programs and related technological approaches supported by more than one agency. In reviewing the strategy for Federal support of R&D, particular attention should be given to the respective roles of the Government and the private sector and how they are interrelated.

GOVERNMENT AND INDUSTRIAL ROLES IN SUPPORT OF R&D

In addition to the broad general objectives for a strong national R&D effort, which I have already mentioned, there are a number of specific purposes for Federal support of R&D. These range from matters of concern to the Nation as a whole, i.e., national missions, to more specific goals which, although affecting the economy as a whole, are for the most part concerns of various segments of private industry.

For national missions, such as defense and space, the Federal Government supports all phases from basic research to product development. For technology primarily related to commercial products, the role of the Federal Government, with few exceptions, notably agriculture and nuclear energy, generally has been limited to support of basic science and exploratory development of emerging technologies.

For major technology-intensive commercial ventures construed as essential to meet national goals but which are too

large, risky, and long term for private resources to undertake without Government assistance, Government and industry have shared in the R&D costs for a number of years. The development of nuclear power is a prime example. No general policy guidelines have yet been established to determine when, how, and to what extent the Federal Government should be involved in such ventures. These situations, therefore, are treated on a case-by-case basis.

A sponsor of basic research and graduate education may not be able to capture the full benefits of the investment. Hence, industry generally provides only a small share of this support.

The Federal Government must continue to provide major support for basic research and graduate education in both natural and social sciences and the engineering disciplines. Sponsors must recognize that the very nature of basic research is long term, exploratory, and adventuresome, with little or no assurance of positive results from the outset. While it is necessary to assure wise and accountable expenditure of public funds, we should seek ways to fulfill this need without inhibiting freedom of intellectual inquiry, risk taking, and productivity in research. We have no generally accepted formula for the level of Federal support of basic research, but I believe we should establish a long-term investment plan.

In addition, it is important to provide a stable base of funding from year to year. As longer-range plans are developed, the Congress should also consider greater use of multiyear and advanced funding methods for basic research and other selected R&D efforts which require more than one year to complete.

Recently, the need and means for establishing closer coupling between universities and industry has been receiving considerable attention. This issue was addressed by an advisory panel involved in the President's Domestic Policy Review of Industrial Innovation and also by Ed David and Peter Drucker at the annual meeting of the American Association for the Advancement of Science. This is important both to broaden the base for support of university research and to enhance the transfer of research results to the industrial sector.

FEDERAL R&D VERSUS ALTERNATIVES FOR STIMULATING COMMERCIAL TECHNOLOGICAL INNOVATION

A question which has been raised with increasing frequency is whether the Federal Government should provide direct support for R&D to stimulate technological innovation for commercial purposes. It is usually addressed specifically with regard to small business and medium-size industries purported to be adversely affected by foreign competition.

Although there may be situations in which direct Federal support of R&D for commercial purposes is warranted, I believe it should be considered along with other alternatives affecting the climate for industrial innovation. We have thought a great deal about this important issue and have developed an agenda for research which we believe is necessary to determine how the Federal Government can help to stimulate technological innovation and productivity in the private sector.

We believe that further diagnostic studies aimed toward resolving two major issues are needed. The first is how can the Federal Government alleviate the uncertainties in the economic outlook and the regulatory situation to stabilize the climate and enhance the confidence of the private sector for long-term investment in plant expansion and innovative R&D?

The second major issue is what criteria should be used to determine when and how Federal intervention is necessary to assure adequate investment in R&D and capital formation for situations in which externalities and inadequate market forces tend to cause the private sector to underinvest in areas of public need or opportunity?

This agenda undoubtedly requires extensive research and I hope the results of the President's Domestic Policy Review of Industrial Innovation will shed new light on some of the

issues and provide guidance for early action as well as focus for further study. Let me underscore this point because there has been a relative decline in research and development which has an impact on the rate of productivity growth in the economy. During the past ten years, productivity in the United States has increased an average of 1.6 percent per year. During the previous 20 years, productivity growth increased at twice the rate--3.2 percent per year. Our major trading partners in recent years have achieved increases of 5 to 6 percent per year. A recent Bureau of Labor Statistics survey shows that three-fourths of the industries surveyed showed lower productivity growth in 1977 than in 1976.

A return to historic growth rates would dramatically reduce unit labor costs which are now increasing at approximately 8-1/2 percent a year. Our ability to deal with inflation is therefore greatly affected by productivity growth. Moreover, three-fourths of the long-term expansion of the economy has been directly attributable to increased productivity. Forty-five percent of the growth in the economy from 1929 to 1969 has been due to technology innovation. From 1950 to 1974, high-technology industries had productivity rates twice as high as the low-technology industries. These industries had a real growth three times as high as low-technology industries, only one-sixth of the annual price

increases, but nine times the employment growth as the rest of the economy.

Equally important, productivity and high technology contribute to our competitiveness in the international market. The high-technology industries in 1976 showed a favorable trade balance of $28 billion; the others showed a net deficit of $16 billion.

In attempting to explain the slowdown of productivity advance in the past decade and to project to the future, economists tend to concentrate on four measurable factors: slowdowns in the growth of capital stocks per worker, increasing proportions of inexperienced employees, changes in the industrial composition of employment, and declines in research and development. Other factors believed to have depressing effects on productivity include sharp increases in energy prices, a slowdown in the pace of technological programs, changing attitudes toward work and leisure, a questioning of the role of science and technology, and the increase in Government involvement in the economy.

While recognizing that productivity and technological innovation are affected by many factors, of particular concern is a relative decline in the R&D outlays over the past decade which will have adverse effects in the years ahead. For example:

--Total research and development spending in 1977 was estimated by the National Science Foundation at 2.3 percent of the gross national product compared to 3.0 percent in 1964.

--The United States spends about half its research dollars in defense efforts, while the bulk of expenditures by other major industrial nations with better productivity records has been in nondefense areas.

--In 1975, private industry employed 5 percent fewer scientists and engineers than it did in 1970.

One of the important areas for the Committee's consideration is how we can maximize private sector research and development which has concentrated in recent years on low-risk, short-term projects directed principally at improving existing products. Emphasis on longer-term projects that could lead to new products and processes has decreased. For example, industry now spends only 25 percent of its research and development expenditures on long-term research, down from 36 percent in 1957.

With the winding down of space and defense programs, Government support of industrially performed research and development also has diminished. From 1957 to 1967, the Government annually supported more than one-half of industrial R&D activity. This level of support reached almost

60 percent from 1959 to 1964, but has been falling consistently and is 35 percent today.

Other governments are doing much more than the United States to support civilian research and development. Japan, for instance, is putting $300 million of government money into microelectronic research this year. West Germany is providing from 50 to 95 percent of the research and development funds for those civilian industries requesting aid and judged to be important to the economy as a whole. In addition, both countries have supported the creation of specialized institutions responsible for the financial support of small firms involved in patenting new products or creating new enterprises.

Mr. Chairman, in an attachment to my statement, we suggest a number of improvements in the budget presentation and analysis which we believe would greatly assist this Committee in exercising its broad oversight of R&D expenditures. In total they call for some increase in the central policy, budget formulation, and oversight of R&D compared to what has been exercised in the past.

Conclusions

In this statement I've tried to lay out the background, perspectives, current economic and policy factors, and budget process factors that need to be considered in changing the Federal budget presentation and analysis for R&D. We are

talking about the oversight and policymaking process for 50 percent of the Nation's R&D resources--about $32 billion for fiscal year 1980.

Our successes of the past have been based to a large extent on the concepts of pluralism. Since these concepts have been successful, we need to retain them to the greatest extent we can.

But, we are facing changing social and economic conditions which are generating a greater diversity of needs while increasing constraints on our resources. Therefore, we are going to have to make some tough choices. I believe many of these choices must be made centrally, based on information and analyses about the full scope and nature of both Government and private R&D. To do this, participation by OSTP in the budget formulation needs to be continued and possibly strengthened.

In future years I hope that this Committee will hold its annual oversight hearings on the Federal R&D budget early enough to be able to report its "views and estimates" on the research and development budget to the House Budget Committee as a supplement to existing coverage.

With appropriate timing and improvement, the Annual Report on Science and Technology could be designed to provide substantial information and focus for review of both R&D budget and policy. This would be especially true if

OSTP, rather than NSF, assumed the primary responsibility for the portions of this report which reflect the Administration's strategy. The Special Analysis of R&D also needs to be improved.

Since the basic budget presentations and analysis now use the budget functional or national needs classifications, I suggest that they be used for aggregating the R&D budget also, similar to the approach used in the R&D missions display. A supplemental category could be used for the technology base. This would facilitate its use in the executive and congressional budget processes.

This concludes my formal statement. I'll be pleased to answer any questions the Committee may have.

GAO SUGGESTIONS FOR IMPROVING THE BUDGET PRESENTATION FOR RESEARCH AND DEVELOPMENT

In preparing for the hearings by the House Committee on Science and Technology on "the Federal R&D budget," we reviewed existing program and budget data sources for Federal R&D programs and our prior work that addressed potential improvements in budgeting for R&D. This attachment summarizes our views on the data now available to the Committee and the two reports issued by GAO on this subject.

ANALYSIS OF "THE FEDERAL R&D BUDGET"

The Special Analysis of R&D and the R&D Display by Agency Missions

The Special Analysis of R&D (for fiscal year 1980, Special Analysis L), prepared by OMB, summarizes the R&D funding for essentially the entire Federal Government. The Analysis is divided into two sections: "Highlights and Trends," an overview of Federal R&D funding for fiscal year 1980, and "Agency R&D Programs," a more detailed summary of the R&D efforts of the 12 major R&D agencies.

We were pleased that the Special Analysis has been expanded this year, but it still does not provide all the information the Congress needs for oversight and policymaking. The document contains only brief descriptions of the R&D programs. For those programs which are wholly within the purview of a single authorizing committee, this may not be a

problem since each committee has the benefit of the agency testimony and supporting documents. However, for broad science and technology oversight, the Congress needs better program descriptions and a more detailed explanation of the rationale for priorities reflected in the budget. The Special Analysis describes only four interagency R&D programs and gives the total level of support for each without disclosing the portion provided by each agency. Other interrelated mission R&D efforts of different agencies are not identified. For example, the Federal Aviation Act directs the Administrators of the Federal Aviation Administration (FAA) and the National Aeronautics and Space Administration (NASA) and the Secretary of Defense to arrange for the timely exchange of information on policies, programs, and requirements of common interest. In addition, the Act specifically provides for military participation in FAA's research and development. This mandate has resulted in procedures designed to insure that the technology of the Department of Defense and NASA is incorporated in FAA's programs where applicable. The Special Analysis does not reveal this relationship in R&D.

Also lacking in the Special Analysis is any form of interagency comparison in related areas of the science and technology base. For example, the Committee may wish to know how much total R&D is being federally supported in

generic laser technology, life sciences, materials research, computer sciences, energy conservation, and weather modification--to name a few.

Special Analysis L contains a general statement that one of the Federal Government's focuses for investment in R&D is "where the Government seeks to augment, but not supplant, the R&D efforts of the private sector because of an overriding national interest and the need to accelerate or increase the range of technological options available to the Nation." However, it refers to consideration of this policy only qualitatively and only with respect to support of basic research and solar and other nonnuclear energy R&D. Noteworthy for the absence of explicit consideration of private R&D investment is a major interagency R&D initiative in microelectronics and submicron science and technology that is deemed "important for the industrial strength and defense of the Nation."

Another example of a Federal agency R&D effort that should be examined in relation to related industry-sponsored R&D is the Department of Interior's program to investigate new technologies for surface and underground coal and oil shale mining designed to lead to improvements in environmental control technology, mine health and safety, and technology for productivity improvement in nonfuel mining.

Special Analysis L did not mention industrial R&D investment in either of these cases.

OMB also published, in May 1978, an R&D display by agency missions for the Appropriations and Budget Committees. R&D data were presented for 28 executive agencies in three categories: (1) science and technology base, (2) concept and demonstration development, and (3) full-scale development. This publication provides useful supplementary data on R&D spending. One problem with this display, however, is that missions and programs are unique to each agency and cross-agency comparisons within the three categories are difficult. The timing of this publication also prevents its use in early congressional consideration of the R&D budget.

The Science and Technology Annual Report

The first issue of the Science and Technology Annual Report, prepared by NSF, was published last fall, too late to be of much use for congressional action on the fiscal year 1979 budget. We have been advised that future issues will be published in February of each year to be of immediate use in the congressional budget cycle. Although we recognize that this report was not meant to serve as a complementary document to any specific budget, the content of this report is relevant to the priorities reflected in "the R&D budget."

The Annual Report provided some analysis of issues which transcend agency jurisdictions and budget classifications.

The strategic overview in the Annual Report was a discussion by the Office of Science and Technology Policy (OSTP) of selected transcending and crosscutting issues. But the overview does not provide a substantial context on which to evaluate R&D budget proposals. Instead, attention is directed to one overriding issue, that: "We need a better definition of * * * our long-term goals in R&D."

The Annual Report analyzes total Federal spending for R&D in terms of budget functions. The eight functions used in the report that have R&D are: national defense, space, energy, health, general science and basic research, natural resources and environment, transportation, and agriculture. However, the budget categories used are unique to each function and, hence, neither interfunctional nor interagency comparability is possible in most of the areas. Furthermore, large categories, such as the Department of Defense technology base, now in excess of $2.2 billion, are not subdivided in ways that permit comparisons with the long-range R&D of other agencies.

In this presentation of the R&D effort by functions, the Annual Report goes a step further than the Special Analysis in stating the decisions of the Administration to increase or decrease funds. This is a start in giving the Committee the necessary background for assessing budget requests. However, as in the Special Analysis, the Annual Report doesn't explain the reasons for most of the decisions.

Suggestions for Improvements

In summary, with respect to broad oversight of Federal R&D, we have identified three major deficiencies in the material which is presented with the budget--(1) not enough data and analysis are provided to compare R&D budget figures of agencies involved in similar or related missions, or from a functional standpoint, using categories which are comparable between agencies; (2) insufficient discussion of the rationale for decisions made concerning changes in R&D priorities; and (3) insufficient explanation of relationships between Federal and industrial support of R&D.

Numerous other limitations in the existing R&D budget analyses have been identified and discussed in detail in the annual AAAS reports on R&D in the Federal budget. We have found these reports and the AAAS annual symposium on R&D to be extremely useful in providing independent perspectives on the Federal R&D budget process, analysis of each year's budget, and discussion of related science and technology policy issues.

Assuming that the next Annual Report on Science and Technology will be released in February 1980, we believe that, at least in part, it should be planned specifically to supplement the Special Analysis of R&D in the Federal budget. These two reports in combination could then be designed to provide the more comprehensive treatment of the R&D budget,

with particular emphasis on the broad oversight and related policy issues. We hope the Five-Year Outlook report, also due for the first time in the fall of 1979, will contribute substantially to strategic planning and the five-year Federal budget projection for R&D.

However, it may not be feasible for the Annual Report and the Five-Year Outlook to include the requisite information pertinent to broad oversight of Federal R&D, since the responsibility for the reports is now assigned to the Director of NSF. He may be able to provide a good analysis of the transcending and future issues concerning science and technology as a broad context for assessing the budget. However, he may be constrained in dealing with the crosscutting and interagency issues which involve evaluating programs or policies of other Federal agencies. Additionally, NSF, as an affected agency, may not be the appropriate organization to provide the rationale for the Administration's R&D budget proposals.

In view of these constraints on NSF, OSTP is the logical agency to speak for the Administration's strategy and priorities on the budget for R&D and how they were chosen. Therefore, although it could delegate much of the staff work, we believe that OSTP should assume responsibility for at least these portions of the Annual Report and the Five-Year Outlook. This would provide a more comprehensive authoritative basis

for congressional oversight of R&D policy and budget. The public also would have an opportunity to react to the budget proposals, and hearings such as these can be used to assess the R&D proposals, with OSTP's testimony to further support and clarify the Administration's position.

PREVIOUS GAO RECOMMENDATIONS REGARDING R&D BUDGET STRUCTURE

In recent years, GAO has issued two reports that addressed potential improvements in budgeting for research and development. The first report discussed the need for a Government-wide R&D classification structure to support policy level analysis of R&D (PAD-77-14, March 3, 1977) and the second described the concept of mission budgeting and its application to R&D programs at the agency level (PSAD-77-124, July 27, 1977). These are two complementary approaches to improving congressional review and oversight of "the R&D budget." In the following sections, we explain each approach briefly and then discuss how the two approaches could provide insights that will help improve the R&D budget presentation and the information available to the Committee.

Government-Wide R&D Classification Structure

Title VIII of the Congressional Budget Act of 1974 requires the Comptroller General to identify and specify congressional committee and Member needs for fiscal, budgetary, and program-related information and to develop classification

structures for all Federal agencies to use in supplying such information to the Congress. Based on discussions with the staffs of this and other committees and related work for two House Appropriations Subcommittees, we identified a need for a Government-wide presentation of Federal R&D funding. We developed an objective-oriented classification structure across agency lines to show the amount of Federal funds each agency commits to specific national objectives.

Chart 1 (p. 10) shows the basic classification structure we developed back in 1975. The list contains thirteen broad national objectives that were the focus of R&D at the time. Within each broad objective, we developed detailed categories and subcategories. These are set forth in Appendix II of our March 3, 1977, report. Chart 2 (p. 11) lists the detailed categories for the Space Flight Systems Technology objective which is in the jurisdiction of the Committee.

We designed this Government-wide structure to provide a hierarchy of objectives or program categories to which individual R&D missions, programs, and projects could be assigned based on their primary purpose, regardless of who was funding or performing them. In our report, we stated that a presentation of Federal R&D dollars using such a structure should improve Congress' analytical and oversight capabilities in two important ways:

CHART 1

GAO'S GOVERNMENT-WIDE CLASSIFICATION STRUCTURE FOR FEDERAL RESEARCH AND DEVELOPMENT
(Proposed in 1975)

Education and Training

Energy Development and Conservation

Environmental Quality Improvement

Food, Fiber, and Other Agricultural Products

Health

Housing and Community Development

Law Enforcement and Justice

Military

Natural Resources

Science and Technology Base

Space Flight Systems Technology

Transportation

Other

CHART 2

PROGRAM CATEGORIES IN

SPACE FLIGHT SYSTEMS TECHNOLOGY OBJECTIVE

GAO UNIFIED CLASSIFICATION STRUCTURE

Space Flight Systems Technology

A. Space Transportation Systems

1. Space Shuttle
2. Spacelab
3. Interim Upper Stage/Tug
4. Other Space Transportation Systems

B. Space Flight Equipment Engineering

1. Energy Systems
2. Human Operations in Space
3. Information and Communication Systems
4. Materials Used in Space Vehicles
5. Propulsion Systems
6. Space Vehicle Aerothermodynamics
7. Systems and Design Studies
8. Vehicle and Satellite Structures
9. Vehicle Guidance and Control

- First, by requiring all agencies to assign their research projects to a common set of national objectives or needs, the structure would enable users to determine more easily the purposes for which Federal R&D dollars are being spent.
- Second, linking R&D activities to national objectives or needs would show where participating Federal agencies need to more effectively coordinate their programs.

OMB and some agencies experimented with this approach using the fiscal year 1977 budget data. The committees and subcommittees which received the first test data found it to be useful, and some of them relied on it during hearings and markup sessions. We believe this effort demonstrated that information on the Federal R&D effort can be collected, presented, and used in a more rational and effective manner than heretofore had been possible.

However, in October 1976, OMB said it disagreed with our recommendation primarily on the basis of workload. Instead, it suggested that some limited supplementary R&D data on an interagency basis be developed to cover specific problem areas identified by the Congress, and thus avoid the collection of too much data.

In retrospect, we believe there were really three additional issues involved.

- There was no support at that time from the central R&D policy people in the executive branch for improvement in and use of the Government-wide data.
- There was concern among some agency R&D officials that a Government-wide R&D budget system could be used by central science policy officials to exercise greater influence over Federal R&D spending of the individual agencies.
- There was no agreement on any list of "national objectives"; either the one that emerged from our R&D analysis (Chart 1, p. 10), the then existing budget functions, or the yet to be defined "national needs" categories required to be used in the fiscal year 1979 budget.

Mission Budgeting for R&D Programs

We studied and reported on the mission budgeting concept as applied to Federal R&D programs following our participation in the activities of the Commission on Government Procurement. In 1973, the Commission reported that it was virtually impossible for the Congress to review R&D budgetary requests effectively because:

--Traditional budgetary information overburdens the Congress with detailed reviews of technical projects that obscure the overall pattern.

--There are too many projects for the Congress to review.

--Many projects are not linked to needs and do not show the purpose for which the activity is being undertaken.

--Many projects forego alternatives and set the course for what later emerges as a noncompetitive development of a major system with a several-hundred-million-dollar budget.

The Commission urged that the Congress adopt a mission end-purpose approach to budgeting. The Congress has taken an initial step through Title VI of the 1974 Budget Act by requiring a mission display in the President's budget but has yet to fund budget requests of the agencies on that basis. We previously noted that OMB also has supplied the Committees on Budget and Appropriations an experimental display of R&D by agency mission. A number of committees are beginning to experiment with the concept. Finally, DOD recently decided to implement a mission-area structure as the basis for reviewing internally their research, development, and system acquisition programs.

A mission budget assembles and groups various kinds of expenditures according to their end purposes. Missions at the highest level in the budget structure represent basic

end-purpose responsibilities assigned to an agency. Descending levels in the budget structure then focus more sharply on specific mission purposes, needs, and programs to satisfy them. At the lowest levels are supporting activities; that is, line items or the means decided upon to satisfy the need. Chart 3 (p. 16) compares the traditional and mission approaches to budgeting.

The mission approach has four main features. First, it encourages a periodic policy review of the agency's missions. Congress could appraise the current relevancy of the missions, the agency's approach to executing the missions, and how well they are being accomplished. The kinds of capabilities needed to carry out missions in terms of overall priorities and resource availability could also be considered. Missions could be updated and related programs accelerated or phased out. Chart 4 (p. 17) depicts the various dimensions of policy review afforded by the mission approach.

The second main feature would be a shift in emphasis on program oversight from the back end of a program's life cycle to the front end. Mission budgeting illuminates for agency administrators and the Congress early (front end) decisions that determine the program's purpose and future course. These decisions have to do with the program's need, priority, objectives, and the competitive explorations of alternative solutions to carry out the program.

CHART 3

BUDGET STRUCTURES COMPARED

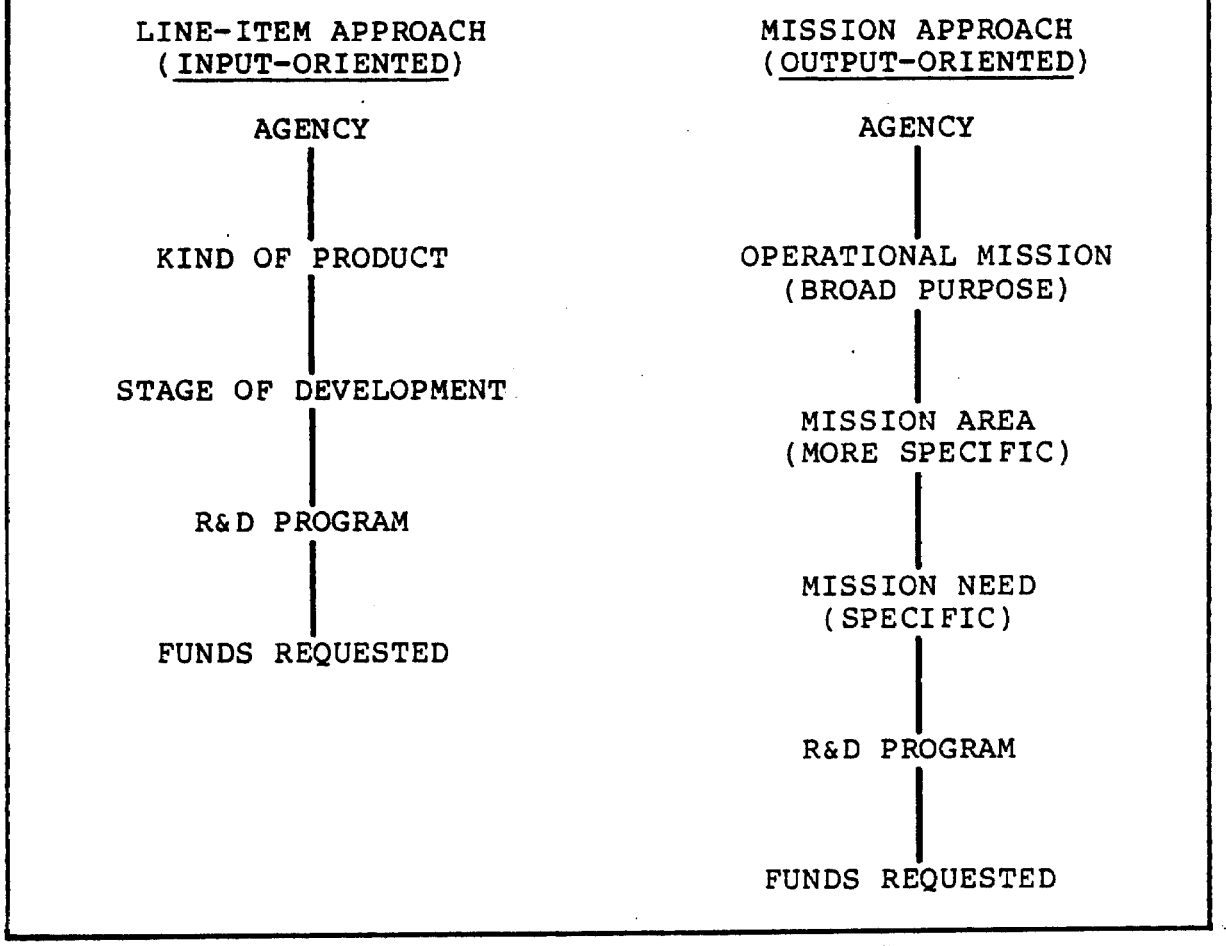
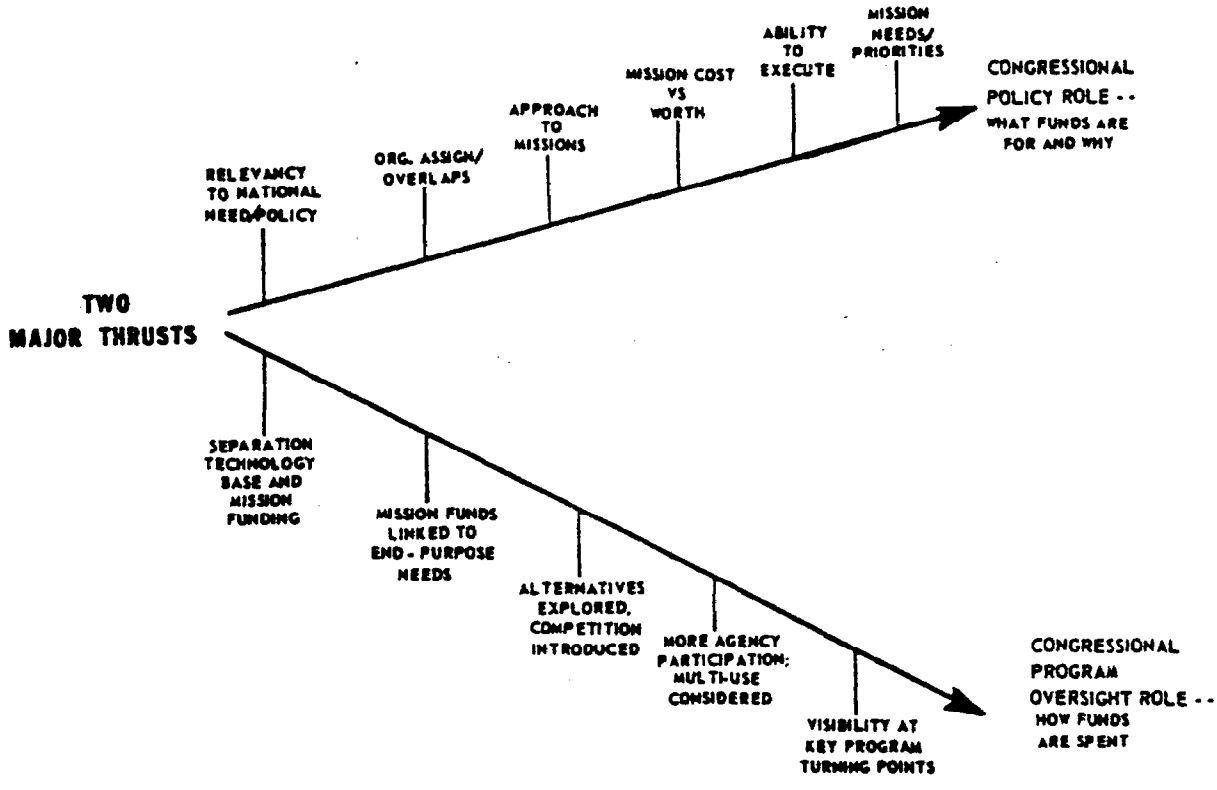


CHART 4

MISSION BUDGETING



A third feature of mission budgeting is that a technology base is funded separately from specific programs. This would provide greater visibility to the sustained support needed to develop new knowledge for future innovation and help guard against the use of technology base funds to predetermine solutions of new programs and lockout competition. Chart 5 (p. 19) illustrates how technology-base funding is diffused and scattered in a line-item budget and how these same funds would be collected in a mission budget and treated as a separate category for funding purposes.

Last, mission budgeting could provide the means for the Congress to adjust the funding levels of agency missions up or down based on analysis of agency purposes, needs, capabilities, and ongoing programs. In making this judgment as to mission-funding levels, Congress would tend to stress relative value and affordability rather than resources demanded and cost. Thereafter, agency accountability would shift from inputs to outputs or specific performance levels associated with mission purposes and levels of funding.

Chart 6 (p. 20) illustrates the direct linkup between a National Aeronautics and Space Administration (NASA) mission, a mission area, a mission need, a program to satisfy that need, and several R&D candidate solutions to be explored. Mission budgeting would relate each level of the

CHART 5

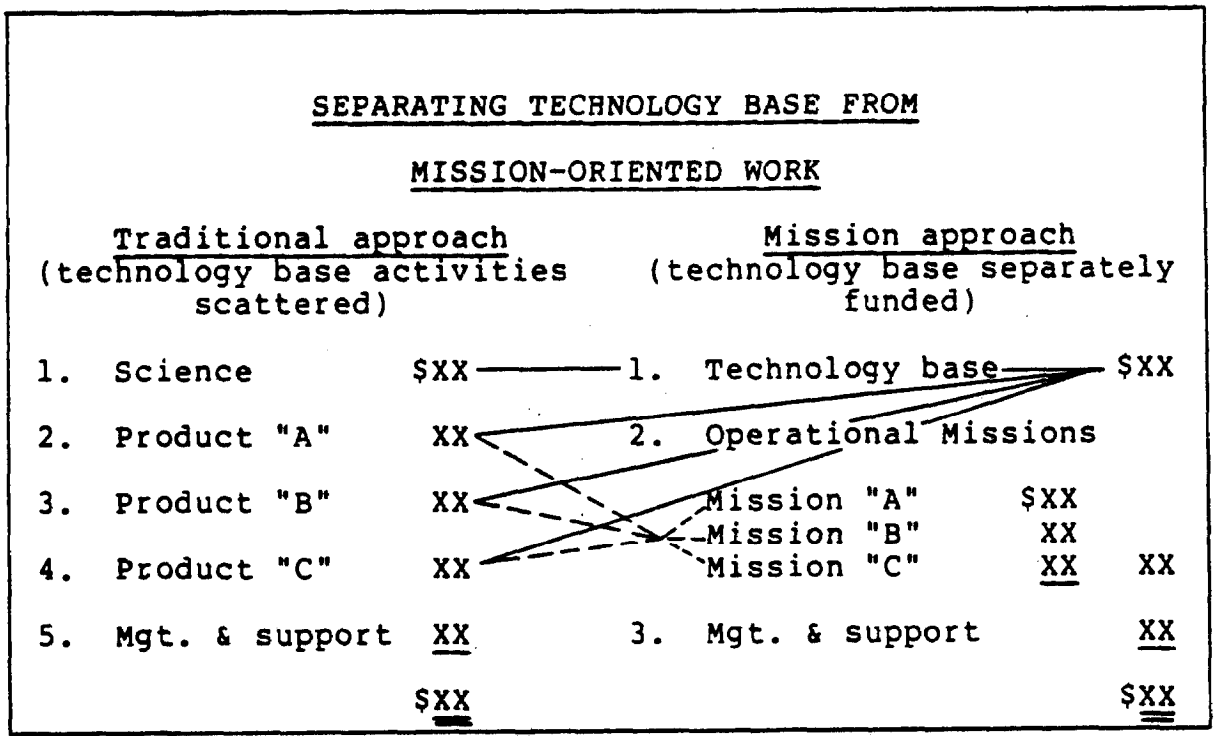
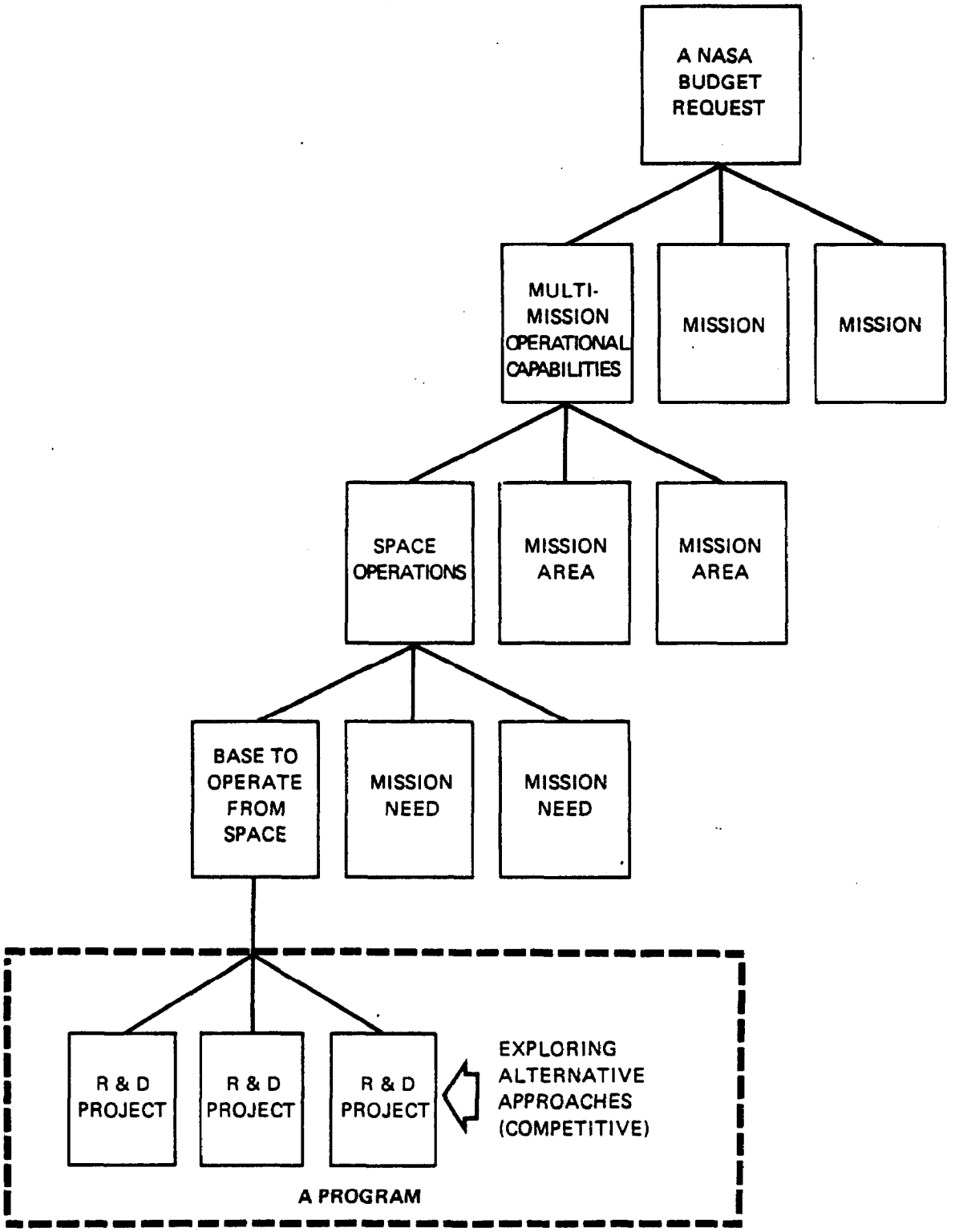

SEPARATING TECHNOLOGY BASE FROM
MISSION-ORIENTED WORK
Traditional approach
(technology base activities scattered)
1. Science $XX
2. Product "A" XX
3. Product "B" XX
4. Product "C" XX
5. Mgt. & support XX
$XX
Mission approach
(technology base separately funded)
1. Technology base $XX
2. Operational Missions
Mission "A" $XX
Mission "B" XX
Mission "C" XX XX
3. Mgt. & support XX
$XX

CHART 6

A MISSION APPROACH



budget structure to NASA missions defined in terms of end-purpose responsibilities. The first or highest level in the structure would show NASA's broad responsibilities for meeting specified national needs or goals which would be part of the Government-wide budget structure. Descending levels of the agency's R&D budget structure would provide a sharper focus on the end purposes to be served and specific needs to be met. The lowest levels of the budget structure would then indicate the type of activity being funded or means to accomplish the end purposes and the progress being made on specific programs.

In our report of July 27, 1977, we concluded that the mission budgeting concept offers significant possibilities, and we recommended that the Congress begin to experiment with the concept in carrying out its budget review, authorization, and appropriation functions.

Government-Wide Classification and Mission Budgeting

What can we gain from these two approaches to budgeting and how will they help the Committee perform its jobs? There are legitimate differences between these approaches. One focuses on Government-wide policy objectives and the other on individual agency missions. But the essential objective of both is to provide the Executive and the Congress with information about what purposes are supposed to be achieved with the funds budgeted for Federal R&D programs and to

improve congressional oversight. Present budget systems and other information sources provide only partial data.

The primary feature of the Government-wide classification structure is the ability to track funds budgeted across agency lines; this feature could be built into a mission-budgeting process. The key elements in the successful implementation of any such system are a congressional mandate and the willingness of a strong, central agency with a Government-wide perspective to foster the needed change and reconcile differences between individual agency systems.

The primary features of mission budgeting are the focus on end purposes and needs and the stress on early decisions that direct a program's future course. The mission budget approach can be implemented agency by agency, and we have encouraged this whenever we have had the opportunity. We would like to see the Government-wide budget developed also. The soon-to-be-published R&D missions display may be a partial answer.

Since the basic budget presentations and analysis now use the budget functional or national needs classifications, We suggest that they be used for aggregating the R&D budget also, similar to the approach used in the R&D missions display. Instead of the classification we recommended earlier (Chart 1, p. 10), a supplemental category could be used for the technology base. This would facilitate its use in the executive and congressional budget processes.