The original documents are located in Box 66, folder "FY 1978 Director's Review - NASA (1)" of the James M. Cannon Files at the Gerald R. Ford Presidential Library.

National Aeronautics and Space Administration
Director's Review
1978 Budget

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Overview

<u>Overview - FY 1978 NASA
Budget Proposal</u>

<u>Background</u>

The FY 1978 budget decisions are potentially of major significance for the future of NASA and the long-term use of U.S. capabilities in space developed through NASA programs. In this sense, FY 1978 is likely to be a watershed year for NASA and the future of the U.S. in space.

The key budgetary issues which must be addressed this year include the following items (listed generally in order of their overall significance in relation to national policy implications, to future NASA program directions and to NASA out-year budgetary implications):

° <u>Space Shuttle Program</u>--The <u>specific</u> issue is how many space shuttle orbiters to buy for the "national fleet" for military and civilian purposes and how to fund (DOD or NASA) the additional one or two orbiters that may be required beyond the three orbiters now included in the runout of the NASA budget. (The more <u>general</u> issue is how large a national space capability the U.S. should have when the space shuttle becomes operational and whether the shuttle will in the future replace essentially all expendable launch vehicles currently in use by the U.S. as was envisioned at the time the shuttle program was initiated.)

° <u>Landsat-D Earth Resources Survey Satellite</u>--The <u>specific</u> issue is whether to initiate development in FY 1978 of a fourth (second-generation) earth resources satellite, which provides significant increases in capabilities over the first three LANDSAT's, of which two are now in operation and a third will be launched in 1978. (The more <u>general</u> issue is whether the U.S. should as a matter of national policy commit to the continued development of this technology that can lay further groundwork for future operational deployment of such satellites, if they prove to be sufficiently valuable from a broad national and international perspective.)

° <u>Space Telescope</u>--The <u>specific</u> issue is whether to go forward with this expensive but highly productive scientific initiative deferred for consideration from last year. (The more <u>general</u> issue concerns how NASA's space science programs, which are inherently expensive to conduct, fit in with our overall national strategy for the support of basic research. A subsidiary consideration is that the telescope is likely to provide an early demonstration of the potential values for science and other applications of the unique capabilities for space research that will be made possible once the space shuttle becomes operational.)

- <u>Jupiter Orbiter Probe</u>--The <u>specific</u> issue is whether to commit this year to this "next step" scientific mission for exploring the planet Jupiter beginning in 1984. (The more <u>general</u> issue concerns how this particular mission will fit into our overall strategy for carrying out the systematic scientific exploration of the solar system. The project should also be considered with respect to overall Federal support of basic research. An important subsidiary issue which may affect the timing of the commitment to this project, is how to "match up" scientific and institutional capabilities of NASA with the wide year-to-year swings in the dollar funding for the NASA planetary program. A related immediate concern is that the scientific and technical staff at the Jet Propulsion Laboratory (an institution with a unique, highly successful, capability in the scientific and technical management of planetary missions) are now facing large near-term employment reductions as the result of the completion of the Viking missions to Mars.)

- <u>Space Industrialization</u>--The <u>specific</u> budgetary issue is whether to provide $15 million in FY 1978 funds for NASA to conduct major engineering studies which would support a future decision (probably FY 1980) to begin development of a permanent space station as the next large advance (after shuttle) in U.S. manned capabilities in space. (The <u>general</u> issue is whether the Administration should plan to commit to another large engineering and development project in space as a follow-on to the space shuttle program which will soon begin to phase down--assuming technical success in the shuttle program. A clear decision early in the next Administration as to whether there will be such a follow-on project in NASA's future could have significant impact on future NASA program priorities and on the size of the NASA field center establishment needed to carry out future NASA programs, after the space shuttle is completed.)

Dr. Fletcher's June 4 letter to the President

Significant as background to NASA's FY 1978 budget proposal, is Dr. Fletcher's letter to the President on the future of NASA (which is reproduced in part at the end of this overview).

Dr. Fletcher's major concerns expressed in the letter are:

- that "over the past five years we have not been permitted to maintain the program breadth or momentum necessary for continued contributions" of NASA to national objectives;

- that NASA has been held below "its critical threshold" required to allow the agency to make important contributions to society;

- that the agency has reached a "breaking point" and is in danger of losing its capabilities which may result in the U.S. falling behind the U.S.S.R. and other foreign nations in space capabilities; and finally

- that "if we cannot expand the scope of NASA's activity, the civil space program will be irreparably damaged".

The future program thrusts that Dr. Fletcher emphasized are as follows:

- a global information system (this assumes that the LANDSAT program will prove successful and that in the future the U.S. will want to extend and broaden these capabilities as an operational program);

- permanent American occupancy of space (the term "space station" is played down but that is clearly the next step that NASA will want to take, probably as a follow-on to the shuttle program once employment and funding turn down on the shuttle);

- the integrated scientific exploration of the Universe (a worthy goal on its face, but issues remain of timing and priority); and

- reestablishment of American preeminence in aviation (Dr. Fletcher assumes that the U.S. commercial aviation industry can no longer compete for foreign markets and that the solution is more NASA technology. Both the "problem" and the "solution" deserve a careful look.)

Dr. Fletcher's September 14 Budget Transmittal Letter

This letter refers back to the June 4 letter to the President and proposes a specific FY 1978 budget request which seeks to configure a NASA program so as to:

- Reverse the trends of the past few years which have caused a real erosion in NASA's programs and in this Nation's technological capabilities;

- Move in the direction of the goals for the next decade summarized in the attachments to Dr. Fletcher's letter to the President and reflected in NASA's current five-year planning.

The letter emphasizes that in constant FY 1978 dollars, the NASA budget has been reduced by $1.4 billion or 26 percent below NASA's real level-of-effort in 1972, which is the year in which NASA "leveled off" after the Apollo program. The NASA proposed budget for FY 1978 is said to represent only 4 percent growth (in real terms) above the FY 1977 level--and the outyear implications of Dr. Fletcher's program plan (as envisioned in the letter to the President) would not in future years exceed $4.3 billion (FY 1978 dollars), unless a decision were reached to fund the fourth and fifth shuttle orbiters as an add-on to the NASA budget (or to make an early commitment to a Mars follow-on mission or the space station).

The letter goes on to emphasize that priority for funding support in FY 1978 should be given to: the Space Telescope; planetary exploration (includes the Jupiter Orbiter Probe mission; and a possible Mars follow-on mission still under consideration which NASA may want to propose in December for initial budget support in FY 1978 ($5 to $10 million in FY 1978 outlays)--if scientific returns from Viking are favorable); LANDSAT-D; and the procurement of space shuttle orbiters #4 and #5.

OMB Assessment

The following tabulation summarizes the dollar amounts included in the NASA request and Division recommendations. (The details of the recommendation are presented in the issue papers and in a summary of other recommendations provided at the end of the review book.)

	($ in millions) BA	Outlays
° Planning ceiling letter to NASA	3,795	3,768
- Plus OMB reserve for FY 1978 "New Starts"	+90	+40
° OMB Planning Assumptions	3,885	3,808
° NASA Request	4,107	3,927
- Differences	+222	+119
° Recommended Reductions	-193	-100
° Division Recommendation	3,914	3,827
- Differences from OMB Ceiling	+ 29	+ 19

NASA has during the past year undertaken an extensive five-year agency planning effort as described in Dr. Fletcher's letter to the President. The results of this effort have just been made available to us. We have not had the opportunity to review this material in detail, but we are providing below a brief summary of how the NASA plan, if implemented in total, might affect the level of future NASA budgets. In projecting the out-year implications of the Division recommendation for FY 1978, we have simply assumed that the future year "planning wedge" contained in the NASA five-year plan could be added-on to the "adjusted" FY 1978 budget runout we are recommending--i.e., we have assumed that NASA would have to rework its out-year plans and priorities to adjust to the 1978 Division recommendations and the deferrals we have recommended in FY 1978. The resulting OMB assumptions can be taken as an "upper limit" projection of the future NASA budget. (Substantial flexibility exists for reducing future year funding based on long-range policy and budget decisions in future budgets.)

The basic projection amounts (budget authority in millions of constant FY 1978 dollars) are as follows:

	FY 1977	1978	1979	1980	1981	1982
NASA Assumptions:						
- FY 1978 Budget Request	3,693	4,107	4,160	3,837	3,318	2,899
- Future-year Budget Initiatives....	--	--	+ 353	+ 876	+1,415	+1,810
Total, BA ..	3,693	4,107	4,513	4,713	4,733	4,709
OMB Assessment of "Upper Limit" NASA Budget Threat:						
- FY 1978 Budget Recommendations..	3,693	3,914	3,882	3,570	3,130	2,760
(Shuttle Dev.) ..	(1,288)	(1,303)	(1,115)	(680)	(345)	(135)
- Future-year Budget Initiatives (same as NASA) ..	--	--	+ 353	+876	+1,415	+1,810
Total, BA	3,693	3,914	4,235	4,446	4,545	4,570
- Implied Outlays ...	3,675	3,827	4,025	4,250	4,350	4,500

The major conclusion of these projections is clear: assuming that the space shuttle development program remains on schedule and meets its technical and cost objectives, the next several years should be very important in terms of defining the future NASA program -- with major implications for both policy and budgets. The shuttle will provide major new capabilities in space, which are only now beginning to be fully understood in terms of the technical and service opportunities it might provide. Policy and budget issues will no doubt increasingly turn to discussions of how to use--and pay for--these capabilities for scientific and applications purposes.

Using the NASA planning material now available, it should be possible to examine various alternative 5-year plans that might be considered for NASA, including rough comparisons of alternative funding implications. We have not attempted such a multi-year assessment here because of time constraints and the important near-term issues which need to be addressed in the FY 1978 budget process. This review book is focused on the decisions which are required now.

Functional Analysis of the NASA Budget

From the nature of the Director's questions in the NASA Spring Planning Review it was very clear that he wanted more insight into the character of the NASA R&D programs; how these programs fit into the overall strategy of Federal R&D support; and more specificially, he wanted a rationale for NASA's so-called "applications" programs and how these relate to the activities of other Federal agencies. In attempting to satisfy the Director's concerns, we have taken several steps reflected in the organization of our review material and our specific issue recommendations. These steps included:

- Asking NASA to make a "special analysis" (see below) of its program in several categories which differ somewhat from the official budget categories, but provide more insight into the type of effort involved in NASA programs and the objectives which they serve.

- Attempting to work more closely with budget examiners in other divisions and branches to assess the priority and value of new NASA project proposals which affect other (mission) agencies.

- Providing a brief descriptive summary as background for major budget issues in each area of the NASA program, which seeks to describe in functional (and policy) terms what NASA is doing (or wants to do) and why the agency believes this is important.

Table 1 (next page) provides a functional breakdown, or matrix, which describes the resources included in NASA's FY 1978 budget request. The table classifies NASA effort in the conduct of research and development in two frames of reference:

1. <u>By objective of effort</u>

   (a) Expansion of Scientific Knowledge
   (b) Application of Technology
   (c) Capability Development

2. <u>By type of effort</u>

   (a) Basic and Applied Research
   (b) Proof of Concept and Verification
   (c) Full-Scale Development

The result is a matrix identifying nine classes of effort.

The "objective categories" are basically aligned to NASA's responsibilities under the Space Act to expand human knowledge, to promote the peaceful uses of space, to develop and operate space vehicles, and to preserve U.S. leadership in aeronautical and space science and technology.

The "type-of-effort" categories are consistent with the classification described in the OMB request to NASA for this analysis.

It should be emphasized that these are not budget categories and that the agency budget is not structured in this manner. Our objective is to describe and elucidate the nature of the NASA program. NASA staff place the following "caveats" on the material provided for this effort:

> "Assignment of effort to categories ... is necessarily subject to judgment on the part of the classifier, and a number of items could be assigned to different categories or split between categories with good logic. The approach followed is to assign entire projects to the category we regard as most appropriate for the effort involved."

Several general conclusions or observations can be made from studying Table 1:

- The NASA program is heavily weighted toward full-scale development programs (69 percent of the FY 1978 request), which reflects the technical complexity and high cost of developing space technology and operating space systems. The current program is heavily influenced by the development of the space shuttle which alone accounts for nearly half of NASA's FY 1978 budget request.)

- The actual "conduct" of basic and applied research accounts for only about 16 percent of the total NASA budget. It must be recognized, however, that the other 84 percent is an essential element of the program and necessary to the conduct of the space and aeronautics program--the "price of admission" to the space program, on the scale to which the U.S. has committed (as a matter of national policy) is quite high.

- Equal proportions of the balance of the program are devoted to the "expansion of scientific knowledge" (roughly basic research) and to "applications of technology" (roughly "applied research", such as earth resources satellites, meteorology, aeronautics, etc.). It should be recognized, however, that the "applications" category also includes a fair amount of

Table 1: Special Analysis of NASA FY 1978 Budget Request

(Budget Authority in millions of dollars)

	Basic and Applied Research		Proof of Concept and Demonstration		Full Scale Development		Total	
	$	% of Total	$	% of Total	$	% of Total	$	% of Total
Conduct of Research and Development								
Expansion of Scientific Knowledge (e.g., Viking)	175	4.3	51	1.2	671	16.3	897	21.8
Application of Technology (e.g., LANDSAT)	344	8.4	273	6.6	253	6.2	870	21.2
Capability Development (e.g., Space Shuttle)	153	3.7	64	1.6	1927	46.9	2144	52.2
Total Conduct of R&D	672	16.4	388	9.4	2851	69.4	3911	95.2
Research and Development Facilities							196	4.8
Total NASA							4107	100.0

scientific activity (e.g., as in the case of weather and climate R&D which is classified as an applications activity).

- The development of future space capabilities currently accounts for half of the NASA program. As a consequence, when the space shuttle is completed, there will be an opportunity for increasing the proportion of NASA effort going to basic and applied research within a fixed budget; for reducing total dollar commitments to the agency; or some combination of both.)

Organization of this Review Book

At the beginning of each major section of issue papers, we have provided more detail on the composition of the NASA budget request in the categories described above, along with a narrative description which seeks to provide a policy perspective for the issues that follow. We hope this provides an informative perspective for considering major components of the NASA budget and our recommendations.

NASA

National Aeronautics and
Space Administration

Washington, D.C.
20546

Office of the Administrator

SEP 14 1976

Honorable James T. Lynn
Director
Office of Management and Budget
Washington, DC 20503

Dear Jim:

This letter transmits the budget recommendations for NASA for FY 1978, and discusses briefly the principal policy questions involved. The estimates for FY 1978 are summarized in the enclosed table. Detailed estimates and supporting materials are being made available to your staff.

In my letter to the President of June 4, 1976, I expressed my deep concern about the steady erosion of the United States' space program. I indicated the imperative need to reverse this trend in the FY 1978 budget, and I pointed out some of the opportunities on which our long-range planning is focused.

Since it has not been possible to reach decisions on these matters prior to the submission of FY 1978 budget estimates as I had hoped, I have concluded that the responsible way to proceed is to configure the NASA programs to:

1. Reverse the trends of the past few years which have caused a real erosion in NASA's programs and in this Nation's technological capabilities;

2. Move in the direction of the goals for the next decade summarized in the attachments to my letter to the President and reflected in our current five-year planning; but:

3. Exclude, unless the President decides otherwise, provision for major commitments to new goals or programs in the long-range plan, i.e., limit new commitments in the FY 1978 budget submission to a few previously anticipated new starts and normal extensions and next steps in current program areas.

The estimates we are submitting on this basis exceed the target provided in your letter of August 19, 1976, but are less than half the ten percent real increase referred to in my letter to the President. As discussed below, I believe that the estimates submitted and the implied future funding envelope demonstrate that support of the NASA program at the level required in the national interest does not represent a major "budget threat."

I will not repeat here the reasons for a strong national program in aeronautics and space and the crucial importance of advanced technology to the future of the United States; I feel these were properly covered in my letter of June 4. I will confine myself to pointing out some of the principal policy and program features of the estimates we are submitting.

1. Total budget level: Reversing erosion - The enclosed chart illustrates the erosion of the NASA program in recent years, the steps proposed in our FY 1978-79 estimates to reverse this trend, and the fact that the future implications of our budget proposals do not constitute a major budget threat.

a. In constant FY 1978 dollars, there has been a $1.4 billion or 26% reduction in NASA work since the program "leveled off" in 1972 after the Apollo Program. The FY 1977 budget provided some relief for the corresponding problems in research and technology programs of the National Science Foundation and the Department of Defense, but not for NASA.

b. The total NASA FY 1978 estimates submitted herewith ($4.1 billion in budget authority; $3.9 billion in outlays) represent a real increase over FY 1977 of only 4% in budget authority and would make up less than one-sixth of the ground lost since 1972.

c. For FY 1979 and future years, our projections indicate that a small further real increase in budget authority to $4.3 billion (FY 1978 budget dollars) would provide a new budget level adequate to provide the program augmentations, extensions, and new starts consistent with the goals summarized in my letter to the President. Even if it is decided that production of Shuttle orbiters #4 and #5 is to be budgeted by NASA rather than DOD, it is evident that our recommendations involve only a limited increase that is not a significant future budget threat.

2. Space Telescope - As anticipated in the FY 1977 budget decisions, we have included the starting of the Space Telescope project in our FY 1978 estimates. During the extra year of preparations resulting from last year's decision to defer this project a year, we have taken measures, with the concurrence of OMB, to improve the industry's competitive posture. These steps have greatly increased our confidence that the project can be completed within our current cost estimate of $435 to $470 million in FY 1978 dollars over six years. As you know from our prior discussions, the establishment of this observatory facility in space is universally regarded as the most significant single step to be taken in the 1980's for astronomical exploration and the scientific understanding of the universe.

3. Planetary Exploration--Next Steps - Our FY 1978 estimates also provide for the initiation of the "Jupiter Orbiter-Probe" (JOP) mission, another top priority space science project which was anticipated in the FY 1977 budget. JOP will provide for a launch to Jupiter in December 1981 of a spacecraft which will go into orbit around the planet in 1984 to make detailed observations of Jupiter and its satellites. Shortly before orbit capture, an instrumented probe will be released into Jupiter's unique and mysterious atmosphere. This probe will use technology developed for the Pioneer Venus mission. The orbiter will be designed to be adaptable with minimum modifications for future orbiter-probe missions to the planets, thereby assuring future cost savings.

With the outstanding success of Viking 1, which is returning daily a large volume of scientific data of superior quality and significance, and with the prospect of even more important findings from Viking 2, I have concluded that we should provide in the FY 1978 budget for the option to follow up the exploration of Mars in the early 1980's. The selection of the missions to be flown and the types of experiments that will be most important depend on further assessment of the Viking results and additional preliminary study of technical and cost aspects of alternative possible missions. Several options are now being studied; our plan is to arrive at preliminary recommendations by December of this year and to present final proposals for a commitment to proceed a year from now in our FY 1979 budget submission, prior to the actual obligation of FY 1978 funds. Lead-time considerations and the fixed times of Mars launch opportunities require that funds for initiating the next Mars mission, if approved, be available in FY 1978. We have, therefore, included $20 million in our present submission, subject to future definition as indicated above.

4. Landsat - Our estimates for FY 1978 include provision for starting work on Landsat D to be a Shuttle-retrievable and refurbished multi-mission spacecraft to test the advanced high-resolution thematic mapper instrument presently under development and to provide a test period of several more years for the current experimental uses of multispectral earth resources survey data. Because of the special interest of your office in the Landsat program, I am presenting a discussion of this recommendation in some detail in a separate letter.

5. Procurement of Orbiters #4 and #5 - As you know, Secretary Rumsfeld and I have had discussions on the question of whether procurement funds for the fourth and fifth Space Shuttle orbiters should be carried in the DOD or the NASA budget. We agree that it is a matter which will probably require a Presidential decision, and this was mentioned to the President in the course of my meeting with him last week. I understand that Secretary Rumsfeld strongly supports the need for a single fleet of orbiters to meet total defense and civil needs, including future defense and civil needs not yet defined, and to provide for necessary operational flexibility, for future specialized modifications if necessary, and for a conservative hedge against possible attrition. My discussions with Secretary Rumsfeld suggest strongly that it may be desirable, for reasons of unified program management and Congressional acceptability, that the procurement of orbiters #4 and #5 be carried in the NASA budget. I have included the funding requirements for orbiters #4 and #5 as a separate item in NASA's budget submission, over and above our budget planning, to ensure that the necessary amounts will be included in either the NASA or the DOD budgets, depending on the President's decision.

Dr. Lovelace and I will be pleased to discuss these and any other aspects of our FY 1978 budget estimates with you and your associates at the appropriate time during the OMB review.

Sincerely,

James C. Fletcher
Administrator

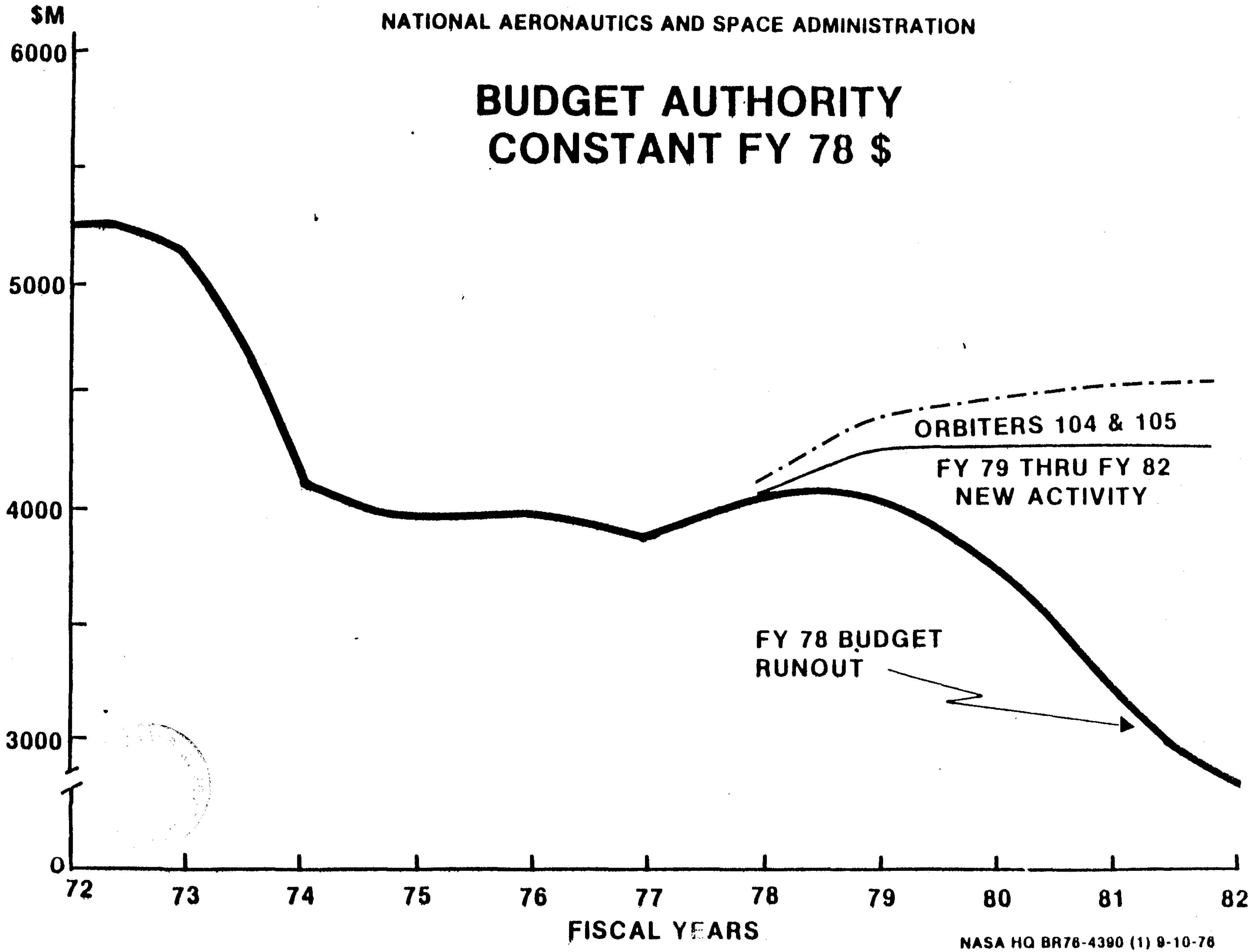
Enclosures

National Aeronautics and Space Administration

FY 1978 BUDGET
($ in Millions)

	Budget Authority	Outlays
Research and Development	3093	2972
Construction of Facilities	196	135
Research and Program Management	818	818
Total NASA budget	4107	3925
Additional Requirement for Procurement of Fourth and Fifth Shuttle Orbiters to be added to NASA budget in the event that a decision is made that NASA is to be the funding agency	47	25

ENCLOSURE 1


NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
BUDGET AUTHORITY
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FY 79 THRU FY 82
NEW ACTIVITY
FY 78 BUDGET
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NASA HQ BR76-4390 (1) 9-10-76

ENCLOSURE 2

NASA
National Aeronautics and
Space Administration
Washington, D.C.
20546
Office of the Administrator

6/9

June 4, 1976

Mr. James T. Lynn
Director
Office of Management and Budget
Executive Office of the President
Washington, DC 20503

Dear Jim:

Enclosed is a letter I am sending to the President expressing my deep concerns about the future of our civil space program. As you know, we are in the process of formulating five-year plans for some of our major areas of activity as one element in determining the proper program for the FY 1978 budget submission. My present view is that NASA will have to be operating at an austere level of something over $4 billion in order to maintain a viable program content and performance.

Sincerely,

Jim F

James C. Fletcher
Administrator

Enclosure

NASA

National Aeronautics and
Space Administration

Washington, D.C.
20546

Office of the Administrator

June 4, 1976

The President
The White House
Washington, DC 20500

Dear Mr. President:

I have had the honor to serve as the Administrator of your National Aeronautics and Space Administration for the past five years. During that time, this exciting and dynamic agency has realized many proud accomplishments -- but these have come about largely as the consequence of earlier investments in science and technology.

As a matter of conscience and duty, I must inform you of the steady erosion of the United States space capabilities and of the dangers this poses. Over the past five years, we have not been permitted to maintain the program breadth or momentum necessary for continued contributions to national security, international policy, and technological progress.

If the civil program continues to be held below its critical threshold, we run a real risk of foregoing rich future benefits in international prestige, military spinoffs, economic and industrial stimulation, and constructive noninflationary employment -- as well as in critical new space capabilities. I feel we are also risking what may be the single most important potential for inspiring America's future generations. I have recently mentioned these problems to the Vice President, Brent Scowcroft, and Jim Cavanaugh among others. I believe they all were surprised at the serious loss of our abilities to compete, cooperate, or advance in space.

In my view, we have reached a breaking point: We have already lost much of the capability of our unique government-university-industry aerospace team, and are in danger of losing even more. ✓ We are risking not meeting important expanding international commitments. We are in danger of losing a critical national resource as well as our leadership as a space power. Even the usually conservative financial community is recognizing the signs of a national technological crisis -- and the shrinkage of the NASA program has been a major contributor to that crisis.

Mr. President, I wholeheartedly support your strong commitment to fiscal responsibility and balanced budgets. However, I must point out that NASA, the Executive Agency dedicated to creating long-term future technological strength for the Nation, is in critical difficulty. In blunt terms, if we cannot expand the scope of NASA's activity, the civil space program will be irreparably damaged.

I believe it is important to express my concerns directly to you before the start of the normal budget cycle. I am writing separately to Jim Lynn on this subject, and I will, of course, be working with him during the fall. In my judgment, the effort required to reverse current trends is relatively small. An initial 10% of real growth in program content can make the difference between a strong national program and one at or below the threshold of survival.

If you could make some time available, I would be most pleased to discuss the issue of NASA's future with you in detail. Recognizing your extraordinarily full schedule, I am enclosing two attachments which may help focus both the problem and opportunity: the first is a short paper on the civil aerospace program, and the second is a summary of a new five-year plan for space and aeronautics currently being developed.

On a different but related matter, Don Rumsfeld and I hope to meet with you later in the year to recommend a joint approach to the procurement of the operational Space Shuttle.

Respectfully,

Jim

James C. Fletcher
Administrator

2 Enclosures

cc: The Vice President
James T. Lynn
James M. Cannon
Lt. Gen. Brent Scowcroft
L. William Seidman
James H. Cavanaugh

SPACE AND AERONAUTICS: CHALLENGE AND OPPORTUNITY

A rational, productive aerospace program is a vital component of the near- and long-term future of the United States -- and of the world.

- Space technology is an integral element of international policy: the satellite has become indispensable to intercontinental communications and to international weather services; satellites are positive contributors to accurate United States information on global earth and ocean resources and conditions; aerospace programs provide the United States powerful selective options for cooperation or competition with advanced and developing nations.

- Space technology -- and the concomitant of an advanced and imaginative aerospace industry -- is critical to the national defense posture of the United States. Civil programs, because of their open, exploratory character, generate broad technological advance that energize entire industries as well as being directly employed for civil or military ends.

- Aerospace programs, by their nature, are at the cutting edge of technological advance -- they demand and create, above all, "high" technology. Technology of all levels is recognized as a necessary major contributor to national productivity; what is less well recognized is the enormous economic leverage exercised by investment in and development of "high" technology. Recent assessments indicate that a dollar spent in NASA R&D creates a 14:1 return over 10 years in terms of increased productivity alone, and that small but sustained changes in the levels of NASA expenditures have a disproportionately large effect in creating and sustaining permanent new jobs in the national economy.

- The challenge of space is an exciting inspiration to the younger generations of America and the world. The nation that meets this challenge boldly will strengthen and enlarge the spirit of all its citizens and create the drive for future progress and achievement.

- The civil space agency -- NASA -- is the single Federal instrumentality squarely focused on the future. NASA has developed into the nation's most effective technical problem-solving agency. It is an instrument available for use; it should not be allowed to sag into mediocrity or to dwindle away for lack of forward-looking assignments.

An immediate opportunity now lies before our country: to mobilize its civil aerospace resources in pursuit of national objectives. If action is not taken, the nation's ability to mount effective programs will erode beyond repair, and the international competitors of the United States will establish commanding leads in such areas as permanent manned facilities in space, planetary exploration, space communications, and high speed intercontinental aviation. Aerospace objectives of great value and importance are:

- A global information service -- strengthening the United States' posture at home and abroad with revolutionary improvements in timely and accurate reporting on worldwide economic and environmental conditions through the organized use of space-based observation systems.

- Permanent American occupancy of space -- guaranteeing free access to space by all for peaceful purposes, providing a new and expanding dimension for United States industry and commerce in exploiting the unique environment and technology of space for new goods and services, and opening new horizons for the human spirit.

- The integrated scientific exploration of the Universe -- to find the answers to central questions of life, matter, and energy.

- Reestablishment of American preeminence in aviation -- creating the commercial competence to compete effectively in world markets with new aircraft using new designs, materials, propulsion and technology.

The returns from investment in civil aerospace are power -- economic, scientific, and political. This can flow only from a steady level of activity; research and development cannot thrive or deliver its technological products in an environment of uncertain commitment or sporadic support. Focused investments in high technology are significant national economic tools in the search for prosperity without inflation.

To provide for the future requires thoughtful and prudent investments in the present. At stake are the leadership, prestige, and power of the United States in a critical technological domain affecting the life and livelihood of every citizen -- and, through example and political extension of that power, the future of all the world.

June 4, 1978

Summary Data

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National Aeronautics and Space Administration
1978 Budget

Summary Data

	(In millions) Budget Authority	Outlays	Employment, end-of-year Full-time Permanent	Total
1976 actual	3,552	3,669	24,039	25,426
1977 Budget, January 1976 estimate	3,697	3,675	23,816	25,211
enacted	3,693	3,675	23,816	25,211
agency request/OMB recommendation	3,693	3,675	23,816	25,211
OMB employment ceiling	xxx	xxx	23,816	25,211
1978 planning target	3,885	3,808	23,746	25,141
agency request	4,107	3,927	23,746	25,141
OMB recommendation	3,914	3,827	23,746	25,141
1979 OMB estimate	3,882	3,921	23,746	25,141

Summary of Issues

	1978 Agency Req. BA	1978 Agency Req. O	1978 OMB Recom. BA	1978 OMB Recom. O	1979 OMB est. BA	1979 OMB est. O
Issues:						
#1 Space Shuttle Orbiters (NASA Costs)	1,391	1,368	1,391	1,368	1,248	1,274
#2 Earth-Orbiting Space Telescope	36	22	35	21	76	62
#3 Jupiter Orbiter/Probe Mission	21	12	21	12	79	47
#4 Lunar Polar Orbiter	7	3	--	--	--	--
#5 Aircraft Energy Efficiency Program	75	48	65	43	95	78
#6 NASA/DOD Joint Programs	10	6	1	1	3	1
#7 LANDSAT-D Development Proposal	33	12	22	8	51	30

National Aeronautics and Space Administration
1978 Budget

Distribution of Budget Authority
(In millions of dollars)

	1976 Act.	1977 Jan. Budget	1977 Agency Req.	1977 OMB Recom.	1978 Agency Req.	1978 OMB Recom.	1979 OMB Est.
B. Discretionary programs (relatively controllable) Research and Development							
1. Space Flight	1,561	1,645	1,642	1,642	1,739	1,709	1,560
Space Shuttle Development	1,206	1,288	1,288	1,288	1,303	1,303	1,115
Space Shuttle Operations Capability .	11	17	19	19	68	63	90
Space Shuttle Operations	--	--	--	--	18	18	80
Other Space Flight Programs	344	340	335	335	350	325	275
2. Space Science	434	379	380	380	441	402	472
Space Telescope	5	--	--	--	36	35	76
Jupiter Orbiter/Probe Mission	--	--	--	--	21	21	79
Lunar Polar Orbiter	--	--	--	--	7	--	--
Viking Mars Follow-on	--	--	--	--	20	5	--
Other Space Science Programs	429	379	380	380	357	341	317
3. Space Applications..................	178	198	198	198	225	206	197
LANDSAT-D	--	--	--	--	14	9	33
Other Space Applications Programs ...	178	198	198	198	211	197	164
4. Aeronautical Research & Technology ..	175	189	190	190	246	223	250
Aircraft Energy Efficiency	10	40	40	40	75	65	95
NASA/Navy Lift Cruise Aircraft	--	--	--	--	4	--	--
Other Aeronautical R&T	165	149	150	150	167	158	155

	1976 Act.	1977 Jan. Budget	1977 Agency Req.	1977 OMB Recom.	1978 Agency Req.	1978 OMB Recom.	1979 OMB Est.
5. Space Research and Technology	75	82	82	82	115	94	101
6. Multimission Spacecraft	--	--	--	--	25	10	20
7. Supporting Activities (e.g. Satellite Tracking and Data Acquisition)	255	266	270	270	302	296	325
Total Research and Development	2,678	2,759	2,762	2,762	3,093	2,940	2,925
Construction of Facilities	82	124	118	118	196	161	147
1. Space Shuttle Facilities	47	40	31	31	70	70	50
2. National Transonic Facility	--	25	25	25	24	24	25
3. 40X80 Wind Tunnel	--	--	4	4	16	16	17
4. Other Construction	35	59	58	58	86	51	55
Personnel and Administration	792	814	813	813	818	813	810
Total NASA	3,552	3,697	3,693	3,693	4,107	3,914	3,882
Space Shuttle Orbiter 4 & 5 Procurements (1st increment)	--	--	--	--	+ 47	--	--

National Aeronautics and Space Administration
1978 Budget

Distribution of Outlays
(In millions of dollars)

	1976	1977			1978		1979
	Act.	Jan. Budget	Agency Req.	OMB Recom.	Agency Req.	OMB Recom.	OMB Est.
Discretionary programs (relatively controllable) Research and Development							
1. Space Flight	1,574	1,617	1,617	1,617	1,736	1,716	1,625
Space Shuttle Development	1,161	1,251	1,251	1,251	1,307	1,307	1,160
Space Shuttle Operations Capability	10	16	16	16	50	47	80
Space Shuttle Operations	--	--	--	--	10	10	60
Other Space Flight Programs	403	350	350	350	369	352	325
2. Space Science	441	398	398	398	405	384	456
Space Telescope	4	3	3	3	22	21	62
Jupiter Orbiter/Probe Mission	--	--	--	--	12	12	47
Lunar Polar Orbiter	--	--	--	--	3	--	--
Viking Mars Follow-on	--	--	--	--	10	5	--
Other Space Science Programs	437	395	395	395	358	346	347
3. Space Applications	191	203	203	203	210	198	194
LANDSAT-D	--	--	--	--	4	2	13
Other Space Applications Programs .	191	203	203	203	206	196	181
4. Aeronautical Research & Technology.	178	177	177	177	220	208	260
Aircraft Energy Efficiency	5	25	25	25	48	43	78
NASA/Navy Lift Cruise Aircraft	--	--	--	--	2	--	--
Other Aeronautical R&T	173	152	152	152	170	165	182

	1976	1977			1978		1979
	Act.	Jan. Budget	Agency Req.	OMB Recom.	Agency Req.	OMB Recom.	OMB Est.
5. Space Research and Technology	82	75	75	75	97	85	90
6. Multimission Spacecraft	--	--	--	--	14	5	10
7. Supporting Activities (e.g. Satellite Tracking and Data Acquisition).......	283	267	267	267	290	286	316
Total Research and Development	2,749	2,737	2,737	2,737	2,972	2,882	2,951
Construction of Facilities	121	125	125	125	136	132	160
1. Space Shuttle Facilities	66	59	59	59	51	51	54
2. National Transonic Facility	--	3	3	3	8	8	20
3. 40X80 Wind Tunnel	--	--	--	--	2	2	15
4. Other Construction	55	63	63	63	75	71	71
Personnel and Administration	799	813	813	813	819	813	810
Total NASA	3,669	3,675	3,675	3,675	3,927	3,827	3,921
Space Shuttle Orbiter 4 & 5 Procurements (1st increment)	--	--	--	--	25	--	--

National Aeronautics and Space Administration
1978 Budget

Long-range Estimates
(OMB estimate in millions of dollars)

			1978	1979	1980	1981	1982
A.	Research and Development						
	Space Flight	B/A	1,709	1,560	1,220	960	745
		O	1,716	1,625	1,295	1,005	780
	(Space Shuttle Development)	B/A	(1,303)	(1,115)	(680)	(345)	(135)
		O	(1,307)	(1,160)	(763)	(398)	(171)
	Space Science, Applications and Technology	B/A	712	790	775	675	560
		O	672	750	780	740	620
	Aeronautical Research and Technology	B/A	223	250	220	170	145
		O	208	260	240	205	185
	Supporting Activities	B/A	296	325	395	390	390
		O	286	316	380	390	390
B.	Construction of Facilities	B/A	161	147	150	125	110
		O	132	160	160	140	130
C.	Personnel and Administration	B/A	813	810	810	810	810
		O	813	810	810	810	810
	Total NASA	B/A	3,914	3,882	3,570	3,130	2,760
		O	3,827	3,921	3,665	3,290	2,915

Summary Comparison of Outlay Projections

	1978	1979	1980	1981	1982
1977 Budget January 1976 estimates	3,642	3,491	3,264	2,962	XXX
1977 Budget, Mid-Session Review estimates	3,815	3,856	3,752	3,425	XXX

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National Aeronautics and Space Administration
1978 Budget

Authorizing Legislation Required for 1979
(Under sec. 607(f), P.L. 93-344,
this legislation must be transmitted to Congress
no later than May 15, 1977)

($ in millions)

		1979		1980		1981		1982	
		Req.	Recom.	Req.	Recom.	Req.	Recom.	Req.	Recom.
Existing programs for which authorization must be renewed in 1979:									
Research and Development	B/A	3,142	2,925	2,858	2,610	2,375	2,195	1,971	1,840
	O	3,111	2,951	2,912	2,695	2,535	2,340	2,123	1,975
Construction of Facilities	B/A	200	147	161	150	125	125	110	110
	O	160	160	175	160	175	140	150	130
Research and Program Management	B/A	818	810	818	810	818	810	818	810
	O	818	810	818	810	818	810	818	810
New Administration initiatives to be proposed in 1979 requiring authorizing legislation:									
Research and Development	B/A	353	125	450	275	490	300	380	240
	O	150	60	380	195	425	260	425	300

Agency Request: NASA has focussed considerable top management attention on five-year policy and program planning for future NASA efforts in aeronautical and space research. The NASA budget request for FY 1978 and projection for FY 1979 reflect what NASA believes is required to advance the agency's long-range goals in conducting astronomy of the sun and the universe from earth orbit; the exploration of the planets; advances in ways to apply space technology to world-wide communications, crop prediction, search for natural resources, weather prediction, and the study of the oceans; and cost-effective ways to transport men and material to and from space. The projected NASA funding in FY 1979 would provide for the initiation of new programs as well as replacements for those that have been completed (e.g., the Viking landing which was completed this year).

Impact on existing programs: None

Authorizing legislation is required annually for all of NASA's programs.

OMB Recommendation: OMB included a "new start allowance" for FY 1978 for NASA in the President's 1977 Budget to the Congress. As in prior years our projections are based on the Division's recommendations for FY 1978 and we have also provided an allowance (or dollar planning wedge) for FY 1979 "new starts," which assumes that NASA and OMB will jointly assess priority new initiatives in the review of the FY 1979 budget.

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National Aeronautics and Space Administration
1978 Budget

Discussion of Presidential Management Initiatives

Agency Submission

NASA submitted its action plan related to the Presidential Management Initiatives on August 23, 1976. The PMI action plan submitted by the agency is quite comprehensive and generally covers, as appropriate, all the initiatives outlined in Mr. Lynn's July 27 memorandum to department and agency heads.

OMB Assessment

The NASA PMI action plan has been commented on by various OMB staff and the comments have been compiled into an overall assessment of the plan. A letter was forwarded to Dr. Fletcher on October 2 which provided detailed comments and an overall evaluation of the NASA plan. Generally, NASA submitted a good action plan; however, as we noted in our correspondence with Dr. Fletcher we believe that NASA needs to focus on amplifying some milestones (e.g., what is to be achieved rather than how), on achieving near-term results this calendar year, and on refining procedures whereby OMB can assess the agency's progress (i.e. quantification of specific achievements).

As noted in our comments on NASA's objectives and program evaluation efforts, NASA has an excellent management and administrative system. The initiatives included in NASA's action plan appear to be consistent with the demonstrated management capabilities that exist in the agency.

Progress Reporting

NASA submitted its September 21 progress report to OMB on time. Although the report showed that NASA is moving to achieve responsibly the objectives of PMI, the agency had not received an OMB assessment on the initial plan when the progress report was submitted. We believe that NASA will be responsive to the comments we have provided and reflect these in the next progress report due October 21.

National Aeronautics and Space Administration
1978 Budget

Discussion of Agency Objectives and Program Evaluation Efforts

I. NASA MBO Submissions for FY 1978

- In general, NASA has a good system for identifying program objectives, for specifying key milestones related to their achievement, and for managing agency resources effectively to achieve these objectives on the timetables agreed to in the budget approval process.

- Agency objectives tend to be fairly technical in nature (e.g., launching a mission to Mars on a specific date) and relate more to <u>how</u> to achieve something rather than an assessment of <u>whether</u> it should be achieved. The normal budget review process provides a mechanism for establishing <u>what</u> should be done.

- Recognizing the character of the agency's mission and the technical nature of its specific objectives, NASA has done a good job in developing its MBO's for 1978--priorities have been established and the milestones are specific enough to measure progress.

II. Program Evaluations

- Because NASA tends to measure progress through the development of R&D systems (e.g., the Space Shuttle) and the completion of space missions (e.g., Viking), the agency tends to emphasize <u>administrative efficiency</u> rather than <u>program evaluations</u>. Programs are usually evaluated by their scientific results, and in this regard NASA has been highly successful. The efforts identified by NASA for 1978 appear worthwhile and may result in significant improvements in agency operational procedures (e.g., curtailing use of energy in operating centers, streamlining procurement activities, etc.).

- The agency does not have a formal organization reporting to the Administrator which could be considered the equivalent of the program planning or evaluation staff found in some agencies (e.g., ERDA). However, the agency has an effective system for measuring project performance and for planning future projects both at its field centers and in its headquarters program offices. Agency-wide planning and evaluations are accomplished as needed by special study teams. NASA's approach appears to be appropriate in view of how the agency is organized in relationship to the diversity of its mission.

- In our view NASA has an effective "evaluation" system for reviewing and managing costs, schedules and technical objectives for major projects. The agency has rarely failed to fulfill its objectives for specific projects and has infrequently encountered major cost overruns or schedule delays.

III. Agency Management Quality and Process

- In terms of technical achievements and management capabilities, NASA management performs well--its quality extends into the centers and headquarters program offices.

- There is no reason to expect that the agency will not respond to future suggestions for improvement in specific management areas.

IV. Management Accomplishments Over the Past Two Years

- Some examples from NASA include:

  - Energy conservation program (implemented throughout the agency).

  - Use of "teleconferencing" as a substitute for travel (important in the management of the Shuttle program).

  - Institutional assessment (civil service and support contractor reductions and realignment of "roles and missions" at each of the NASA field installations).

  - Future program planning (NASA has completed extensive studies of potential future activities in both space and aeronautics as one means of guiding future program planning in the agency).

National Aeronautics and Space Administration

MANAGEMENT BY OBJECTIVES
FY 1978 BUDGET PLAN

Goal - Provide more effective means for utilization and advancement of capabilities in space while reducing the cost of space operations.

Objective - Develop the Space Shuttle which will provide roundtrip access to space beginning in the 1980's. The Space Shuttle will offer unique capabilities such as retrieving payloads from orbit; servicing and repairing satellites in space; deploying, operating and recovering space laboratories; and performing rescue missions.

Milestone	Commitment Date
Issue Contract Authority to Proceed for Production of Orbiters 103,104,105 and Modification of Orbiters 101 & 102	October 1977
Complete First Static Firing on Main Propulsion Test Article	February 1978
Complete Design Certification Review (DCR) for First Manned Orbital Flight (FMOF)	July 1978
Complete First Qualification Firing of the SRM	September 1978
Complete Software Verification for FMOF	October 1978
Complete Delivery to KSC of First Orbiter (Orbiter 102) for FMOF	November 1978
Complete Delivery of First Flight Set of Engines to KSC for FMOF	December 1978
Complete Delivery of First Flight Set SRB's to KSC for FMOF	December 1978
Operational Readiness for PAD A at KSC	December 1978

National Aeronautics and Space Administration

MANAGEMENT BY OBJECTIVES
FY 1978 BUDGET PLAN

Goal - Increase scientific knowledge and understanding through exploration of the earth's environment, the planets, and the universe.

Objective - Explore the moon, the planets and their satellites, and the particles and fields of interplanetary and interstellar space, through the use of automated spacecraft which fly by, orbit, enter the atmosphere of, and/or land on those bodies. Pioneer Venus will conduct scientific investigations of the planet Venus and its environment with particular emphasis on detailed characterization of the Venusian Atmosphere. Jupiter Orbiter/Probe will conduct a comprehensive exploration of Jupiter, its atmosphere, physical environment and its satellites by combined observations from an orbiting spacecraft and an atmospheric entry probe. Lunar Polar Orbiter is planned as the first in a series of planetary orbiters to obtain global data on the terrestrial bodies. Analysis of data from the LPO will yield global maps of lunar surface composition, heat flow, magnetism, gravity and topography. The Mars Follow-on Mission objective is to define a logical and productive follow-up to the highly successful Viking landings on Mars. It will take maximum advantage of the Viking scientific inheritance, and utilize the Viking technological inheritance whenever it is cost effective to do so.

Milestone	Commitment Date
Pioneer Venus	
Complete Orbiter Thermal Vacuum Test	November 1977
Complete Probes/Bus Thermal Vacuum Test	February 1978
Deliver Orbiter to Launch Site	May 1978
Launch Orbiter	June 1978
Deliver Multiprobe S/C to Launch Site	July 1978
Launch Multiprobe	September 1978

Milestone	Commitment Date
Jupiter Orbiter/Probe	
Start Mission/System Design	November 1977
Start Probe Detailed Design and Development	June 1978
Lunar Polar Orbiter	
Issue RFP for Design and Development	January 1978
Award Design and Development Contract	July 1978
Mars Follow-On Mission	
Start Mission/System Design	November 1978

National Aeronautics and Space Administration

MANAGEMENT BY OBJECTIVES
FY 1978 BUDGET PLAN

Goal - Increase scientific knowledge and understanding through exploration of the Earth's environment, the Planets, and the Universe.

Objective - Study the nature and evolution of the universe through observation of high energy processes and discover the mechanism by which nature releases such vast amounts of energy. HEAO will explore the previously inaccessible regions of celestial X-ray and gamma-ray sources and of cosmic-ray flux. Solar Maximum Mission will conduct detailed studies of the solar flare process and the associated solar active regions during the next period of maximum solar activity, projected to occur at the end of this decade. The Space Telescope will increase by a hundredfold the volume of space accessible for observation, permitting scientists to investigate fundamental questions concerning the structure, origin, evolution and energy balance in the universe which could never be approached from observatories below the obscuring effects of the Earth's atmosphere.

Milestone	Commitment Date
HEAO	
Complete HEAO-C Spacecraft Critical Design Review	August 1978
Launch HEAO-B	October 1978
Deliver HEAO-C Experiment to Spacecraft Prime Contractor	November 1978
Solar Maximum Mission	
Complete Experiment Environmental Tests	September 1978
Space Telescope	
Award Spacecraft Hardware Contracts	December 1977
Award Contracts for Preliminary Design of Scientific Instruments	March 1978

National Aeronautics and Space Administration

MANAGEMENT BY OBJECTIVES
FY 1978 BUDGET PLAN

Goal - Provide the technology to make possible safer, more economical and environmentally acceptable air transportation systems which are responsive to current and future national needs; and to support the military in maintaining the superiority of the nation's aircraft.

Objective - Develop technology vital to the improvement of the nation's aircraft and air transportation system with a focus on (1) improving aircraft energy efficiency; (2) improving performance; (3) reducing undesirable environmental effects; (4) improving safety and terminal area operations; and (5) advancing long-haul and short-haul air transportation concepts for the future.

Milestone	Commitment Date
Improving Aircraft Energy Efficiency	
Award Contracts for Core Engine Fabrication and Test (Energy Efficient Engine)	April 1978
Initiate Flight Tests of Winglets (Energy Efficient Transport)	April 1978
Complete Flight Evaluation of Adaptive Control with Redundant Digital Fly-by-Wire System	May 1978
Complete Fabrication of Composite L-1011 Vertical Fin Ground Test Article	June 1978
Improving Performance	
Complete F-15 Airframe/Propulsion Interaction Flights	September 1978
Reducing Undesirable Environmental Effects	
Deliver QCSEE Over-the-Wing Propulsion System	March 1978
Complete Variable Cycle Engine Component Screening Tests	October 1978

Improving Safety and Terminal Area Operations

Report on Suitability of the Microwave Landing System for STOL A/C	February 1978
Flight Readiness of Integrated Avionics System for Initial Flight Tests in the XV-15 Tilt Rotor Research Aircraft	December 1978

Advancing Long-Haul and Short-Haul Air Transportation Concepts for the Future

Initiate Detail Design and Fabrication of First Advanced Research Rotor for RSRA	February 1978
Complete First Flight of Quiet Short-Haul Research Aircraft	August 1978
Complete Fuel Tank Sealant Tests on YF-12	September 1978

National Aeronautics and Space Administration

MANAGEMENT BY OBJECTIVES
FY 1978 BUDGET PLAN

Goal - Expand the practical application of space technology.

Objective - Develop and utilize the unique advantages of satellites to locate, map, measure and predict earth resources, and the earth's meteorological, environmental and physical characteristics; and to communicate with remote areas.

Milestone	Commitment Date
Complete delivery of Nimbus-G Protoflight Instruments	November 1977
Launch TIROS-N	March 1978
Select Landsat-D Systems Integration Contractor	June 1978
Launch the Heat Capacity Mapping Mission Explorer	July 1978
Launch Seasat-A	July 1978
Issue LACIE Phase III Final Report	September 1978

National Aeronautics and Space Administration

MANAGEMENT BY OBJECTIVES
FY 1978 BUDGET PLAN

Goal - Improve the effectiveness and efficiency of NASA Centers. Ensure equal opportunity in employment and contracting practices.

Objective - Continue improvement of the management of NASA's institutional resources consistent with the aim of keeping our in-house costs at the lowest practical level, while maintaining the capability to carry out space and aeronautical programs. Achieve continued progress in the Equal Opportunity Programs and in the participation of minorities and women in all NASA programs.

Milestone	Commitment Date
Implement automated contract/purchase order generation system	December 1977
Increase the dollar amount of contracts awarded to minority firms in the total NASA procurement activity	September 1978
Increase minority and female employment and participation with the following targets for FY 1978:	
Hire 216 minority and female professionals	September 1978
Hire 214 minority non-professionals	September 1978
20% of new professional hires at GS-14 and above will be minorities and females	September 1978
10% of promotions at GS-14 and above will be for minority and female professionals	September 1978

Space Shuttle Issue

Overview: Development of Advanced Capabilities for Effective Space Operations

1978 NASA Budget Request
(BA in $ Millions)

	Amount			Distribution		
	FY 1977	1978	1979	1977	1978	1979
Capability Development	1,972	2,144	2,038	100%	100%	100%
- Basic and Applied Research	145	156	156	7	7	8
- Proof of Concept	18	60	47	1	3	2
- Full Scale Development	1,809	1,928	1,835	92	90	90

Program Objectives

- Develop technologies that provide for more effective access to space (e.g., greater flexibility) and the capability to expand our uses of space for civilian and military purposes (e.g., the space shuttle).

- Develop technologies which will provide for less costly future operations in space through reuse of hardware, standardization of spacecraft, subsystems and components (e.g., space shuttle, multi-mission spacecraft modules, Spacelab).

- Develop capabilities for totally new applications of space (e.g., Spacelab which can be used to conduct materials research in a weightless, near-perfect-vacuum environment).

- Develop new systems for supporting a broad range of space applications--manned and unmanned (e.g., tracking and data relay satellites as alternative to ground tracking networks).

Program Content

Major elements include:

- Space shuttle development
- Spacelab development (i.e., reusable manned laboratory to be flown in the shuttle cargo bay--joint ESA/NASA project)
- Spinning solid upper stage rocket development (to provide a cheap, reliable method to get payloads from the shuttle to geo-synchronous orbit--22,500 mile orbit)
- Space shuttle/spacelab ground support facilities and equipment (e.g., NASA mission control center).
- Shuttle operations support (including spares, procurement of expendable tanks, fuel, etc.)
- Supporting and advanced research and technology development for science and space applications (manned & unmanned).
- Multi-mission spacecraft development
- Tracking and Data Relay Satellite System (this is a commercial development--services to be leased by NASA)
- Basic and applied research include supporting research and technology activities related to the development of advanced capabilities (e.g., feasibility tests of new types of space propulsion systems, advanced electronic devices, etc.).

Trends/New Initiatives

- Shuttle development now requires most of these resources, but will begin to phase down in FY 1979.
- Shuttle Operations will begin to build up beginning in FY 1978, keyed to first flight of the shuttle in 1979.

- FY 1978 new NASA initiatives include:
  - Procurement of shuttle orbiters #3, #4, and #5.
  - Development of NASA upper stages.
  - Space Industrialization (i.e., studies of a future space station).
  - Multi-mission spacecraft development.

Rationale for Federal/NASA Role

- Major national policy decision (Space Act of 1958) to develop/maintain U.S. leadership in space and aeronautics capabilities and applications.
- Presidential decision in 1972 to develop space shuttle to provide for cheaper/ easier U.S. access to space for U.S. civilian and military (as well as international) purposes.

Policy Considerations/Problems

- How many shuttle orbiters are needed? Who will fund--NASA or DOD? (See Issue #1.)
- Should the Administration accept NASA's proposed "user charges" policy for space shuttle? (We will provide memo of analysis later.)
- What next steps will be taken by NASA when shuttle development is completed--e.g., will there be a space station? When? (See "other recommendations" section.)
- What changes are required in NASA field center complex staffing levels when shuttle development is completed? (To be addressed in FY 1979 Spring Planning Review.)

Issue Paper

National Aeronautics and Space Administration
1978 Budget
Issue #1: Procurement of Space Shuttle Orbiters

Background

The decision to develop a manned reusable space shuttle was announced by President Nixon in January 1972. During the FY 1976 and 1977 budget reviews, Presidential decisions reaffirmed Administration support for the shuttle as the key program to continue a U.S. manned presence in space as well as a means to reduce the overall costs of future space operations. Although DOD has never made a firm commitment to purchase shuttle orbiters, a key NASA assumption has been that NASA would plan to procure three orbiters to initiate shuttle flights from Kennedy Space Center (KSC) and DOD would procure two more orbiters to fill in the overall requirements for both civilian and military flights. The orbiters will be identical, however, and interchangeable so that the five would serve as a fleet to be flown from launch sites on both coasts (KSC and Vandenberg Air Force Base). DOD has committed to build an upper propulsive stage for NASA and DOD use to place satellites in high earth orbit (22,500 miles) beyond the capability of the shuttle orbiter which is limited to low earth orbit. The DOD also has committed to build shuttle launch and landing facilities at Vandenberg Air Force Base (which under current plans would be operational by December 1982). These plans and commitments are outlined in Memorandums of Understanding and correspondence between NASA and the DOD.

The DOD has supported the space shuttle as being beneficial to the DOD mission in testimony before the Congress and in public statements (although there have been mixed views within Defense regarding the value of the shuttle to Defense relative to continued reliance on expendable launchers). In addition, interagency working groups have been operating since 1971 to insure that characteristics of the shuttle orbiter (e.g., cross-range and the size of the orbiter's cargo bay) will satisfy DOD requirements. During the past year, the DOD made firm decisions to to ahead with the development of a solid fuel upper stage; to maintain the option to provide shuttle launch and landing facilities at Vandenberg Air Force Base beginning in 1982;

to continue payload integration studies; and to provide for transition period expendable launcher backup. The DOD has allocated $1.8 billion for these items in its five-year plan. On the other hand, Defense has been unwilling to assume responsibility for the procurement of the two additional orbiters (orbiters number 4 and 5). This was stated in a letter from Deputy Secretary of Defense Clements to Dr. Fletcher last fall. The fourth and fifth orbiters are neither included in the Defense five-year plan nor in the NASA budget run-out.

NASA is now well into peak development on all elements of the shuttle vehicle--the orbiter, main engine, external tank, solid rocket booster, and electronic flight control systems. On September 17, the first completed shuttle orbiter was "rolled out" in ceremonies at the orbiter contractor's plant in Palmdale, California. By the end of 1976 about 55 percent of development work on the shuttle will be completed and about $4 billion will be invested (including facilities).

Major near-term milestones include full-power testing of the main engine (by mid-December), completion of systems test and checkout of the first shuttle orbiter (by early 1977) and the initiation of approach and landing tests of the first orbiter, which is to be dropped from a 747 aircraft (beginning in June of 1977). The first orbital flight of the shuttle is scheduled for mid-1979; full operational capability at KSC is scheduled for mid-1980.

NASA has developed a proposed "user charge" policy which will apply to other civilian agencies, to commercial and foreign users, and also to the DOD for operations at KSC. The final outcome of this issue on the size of the national orbiter fleet could impact both the user charge policy (i.e., the groundrules) and the level of charges to be assessed by NASA for use of the shuttle to support activities of other civilian organizations, including commercial and foreign users of shuttle services. (We will provide a follow-up memo of analysis on the shuttle user charge policy at a later time.)

<u>Interagency Study of Space Shuttle Options</u>

As follow-up to the Spring Planning Review discussion of this issue, letters were sent to the NASA Administrator, the Secretary of Defense and the Director of Central Intelligence requesting a coordinated interagency assessment of the major alternatives at this juncture of the Space Shuttle development program. A draft report from the agencies was received on September 15--and a final report is expected by October 15. Although none of the agencies with major involvement has officially endorsed the draft report, it appears that the agencies will reach the following major conclusions:

1. That five shuttle orbiters should be procured as a "minimum acceptable" national fleet.

2. That the most cost-effective (i.e., least-costly) alternative for Defense (but not for the nation) is a four orbiter fleet located at KSC (because in this option, the cost of constructing the Vandenberg facilities would be avoided.)

3. That, based on current assumptions about future space missions, the five orbiter fleet would be the most cost-effective approach to meeting future national space transportation requirements.

4. That the projected future utilization of the shuttle suggests that DOD is now making a "fair share" contribution to shuttle development and deployment without funding two operational shuttle orbiters (i.e., numbers 4 & 5).

5. That orbiters number 4 & 5 should, therefore, be funded as an "add-on" to the NASA budget.

Our general assessment of the draft report on shuttle orbiter options is summarized below. More detailed information will be provided separately as a classified annex to this paper (selective distribution). Our preliminary staff conclusions are as follows:

° The study conclusion that five orbiters should be procured as a "minimum acceptable" national fleet is heavily, though not entirely, dependent upon assumptions about the frequency of future missions for the shuttle. Although the projected usage for DOD purposes appears to be realistic in terms of currently projected missions, it does not include possible "new capability" missions that could materialize as the space shuttle becomes a proven and accepted space system. The civilian program, however, implies a significant expansion of space "traffic" in the 1980's, both for the conduct of basic and applied research in orbit (as in the Spacelab) and also for more conventional activities such as launching domestic and foreign communications satellites and U.S. planetary probes. The NASA assumptions are not entirely implausible in terms of projected future budgets for NASA, but the projected number of NASA shuttle flights (averaging nearly one every two weeks over the decade) could only be justified if in fact postulated scientific and application returns from the shuttle's new capabilities turn out to be important in relation to other national priorities.

° On a judgmental basis, it can be argued that the low traffic case considered in the study (which assumes 30-40 total shuttle flights per year for all users) is at least as plausible as the high traffic case used as the baseline in the study (which assumes 50-60 flights per year). Under this assumption, a reasonable case can be made that four orbiters would be a sufficiently large fleet (even if one were lost through accident), provided some rescheduling of priority missions is allowed. If no orbiters are assumed to be lost, a three orbiter fleet could possibly satisfy total launch requirements--although it would raise questions of whether the fleet were adequately sized to provide sufficient assurances of meeting DOD requirements to allow the elimination of expendable launch vehicles for DOD missions.

° The cost-saving argument for the five orbiter alternative is not persuasive because:

-- Savings are quite sensitive to assumptions about annual flight rates.

-- There is inconsistent treatment in the analysis as between NASA and DOD missions in terms of cost-savings to be obtained from use of shuttle-unique capabilities, such as payload retrieval and reuse. (NASA thinks the capability is very important; DOD is apparently not conviced.)

-- There is inconsistent treatment in the analysis of payload transition costs as between NASA and DOD missions (DOD assumes it will cost more than $700 million to repackage and qualify its payloads to fly on the shuttle--NASA argues that the transition costs for its payloads and those of commercial users will be inconsequential. (We are unable to resolve the differences between the agencies varying assumptions and estimates of the costs required to modify specific payloads to enable them to be flown on the space shuttle.)

The differencesnoted above reflect a widely divergent view about how to use the shuttle's capabilities, and whether these capabilities will in the future prove to be important for the conduct of specific civilian and military objectives.

° The "fair share" argument concerning the size of DOD's funding contribution is not compelling because:

-- It is quite sensitive to the mission model assumed (which in our judgment is relatively conservative for DOD and is highly optimistic for NASA programs).

-- The uneven treatment of payload transition costs between DOD and NASA also affects the relative investment contributions claimed for NASA and DOD.

° The funding policy recommendation is based on irrelevant assumptions (see pros/cons discussion below).

<u>Statement of Issue</u>

(Because of its complexity, we have subdivided the issue into two simplified sub-issues to allow discussion in the pro/con format suggested for the review.)

<u>Sub-Issue 1</u>:

Should the Administration provide funds in the FY 1978 budget for initiation of the procurement of a total national fleet of five shuttle orbiters, as proposed by NASA and DOD?

<u>Pros</u>.

-- The originalprogram plan for space shuttle assumed that a total fleet of five orbiters would be built to provide a national capability to launch up to sixty missions per year to support the requirements of NASA, DOD, commercial and international users of the space shuttle.

-- Unless five orbiters are procured, DOD might not be willing to convert entirely to the use of the space shuttle and would in such circumstances continue to maintain and use expendable launch vehicles, thus foregoing at least in part the "benefits" of having the shuttle and possibly resulting in an increase in the overall national cost of space operations. This would have an unfavorable effect on the economics of the shuttle and hence on its attractiveness to civilian users of the shuttle.

-- A decision to not procure orbiters beyond NASA's three planned orbiters could be interpreted by critics of the shuttle as lack of Administration support for the program, and hence potentially could provide a rationale for cancelling the program. (This perception would be less strong if four rather than three orbiters were procured as a national fleet. Progress to date in the program and the size of the dollar commitment already sunk in shuttle development would also argue against the likelihood of cancellation by the Congress.)

-- The interagency study concludes that a five orbiter fleet is considered to be the "minimum acceptable" fleet size to meet planned national requirements (civilian and military) and to provide the nation with a level of space capability with which the U.S. can maintain world leadership in space.

-- A five orbiter fleet (rather than four or three) would provide greater assurance of shuttle availability considering the possibility of loss of an orbiter which could take as long as six years to replace.

-- Cost-effectiveness analyses of alternatives involving 5, 4, and 3 orbiters show that the five orbiter fleet operating from both KSC and VAFB is the least-cost approach for meeting the "mission model" postulated in the interagency study.

-- The "marginal cost" of procuring a five rather than a three orbiter fleet (after accounting for potential cost penalties) is about $960 million. This difference of about 10 percent in nonrecurring costs to the shuttle program represents about forty percent of the total launch capability available with a five orbiter fleet (i.e., stated another way, for ten percent more investment the U.S. could buy nearly twice as much launch capability as would be provided by a minimum three orbiter fleet).

Cons.

-- There is considerable uncertainty about future "requirements" for space shuttle launches, particularly with respect to the projected frequency of launches in the civilian space program (which accounts for about half of projected future space missions).

-- If the future space program turns out to be not as expansive as envisioned in the NASA portion of the projected future "mission model", the U.S. will have overinvested in a capability it cannot fully use, which could in turn lead to increased pressures (from NASA and its constituents) to "load up" the shuttle and fly it because it exists--i.e., arguments will be made that we should use "effectively" the capability that has been developed.

-- There are major uncertainties about the extent to which the "new capabilities" of the shuttle will actually be used or prove beneficial--particularly with respect to military applications of the shuttle.

-- The current "wait and see" attitude of the military establishment might argue in favor of minimizing the investment in an operational orbiter fleet and for using the smaller fleet on an experimental basis (but it should be recognized that if the fleet were too small it might never be used for Defense missions because of concerns about vulnerability and the need to provide sufficient backup capabilities with expendable launch vehicles).

-- The potential cost savings from deferring indefinitely the procurement of shuttle orbiters could be substantial--perhaps as much as $2 billion if a decision were reached now to buy only three orbiters and to delay indefinitely construction of the VAFB facilities (probably the limiting case if a full shuttle capability is to be established at KSC). Such "savings" would, however, be offset in part by the need to maintain VAFB and the expendable launch vehicle production capability.

Sub-Issue 2:

If more than three orbiters are to be purchased for the national fleet, should the additional orbiters be funded as add-ons to the NASA budget as recommended by NASA and DOD?

Pros.

-- The interagency study argues that it is important that funding responsibility for the additional orbiters should be placed where the responsibility for management now rests--with NASA.

-- DOD is likely to strongly resist funding the fourth and fifth orbiters unless additional funds were made available, specially ear-marked for this purpose. (Under trade-off conditions, DOD would very likely give higher priority to other programs.)

-- The "fair-share" assessment argues that DOD funding is already sufficient and that NASA should fund all five orbiters as the representative of the civilian users who are projected to make most heavy use of the shuttle's capabilities.

-- Even if the funds were "added-on" to the NASA budget, the out-year increases in the NASA budget would not exceed the total funding level projected for NASA at the time of the shuttle decision (after adjusting for the effects of inflation).

-- The NASA authorization and appropriations committees may be willing to incrementally fund the additional orbiter(s), while the DOD committees would not (this could become important if the Administration wants to commit to a national fleet of four or five orbiters and wants to protect these additional orbiters from Congressional cuts).

Cons.

-- The "fair-share" assessment included in the interagency study is, however, not conclusive because the dollar values computed as a "fair-share" are quite sensitive to the assumption that there will be an expansive civilian space program in the 1980's which will justify a large pro-rata share of shuttle investment in the civilian/NASA programs. Also the "fair-share" calculations in this instance do not recognize that DOD may also benefit in the future from the shuttle's "new capabilities", although DOD thus far has not identified specific missions to make use of such capabilities. Recognition of this potential would argue for a heavier DOD front-end commitment to the program.

-- The argument made for single-agency management of the orbiter program does not preclude DOD funding for the orbiters which can in any case be procured through NASA (as is frequently done in other NASA/DOD cooperative programs).

-- Placing the shuttle orbiters in NASA's budget could result in serious "imbalances" in the future NASA program (might result in the orbiters being funded at the NASA budget margin rather than civilian missions which have merit in their own right. The bargaining situation is that NASA needs DOD support for the shuttle, but DOD doesn't need the shuttle--at least not yet.)

<u>Alternatives</u>

#1. Plan for <u>NASA to procure all five orbiters</u> and conduct all operations at both KSC and Vandenberg and for DOD to develop the upper stage and construct Vandenberg facilities. (Interagency Recommendation)

#2. Plan for a <u>national fleet of five orbiters</u> (and both KSC and VAFB operations) and direct <u>DOD to fund the additional two orbiters</u> (with add-on funds earmarked for this purpose).

#3. Plan for a <u>national fleet of four orbiters</u> (and both KSC and VAFB operations) and direct <u>DOD to fund the additional orbiter</u> (with add-on funds earmarked for this purpose).

#4. Plan for a <u>national fleet of four orbiters</u> and allow <u>DOD to trade-off (within ceiling) the fourth orbiter</u> against other funds currently committed to shuttle and other space operations.

#5. <u>Allow DOD to trade-off (within ceiling) the fourth and fifth orbiters</u> against its overall program priorities.

#6. Plan for <u>NASA to procure only three orbiters</u> and conduct operations only at KSC and DOD to continue development of the upper stage for use at KSC, but construction of Vandenberg facilities and shuttle operations at Vandenberg would be delayed indefinitely.

<u>Analysis</u>

Budget Authority/Outlays ($ Millions)	1977		1978		1979		1980		1981		1982	
	BA	O	BA	O	BA	O	BA	O	BA	O	BA	O
Programs:												
Alt. #1	1393	1360	1720	1497	1900	1633	1611	1571	1245	1517	1186	1248
Alt. #2	1393	1360	1720	1497	2319	1633	1974	1571	967	1517	895	1248
Alt. #3	1393	1360	1712	1493	2490	1619	1398	1547	967	1465	895	1128
Alt. #4*	1393	1360	1712	1493	2490	1619	1398	1547	967	1465	895	1128
Alt. #5*	1393	1360	1720	1497	2319	1633	1974	1571	967	1517	895	1248
Alt. #6	1393	1360	1601	1469	1551	1538	1235	1331	961	1074	783	812

<u>Agency Request</u>	1978		1979	
(Difference from Alt. #1 (Agency request)	BA	Outlays	BA	Outlays)
(Alt. #2	--	--	+419	--)
(Alt. #3	-8	-4	+590	-14)
(Alt. #4*	-8	-4	+590	-14)
(Alt. #5*	--	--	+419	--)
(Alt. #6	-119	-28	-349	-95)

*Costs refer to the national space shuttle program (NASA plus DOD). Alternatives 4 & 5 require DOD to reallocate funds from other parts of the DOD budget in order to go forward with the additional orbiter(s).

(A more detailed breakdown of NASA and DOD costs included in the FY 1978 budget request is provided in two tables at the end of this issue paper.)

Agency Request: Alternative #1. NASA and DOD believe (as documented in the interagency study) that: (1) a five orbiter fleet is required to meet future national mission requirments and to provide sufficient assurances against potential accidential loss of one or more orbiter; (2) the five orbiter fleet is the most cost-effective approach for meeting national requirements; (3) that based on "fair-share" arguments, DOD has already made an adequate investment in the shuttle program; (4) that it is desirable to have funding and management responsibilities for the shuttle program in a single agency; and (5) therefore, the additional two orbiters should be funded as an add-on to the NASA budget.

OMB Staff Recommendations (There are split recommendations as described below.)

SET Division: Alternative #3. In our view, it is desirable that the shuttle program should move forward as a national effort. At least initially, a four orbiter fleet should be sufficient to meet projected traffic requirements on both coasts and the NASA projections of future civilian traffic are probably overstated. It is moreover, very important to the future economic viability of the system that the shuttle system be operated under a regime of incentives which encourages full future utilization of its potential capabilities and such incentives are unlikely to exist in a long-run situation where DOD and NASA are operating competing transportation systems. We strongly believe that if there is add-on funding made available for the fourth orbiter, such funding should be placed in the DOD budget for two reasons: (1) it will enhance the Administration's position in the Congress that the shuttle program is going forward as a national program with full DOD support; and (2) it will avoid the potential situation (which based on previous history is not unlikely) that NASA would in future budgets be forced to trade-off the fourth orbiter against other NASA space projects which have merit in their own right (there seems to be no question that three orbiters would satisfy future civilian needs and NASA has already provided for the procurement of three orbiters within a tightly constrained total NASA budget.)

NS Division: We do not favor Alternatives #2 or #3 which direct DOD to fund additional orbiters. We have no objections to Alternative #4 which allows trade-offs within the DOD space program or Alternative #5 which allows DOD a free choice of trade-offs.

TABLE [illegible]A

Distribution of Space Shuttle Budget Authority and Outlays for NASA and DOD

($ in Millions)

	1977		1978		1979		1980		1981		1982	
	BA	O	BA	O	BA	O	BA	O	BA	O	BA	O
Procurement of Space Shuttle Orbiters												
Alternative #1	1,393	1,360	1,720	1,497	1,900	1,633	1,611	1,571	1,245	1,517	1,186	1,248
NASA Costs	1,319	1,310	1,438	1,393	1,389	1,389	1,191	1,218	1,076	1,115	913	946
DOD Costs	74	50	282	104	511	244	420	353	169	402	273	302
Alternative #2	1,393	1,360	1,720	1,497	2,319	1,633	1,974	1,571	967	1,517	895	1,248
NASA Costs	1,319	1,310	1,391	1,368	1,248	1,274	978	1,036	798	842	622	659
DOD Costs	74	50	329	129	1,071	359	996	535	169	675	273	589
Alternative #3	1,393	1,360	1,712	1,493	2,490	1,619	1,398	1,547	967	1,465	895	1,128
NASA Costs	1,319	1,310	1,391	1,368	1,248	1,274	978	1,036	798	842	622	659
DOD Costs	74	50	321	125	1,242	345	420	511	169	623	273	469
Alternative #4	1,393	1,360	1,712	1,493	2,490	1,619	1,398	1,547	967	1,465	895	1,128
NASA Costs	1,319	1,310	1,391	1,368	1,248	1,274	978	1,036	798	842	622	659
DOD Costs	74	50	321	125	1,242	345	420	511	169	623	273	469
Alternative #5	1,393	1,360	1,720	1,497	2,319	1,633	1,974	1,571	967	1,517	895	1,248
NASA Costs	1,319	1,310	1,391	1,368	1,248	1,274	978	1,036	798	842	622	659
DOD Costs	74	50	329	129	1,071	359	996	535	169	675	273	589
Alternative #6	1,393	1,360	1,601	1,469	1,551	1,538	1,235	1,331	961	1,074	783	812
NASA Costs	1,319	1,310	1,391	1,368	1,308	1,334	1,068	1,126	848	892	639	676
DOD Costs	74	50	210	101	243	204	167	205	113	182	144	136

Table 2B
NASA/DOD Shuttle Outlays
($ of FY 1978 Budget)

	($ in Millions)							
	Prior Years	1976	1977	1978	1979	1980	1981	1982
NASA								
1. Shuttle R&D	852	1,161	1,251	1,247	1,845	408	103	21
2. 3rd Orbiter Production	--	--	--	28	170	203	151	70
3. Modifications to Orbiters, 1&2 .	--	--	--	28	121	115	93	41
4. Kennedy Space Center, Orbiter Ground Support Equipment	--	--	--	4	24	37	51	49
5. Construction of Facilities	60	66	59	51	54	51	36	26
6. Operations	--	--	--	10	60	222	408	452
Total NASA	912	1,227	1,310	1,368	1,274	1,036	842	659
DOD								
1. Upper Stage R&D	--	7	16	38	60	40	11	3
2. Vandenberg Acquisition	--	1	8	3	40	148	220	166
3. Common Payload Support	--	16	23	29	46	61	43	27
4. Payload Modifications/Services .	--	--	--	16	41	50	64	85
5. Backup Launch Vehicles	--	--	3	18	57	54	64	20
Total DOD	--	24	50	104	244	353	402	301
Orbiters #4 & #5 Procurements								
1. Orbiter #4	--	--	--	21	75	118	171	130
2. Orbiter #5	--	--	--	4	40	64	102	157
Orbiters #4 & #5 (NASA):								
BA	--	--	--	47	141	213	278	291
O	--	--	--	25	115	182	273	287
Orbiters #4 & #5 (DOD):								
TOA	--	--	--	47	560	576	--	--
O	--	--	--	25	115	182	273	287

Science Issues

Overview: NASA Basic Science Programs

	1978 NASA Budget Request (BA in $ Millions)					
	Amount			Distribution		
	FY 1977	1978	1979	1977	1978	1979
Expansion of Scientific Knowledge	833	897	954	100%	100%	100%
- Basic and Applied Research	182	175	167	22	20	18
- Proof of Concept	8	51	26	1	6	3
- Full Scale Development	643	671	761	77	74	79

Note: The first line of the above table represents the funds to support the actual work undertaken by scientists, while "proof of concept" and "full scale development" represent the costs of designing and building the spacecraft to gather the data to be researched and are more of a "capital" cost like the cost of a new high energy physics accelerator.

Program Objectives

NASA's basic science programs are almost entirely of a fundamental (non-mission related) research nature providing new knowledge of natural phenomena (but with some expectation of applied results). The objectives of these programs (which are generally analogous to the objectives of NSF supported basic research and ERDA's high energy physics program) are to:

- Extend our understanding of the solar system's formation and apply that knowledge to our understanding of physical processes on earth.
- Seek to understand the origin and continuing evolution of the universe and the fundamental laws of physics which govern observed phenomena.
- Seek to understand the processes by which energy is generated in the sun and how solar phenomena affect the earth's environment.

° Broaden the scientific understanding of life processes, particularly as these are affected by the unique weightless environment of space and seek to relate such knowledge to the areas of medicine and biology on earth.

Program Content*

Includes a broad variety of activities ranging from laboratory and theoretical studies to the development and operation of complex systems such as orbital observatories and scientific probes to other planets in the solar system. The program is broken into three major areas as follows:

° Physics and astronomy -- emphasis is on scientific activities that can be conducted in near-earth orbit with scientific satellites or in the atmosphere with balloons or small sounding rockets.

° Lunar and Planetary -- emphasis is on the development and operation of a variety of automated satellites (some are "orbiters", some are "landers", and some involve atmospheric probes) which are launched to the moon and to other planets in the solar system.

° Life Sciences -- emphasis is on fundamental understanding of the effects of extended time in space by man and other organisms, which can also contribute to fundamental understanding of biology and medicine on earth.

Trends/New Initiatives

° Both in relative and absolute terms there has been a sharp drop-off in NASA funding for the Lunar and Planetary program in the past several years.

° FY 1978 new NASA initiatives include:

- Space Telescope project (physics and astronomy program).

- Jupiter Orbiter Probe (planetary program).

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* To give some indication of the relative funding distribution for these activities, the following amounts of R&D appropriations are requested in FY 1978 for each area: (1) Physics and Astromony - $234 M; (2) Lunar and Planetary - $170 M; (3) Life Sciences - $36 M.

- Viking follow-up mission (planetary program).

- Lunar Polar Orbiter (lunar program).

Rationale for Federal/NASA Role

° There is clearly a role for the Federal Government here because of the "public good" nature of basic research and the prohibitively high cost of such activities for any organization other than the Federal Government.

° NASA space science missions such as Viking have been highly visible indications to the World of U.S. technological capabilities and of the value which the U.S. attaches to the support of fundamental research.

Policy Considerations/Problems

° The usual questions that are raised about a specific space science mission are:

- How good is the science (i.e., its priority relative to other major science projects)?

- When should it be approved (i.e., timing considerations)?

(These questions are addressed in each of the major NASA science issues--#2, #3, #4.)

° A larger question is: How do NASA's "big science" proposals fit in with the overall Federal strategy for the support of basic research? (See strategy discussion below.)

° A specific "problem" this year is the potential impact of the completion of the Viking mission on the staffing levels (and "continuity" of scientific research teams) at the Jet Propulsion Laboratory if no new NASA planetary projects are approved in the FY 1978 budget.

Budget Strategy for the NASA Space Science Program

- Our general strategy for NASA science missions is as follows:

  - Initiate Space Telescope in FY 1978 (NASA's highest priority new science mission which was deferred last year because of budgetary constraints.)

  - Initiate Jupiter Orbiter Probe in FY 1978 (This "next step" mission fits in with the NASA long-range strategy for planetary exploration and its approval now will mitigate the institutional adjustment at JPL following the successful completion of Viking.)

  - Defer Lunar Polar Orbiter for reconsideration in FY 1979 (lower scientific priority than the Space Telescope and the JOP mission).

  - Allow only $5 million BA in the FY 1978 budget (rather than the $20 million NASA request) for initiation of engineering studies of a follow-on Viking mission to Mars. (See "other recommendations" section.)

- We expect that the recommended NASA space science initiatives will "fit" within the Administration's general strategy for overall Federal support of basic research, based on the following assumptions and considerations:

  - The Administration will continue to identify support of basic research as an important Federal responsibility in the broad national interest.

  - Additional government-wide funding for the conduct of basic research will be provided in the 1978 Budget over the 1977 level of $2.6 B (BA) at least to cover increases in costs.

  - The broad base of basic science, across all disciplines, will therefore be adequately supported in the 1978 Budget.

- There are no other contenders for major capital or hardware-intensive investments in basic science among other agencies (such as new accelerators) in the 1978 Budget.

(BA in $ Millions)

	FY 1976	1977	1978	1979	Change 78/76	78/77	79/78
NASA Space Sciences*							
° Current dollars	434	380	402	472	- 7.4%	+ 5.8%	+17.4%
° Constant FY 76 dollars	434	359	358	403	-17.5	- 0.3	+12.6

* These are Research and Development appropriations only. Figures at the beginning of this section include allocations of NASA "supporting" funds.

in overall Federal support for basic research (in the NSF budget) and the relatively higher priority (in 1977) assigned to the proposal to initiate construction of a $ 78 million colliding-beam accelerator in the ERDA high energy physics budget.

Capabilities of the Space Telescope

NASA has conducted major design and cost trade-off studies of the Space Telescope concept during the past several years culminating in the current proposal to orbit a 2.4 meter (95 inch) class (aperture or mirror size) telescope instead of the 3.0 meter telescope previously considered. The total costs for the project have been reduced from about $600 million to the current estimate of $435-470 million. NASA also looked at a smaller telescope with a 1.8 meter mirror, but concluded that the technical performance of this size telescope would not achieve the objectives envisioned for the project, and that costs would only be reduced by another $25 million.

The Space Shuttle will be used in 1983 to launch the telescope, to service it on-orbit and eventually to retrieve, refurbish, and upgrade the telescope prior to returning it to orbit. The Space Telescope would, therefore, become a permanent facility much like a ground-based telescope, with an expected lifetime of 15-20 years and perhaps even longer. Operating costs are projected at about $25 million per year--which may in part be financed through contributions from the European Space Agency (ESA).

The Space Telescope will represent a major advance in overall technical capability for astronomy. For example, the Space Telescope will have ten times greater resolution than the Mount Palomar telescope and can see 100 times fainter objects--or objects about 10 times farther away. Its capabilities have been compared to telling the difference between a dime and a silver dollar at 40 miles distance, or "seeing" a 100 watt light bulb at 5,000,000 miles or twenty times the distance to the moon.

Scientific Contributions

Through its greater technical capabilities the Space Telescope will contribute to astronomy in two ways: by helping astronomers better understand known phenomena, and by making new discoveries. The discovery potential may be very large: for example, we can now observe the universe out to about 6 billion lightyears from earth. The "edge" of the universe has been conjectured to occur near 10 billion lightyears from earth--and the space telescope may well be able to see the brightest objects to 60 billion lightyears, if the universe is that large. It will therefore explore the very limits of our universe for the first time and may "see" up to 1,000 times the "volume" that is accessible to groundbased telescopes.

Timing Considerations

The funding and outlay requirements of the project have been carefully phased in relationship to the space shuttle project (95 percent of outlays for the Space Telescope will occur after FY 1979, when the space shuttle program will be well past its peak funding requirements).

Statement of Issue

Should the Administration support NASA's proposal to initiate development in FY 1978 of a $435-470 million advanced Space Telescope which would provide a major technical advancement in astronomy during the 1980's?

Pros.

-- The Space Telescope clearly provides an opportunity for major advancements in scientific knowledge.

-- The telescope would represent a significant scientific and technological undertaking which the Administration could support as an important national initiative.

-- Despite its large investment cost, the Space Telescope would provide for 15-20 years of scientific return and could lead to improved fundamental understanding of the origin and composition of the universe.

Cons.

-- Although NASA and the scientific community are arguing vigorously for its early approval, the Space Telescope is inherently deferrable.

-- The project is not time constrained like many of NASA's planetary exploration projects which are required to be launched to take advantage of unique launch opportunities or windows. If fiscal stringency requires it, the telescope could be deferred again in FY 1978.

Alternatives

#1. Approve NASA's proposal to initiate the Space Telescope in the 1978 budget to be flown on the Space Shuttle in 1983 (Agency preference).

#2. Approve the project, and require NASA to maximize foreign participation and financial contributions, which would be used to offset in part U.S. costs of developing and operating the telescope (OMB recommendation).

#3. Defer the project to FY 1979.

#4. Disapprove the project.

Analysis

Budget Authority/Outlays ($ Millions)	1976 BA	1976 O	1977 BA	1977 O	1978 BA	1978 O	1979 BA	1979 O	1980 BA	1980 O	1981 BA	1981 O	1982 BA	1982 O
Space Telescope:														
Alt. #1 (Agency Pref.)	5	4	-	3	36	22	79	65	92	89	96	93	67	75
Alt. #2 (OMB Rec.)	5	4	-	3	35	21	76	62	90	87	94	91	66	75
Alt. #3	5	4	-	3	--	--	35	31	76	62	90	87	94	91
Alt. #4	5	4	-	3	--	--	--	--	--	--	--	--	--	--

Agency Request

(Difference from Alt. #1 (Agency request)	1978 Outlays	1979 Outlays)
(Alt. #2 (OMB rec.)	- 1	- 3)
(Alt. #3	-22	-44)
(Alt. #4	-22	-65)

Agency Request: Alternative #1. NASA and the scientific community view the Space Telescope as the next major advance in astronomy and list the project as the highest priority in astronomy. The large investment of $435-470 million would provide for 15-20 years of scientific return and could lead to major advancements in fundamental understanding of the origin and composition of the universe.

OMB Recommendation: Alternative #2. We agree with NASA on the basic justification for this program, but believe that NASA should make a stronger attempt to encourage financial participation--as a matter of principle--by the international scientific community.

We have encouraged NASA to seek as much international cooperation on the project as possible, particularly from the European Space Agency (ESA) in an effort to reduce U.S. investments on a project which will benefit the science community world-wide. NASA has indicated that international cooperation (and joint funding) for such a complex endeavor could be a mixed blessing because of the difficulties in managing and coordinating large cooperative projects. The promotion of international cooperation is recognized by NASA as an important consideration. The attachment (next page) provides NASA's pro/con assessment of the practicability of joint participation with ESA on this project. On balance, we believe that unless NASA objects strongly on technical grounds, the appropriate national policy should be to encourage maximum international cooperation and funding on such large scientific endeavors. We, therefore, recommend Alternative #2.

Table 3. NASA Assessment of Pros/Cons of Joint NASA/ESA Funding and Development of the Space Telescope

Pros:

- Reduces U.S. development costs
- Reduces cost of operations
- Provides greater international scientific return
- Provides back-up detector development for possible use in U.S. instruments

Cons:

- Results in more complex project "interfaces" (i.e., requires more coordination)
- Increases schedule and cost risks (late ESA hardware would result in U.S. cost increases)
- Requires U.S. to establish and maintain contingency plans for U.S. back-ups for ESA-furnished hardware
- Does not result in dollar savings to U.S. as large as the development costs to ESA (because of greater coordination and the need for U.S. back-ups on "critical" hardware)
- Makes product assurance more difficult (i.e., increases the problem of guaranteeing technical success)
- Raises concerns among U.S. science community about guaranteed observing time to be provided to ESA in return for its contribution to the program

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Issue Paper
National Aeronautics and Space Administration
1978 Budget
Issue #3: Jupiter Orbiter/Probe Mission (1981 launch date)

Background

The exploration of the outer planets is viewed by planetary scientists as one of the major objectives of space science during the 1970's and 1980's. The outer planets, Jupiter, Saturn, Uranus, Neptune, and Pluto, and their satellites (moons) comprise 99% of the mass of the solar system. The two largest planets in the solar system, Jupiter and Saturn, are gaseous formations (unlike the solid planets nearer to the sun) and scientists believe that these planets may reveal new knowledge about the early chemical composition, formation, and evolution of the solar system which was formed from the original solar nebula (intergalactic gas).

For some time scientists have identified Jupiter as one of the most intriguing planets in the solar system. Jupiter is the largest planet with a diameter eleven times that of the earth or about 90,000 miles, and has a mass more than 300 times that of the earth. Jupiter has twelve moons or satellites, four of which are larger than the earth's moon, and one, Ganymede, is as large as the planet Mercury. Despite the large size of the planet, it is not solid and is composed largely of ammonia, methane, hydrogen, and helium--the average density of the planet is only 1.31 times that of water and is therefore comparable to the density of the sun. In fact, Jupiter tends to behave somewhat like the sun in that it generates heat and gives off more heat than it receives from the sun. Another unique feature of Jupiter is that despite its size, it rotates on its axis about every 10 hours, which is faster than any other planet.

The first spacecraft to investigate Jupiter were Pioneer 10 and 11 which flew by the planet in 1974. The missions took pictures of Jupiter, and conducted scientific investigations which showed that the planet has a magnetic field, gives off dangerous radiation, and has a radiation belt similar to the earth's radiation belts. The Mariner Jupiter/Saturn missions currently being developed by NASA will be launched in 1977 and will fly by Jupiter in early 1979. The Mariner Jupiter/Saturn mission will use a spacecraft which is more advanced than the Pioneers, and will carry a larger scientific package. This mission will make it possible for scientists to broaden the kind of knowledge gained from Pioneer 10 and 11. Such flyby missions provide only gross exploratory data about a planet because they are short in duration--i.e., because of the tremendous speed of the spacecraft during the flyby of Jupiter investigation times can be achieved lasting only a matter of hours.

The objective of the Jupiter Orbiter/Probe mission is to conduct a comprehensive exploration of Jupiter's atmosphere, physical environment and its satellites by combined observations from an orbiting spacecraft and an atmospheric entry probe. The Space Science Board of the National Academy of Sciences has strongly endorsed the in-depth exploration of Jupiter as "an essential component if there is to be a significant advance in our understanding of solar system evolution". The Jupiter Orbiter with Probe (JOP) mission is viewed as the next step in the exploration of Jupiter: Penetration of the atmosphere by an entry probe will make possible direct measurement of the planet's physical and chemical characteristics. The orbiter will make possible a long-term, overall study of Jupiter, its satellites, and its environment.

The JOP spacecraft will be launched from the shuttle during the December 1981 launch opportunity, arriving at Jupiter in November 1984. Operational lifetime of the orbiter mission is planned to be one year during which time the spacecraft orbit will be changed to permit multiple encounters with the moons of Jupiter. In FY 1977, about $2.5 million in advanced development funding is being used to technically define the project.

Statement of Issue

Should the Administration support NASA's proposal to initiate development in FY 1978 of a $280 million new generation of spacecraft to start in-depth exploration of the planet Jupiter and its satellites during the early 1980s?

Pros.

- There is widespread support for the proposed mission to Jupiter as an initiative of major scientific importance. The Jupiter orbiter probe mission has been under consideration by the scientific community for several years and has been endorsed as the highest priority next mission in planetary exploration in publications issued by the National Academy of Sciences. Jupiter is listed as the first priority because it is the largest planet in the solar system, is the most unusual, and is the most accessible of the outer planets to investigate with current technology. Further flybys would add no new knowledge. The next step is to penetrate the planet's atmosphere with a science package and to conduct experiments from the planet's orbit to better understand the chemical composition and atmosphere of Jupiter.

- In addition, there is considerable concern in the scientific community that despite the success of the Viking mission and the development of Mariner spacecraft to fly by Jupiter and to orbit Venus (a spacecraft is to be launched in 1978 to Venus), no new planetary missions have been undertaken since the Venus mission was approved in the FY 1974 budget. Thus, there could be a period when this country would not be developing new spacecraft for future planetary flights. Recently the Chairman of the Committee of Planetary and Lunar Exploration (COMPLEX) of the Space Science Board (National Academy of Sciences) wrote a series of letters to the President, Dr. Stever and Dr. Fletcher expressing concern about the future of the U.S. planetary space program. (COMPLEX provides policy recommendations regarding planetary exploration, and represents generally the planetary science community.) These concerns are shared by NASA. At the present time, even with a new start in FY 1978, NASA will not have a planetary launch between 1978 and 1981--a hiatus of three years.

- The development of this new generation of spacecraft, using new technology, will provide the basis for possible follow-on missions to Jupiter, Saturn, Uranus, and Neptune. In the planetary exploration strategy, scientists view future missions to <u>all</u> the outer planets as a major long-range scientific goal.

Cons.

- Because of the high technological requirements for planetary missions, they are inherently expensive. For example, Viking employed the latest technology in electronic microcircuitry, particularly for the computer; long distance communications, including X-band to transmit large amounts of electronic data; and substantial miniaturization of science instruments especially for the biology experiment (the biology package on Viking is a major scientific laboratory compressed down to one cubic foot).

- The Jupiter orbiter probe mission will use the latest technology in spacecraft shielding, support structures, and heat resistant materials. The spacecraft is currently estimated to cost $280 million, not including general support. In relation to other NASA missions, the Jupiter orbiter/probe project is relatively expensive. As in the Viking mission, there is always the risk of technical failure and the potential for cost over-runs in such projects.

- The launch window or opportunity for such a mission to Jupiter occurs about every 13 months so there is no urgency attached to the planned launch date in 1981. In addition, there is a large amount of data that is still to be studied by planetary scientists from Viking, Mariner/Jupiter-Saturn to be flown in 1977, and Pioneer-Venus to be launched in 1978.

Alternatives

#1. Approve NASA's proposal to initiate the Jupiter orbiter/probe in the 1978 budget to be launched in 1981 with the shuttle (agency preference/OMB recommendation).

#2. Approve the project, but scale it down to reduce its cost.

#3. Defer the project for reconsideration in FY 1979 or later.

Analysis

Budget Authority/Outlays ($ Millions)	1976 BA	1976 O	1977 BA	1977 O	1978 BA	1978 O	1979 BA	1979 O	1980 BA	1980 O	1981 BA	1981 O	1982 BA	1982 O
Jupiter Orbiter/Probe Mission (1981):														
Alt. #1 (Agency pref./ OMB rec.)	--	--	--	--	21	12	79	47	102	99	61	78	17	39
Alt. #2	--	--	--	--	18	10	60	34	75	76	32	55	15	25
Alt. #3	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Agency Request

(Difference from Alt. #1 (Agency request/OMB rec.)	1978 Outlays	1979 Outlays)
(Alt. #2	-2	-13)
(Alt. #3	-12	-47)

Agency request: Alternative #1. The agency believes that the project should be initiated in the FY 1978 budget as a matter of major scientific importance. NASA and planetary scientists (particularly the Space Science Board of the National Academy of Sciences) list the project as the highest priority in planetary exploration to begin in-depth exploration of the outer planets. In addition, the initiation of the project in FY 1978 is considered important from the standpoint of maintaining an active U.S. planetary program. The U.S. has no missions planned in planetary exploration beyond Mariner-Jupiter/Saturn (launch in 1977) and Pioneer-Venus (launch in 1978), and even with a new project in the FY 1978 budget the country will not launch a planetary spacecraft between 1978 and 1981--a three-year hiatus.

OMB recommendation. Alternative #1. We recommend the initiation of the Jupiter orbiter probe mission in FY 1978. Although we recognize that the size of the investment for the project is large, we believe that the scientific return from the mission would make it cost-effective.

We have examined lower cost ways to conduct the mission--to about $200 million--by means of eliminating the atmospheric probe. The total cost savings over four years would be about $80 million or roughly 30 percent of the total cost of the mission. Our general conclusion is that this alternative would not be cost-effective in terms of scientific return from the mission (although it is impossible to quantify the marginal benefits for science which the Jovian probe would accomplish).

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Issue Paper
National Aeronautics and Space Administration
1978 Budget
Issue #4: Lunar Polar Orbiter (1980 launch date)

Background

A large amount of knowledge has been gained about the surface of the moon from the Apollo program. The internal structure of the moon has been scientifically examined by means of the Apollo Lunar Surface Experiment Packages (left by the Apollo astronauts) including seismic activity and heat flow distributions. The analysis of Lunar samples has provided a body of knowledge about the mineralogy, petrology, chemistry, and evolution of the moon. In addition, a great deal is known about the earth-moon relationship. Moreover, scientists now believe that thermal and tectonic activity died out on the moon almost 2.5 billion years ago, and that the moon therefore provides the most accessible record of early planetary evolution in the solar system.

Despite what is already known about the moon, planetary scientists believe that there is more to be gained through further exploration. Scientists believe that the earth-moon system is and will be, for the foreseeable future, the focal point for understanding the relationship between planets and their satellites. In addition to learning more about the moon itself, scientists share the view that since the inner planets are very similar (e.g., solid bodies with similar chemical composition), a global model of the moon may be able to provide both a scientific and technical base for understanding other terrestrial bodies (such as the planet Mercury). Further exploration of the moon can provide new information about the early years of the earth, the other planets, and aid in understanding the initial conditions in the solar nebula (intergalactic gas) and the process of formation and subsequent evolution of planetary bodies.

The Apollo missions did not explore the polar regions, and were not designed to map the distribution of various kinds of soils on the lunar surface. Thus, the main objective of the Lunar Polar Orbiter is to obtain data about unexplored regions of the moon and to provide global geochemical and geophysical data which will improve the present knowledge and understanding of the moon. NASA believes that the Lunar Polar Orbiter will fill in the gaps in our knowledge of the moon remaining after the extensive exploration carried out on the Apollo missions. Specifically, the Lunar Polar Orbiter is designed to explore the polar regions of the moon, to determine its magnetic fields, and to study variations in its surface composition.

The Lunar Polar Orbiter has been endorsed by the National Academy of Sciences as a priority mission in space science as the first in a sequence of missions to learn about the chemical and physical characteristics of the planets near the sun (the so-called "inner planets") that are similar to the moon including Venus, Mars and Mecury. The NAS strategy for the exploration of these planets calls for a series of polar orbiters in the early 1980s.

The project is expected to cost $110 million, not including general support (e.g., civil service personnel and administrative costs). The mission is designed to orbit the moon and collect data for about one year.

Statement of the Issue

Should the Administration support NASA's proposal to develop the $110 million orbiting spacecraft to conduct additional exploration of the moon beginning in 1980?

Pros.

- The Committee on Planetary and Lunar Exploration (COMPLEX) of the Space Science Board (National Academy of Sciences) has included the Lunar Polar Orbiter in reports for the past several years as a potential new start in FY 1978 as one feature of its strategy for Space Science during the late 1970's and 1980's. COMPLEX is the organization that provides policy and program recommendations for planetary programs and generally represents the opinions of planetary scientists throughout the country.

- COMPLEX and NASA have argued for the Lunar Polar Orbiter as the first in a sequence of similar missions to explore the Moon, Mars, Mercury and Venus during the next 10-15 years. They believe that some balance should be maintained in the exploration of the inner and outer planets (as noted in the overview section on planetary exploration).

- The Lunar Polar Orbiter would cost substantially less than other planetary missions which NASA has proposed in the past.

Cons.

- Despite its relatively low cost, the Lunar Polar Orbiter is ranked lower in overall scientific importance than the Space Telescope and the Jupiter Orbiter Probe mission.

- In addition, although planetary scientists believe that the mission would provide a global model of the moon that could be used not only to better understand the moon but also the other inner planets, they tend to provide more support for understanding basic questions about the outer planets.

- A great deal of new knowledge is currently being acquired about the moon from analysis of the Apollo lunar samples, ground based astronomy, and data from the Apollo Lunar Surface Experiment packages that are still in operation on the moon.

Alternatives

#1. Approve NASA's proposal to initiate the Lunar Polar Orbiter in the FY 1978 budget to be flown in 1980 (Agency preference).

#2. Defer the mission for future consideration (OMB recommendation).

Analysis

Budget Authority/Outlays ($ Millions)	1976 BA	1976 O	1977 BA	1977 O	1978 BA	1978 O	1979 BA	1979 O	1980 BA	1980 O	1981 BA	1981 O	1982 BA	1982 O
Lunar Polar Orbiter:														
Alt. #1 (Agency req.)	--	--	--	--	7	3	44	23	37	43	14	25	3	10
Alt. #2 (OMB rec.)	--	--	--	--	--	--	--	--	--	--	--	--	--	--

	Agency Request	
(Difference from Alt. #1 (Agency request)	1978 Outlays	1979 Outlays)
(Alt. #2 (OMB rec.)	-3	-23)

Agency request: Alternative #1. NASA supports the Lunar Polar Orbiter mission as a new start in FY 1978 to continue new programs to explore the planets nearest to the sun. However, the agency ranks the mission below the Space Telescope and the Jupiter Orbiter Probe for initiation in FY 1978.

OMB recommendation. Alternative #2. We recommend that the mission be deferred for future consideration. We could not recommend the initiation of this mission in addition to the Space Telescope and the Jupiter Orbiter Probe in FY 1978. In addition to these flight projects, we are also recommending funds for studies related to follow-on Viking missions to Mars, increases for Spacelab and Shuttle payloads in the Space Science program, and modest increases for general research that supports the Space Science program.