The original documents are located in Box 66, folder "FY 1978 Director's Review - NASA (2)" of the James M. Cannon Files at the Gerald R. Ford Presidential Library.

Overview: Aeronautics Research and Technology

1978 NASA Budget Request
(BA in $ Millions)

	Amount			Distribution		
	FY 1977	1978	1979	1977	1978	1979
Aeronautics R&T	321	378	446	100%	100%	100%
- Basic and Applied Research.....	167	173	176	52	46	40
- Proof of Concept.....	154	205	270	48	54	60
- Full Scale Development.....	--	--	--	--	--	--

Program Objectives

- Generally strengthen the competitive position of our aerospace industry for commercial and military applications.

- Specifically develop technology considered vital to the improvement of the nation's aircraft and air transportation with a focus on (1) improving aircraft energy efficiency, (2) improving overall performance and safety, (3) reducing undesirable environmental effects, and (4) advancing long-haul and short-haul air transportation concepts for the future.

Program Content

Major ongoing elements include:

- A basic and applied research program in the major aeronautical research disciplines (e.g., structures, propulsion, aerodynamics, materials).

° Focussed technology programs, such as:

- An Aircraft Energy Efficiency program to provide the technology readiness by 1985 for a 50 percent reduction in the fuel consumption of future air transports (civilian and military).

- Experimental research aircraft and engine programs to advance rotorcraft and short-haul aircraft technology.

- A Supersonic Cruise Aircraft study program to maintain basic capability in advanced supersonic transport technology (not keyed to a specific date for a decision to develop a U.S. SST).

Trends/New Initiatives

° The aeronautics research and technology budget shows an increasing trend toward "proof of concept" activities while basic and applied research funding has remained relatively constant. (Proof of concept activities normally involve experimental ground or flight tests of advanced technology--e.g., flight test of a "composite" wing structure--to validate the concepts involved and to reduce technological risk prior to full scale development.)

° NASA, in response to OMB guidance in the FY 1977 allowance letter, is currently seeking industry cost sharing in the Aircraft Energy Efficiency program (primarily in proof of concept activities) as an incentive for both NASA and industry to work on items which have a high probability of being used in future aircraft.

° The domestic commercial aircraft and engine manufacturers are increasingly turning to U.S./foreign joint ventures for development and marketing of new civil aircraft and engines.

- Civil and military aeronautics requirements are continuing to diverge resulting in less technology "spinoff" from the military.

- FY 1978 new NASA initiatives include:

  - Follow-on phases for the Aircraft Energy Efficiency program.

  - NASA/DOD joint programs (e.g., development and testing of an advanced vertical take-off and landing research aircraft).

  - Variable Cycle Engine Component program (to provide initial technology assessment of concepts for an advanced supersonic transport engine).

  - Aerial Application program (to improve aircraft systems for application of agricultural fertilizers and pesticides).

Rationale for Federal/NASA Role

- NASA (and its predecessor NACA) has been the major Federal agency for support of basic aeronautics research since 1915.

- NASA undertakes activities in basic and applied research with open dissemination of research results in order to avoid duplication and to encourage advances in the state-of-the-art of aeronautical research and technology.

- NASA undertakes activities for which there exists substantial national need and benefits but which cannot be adequately supported by private enterprise because of cost, lead-time, or technical risks involved (e.g. basic and applied research, construction and operation of large national aeronautical test facilities).

Policy Considerations/Problems

- How far should NASA proceed in the development of aeronautical technology--i.e., should NASA move toward "prototype" (full scale) development? (See Issue #5.)

- What should be the relative balance (in a limited NASA budget) between basic and applied research and "proof of concept" development? (See Issue #5.)

- To what extent should NASA engage in funding of parallel industry involvement in R&D programs as a means for developing competitive technology options and maintaining industry-wide competition and technology readiness? (See Issue #5.)

- To what extent and under which circumstance should NASA engage in (and fund) joint R&D ventures with the military? (See Issue #6.)

- What will be the future effect of U.S./foreign joint ventures (now becoming common) on maintaining U.S. capability and leadership in civil aeronautics technology? (Not specifically addressed in the issue papers, but important in assessing the overall level and content of NASA support for aeronautics. OMB staff believe that U.S. industry still holds a dominant position in world markets for civil aircraft and engines. Some congressional committees and senior NASA officials believe that the U.S. market position will be seriously challenged in the near future.)

Issue Paper
National Aeronautics and Space Administration
1978 Budget
Issue #5: Aircraft Energy Efficiency Program

Background

In the FY 1977 budget NASA received approval for the first funding phase of a ten-year Aircraft Energy Efficiency (ACEE) program to achieve technology readiness by 1985 for a 50 percent reduction in the fuel requirements of future civil and military transport aircraft. The ten-year program (and funding) plan was prepared with the input of industry in response to a request from the Congress. The program identifies six technological development opportunities in aeronautical propulsion, aerodynamics and composite structures.

The ten-year ACEE program plan consists of a set of "high priority" activities and "lower priority" activities. The "high priority" ACEE program plan identifies for each of the six technology development opportunities one to three overlapping development phases (Phases I, II, and III). Each follow-on phase represents a multi-year effort to further advance a particular technology. Each initial and follow-on phase has associated with it a discrete decision point and funding amount. The attached Fiqure 1 describes schematically the three development phases of the Energy Efficient Engine program--one of the six technology elements. The "lower priority" activities in the ACEE program plan generally consist of further continuations or expansions of "high priority" activities. When introduced during the FY 1977 budget, the ten-year program plan included a $553 million "high priority" program and $155 million in "lower priority" activities.

During the FY 1977 budget process the Administration and the Congress approved initiation of Phase I of (1) an Engine Component Improvement program (TEC of $40 M), (2) an Energy Efficient Engine program (TEC of $19 M) (3) an Energy Efficient Transport program (TEC of $22 M), (4) a Laminar Flow Control program (TEC of $7 M), and (5) a Composite Primary Structures program--no phases after Phase I (TEC of $170 M). The Administration deferred for future reconsideration Phase I of the Advanced Turboprop program.

Since last fall, OMB has encouraged industry cost sharing in the Aircraft Energy Efficiency program to contribute to efficient direction and allocation of Government resources. In July 1976 OMB and NASA reached initial agreement on a cost sharing policy whereby NASA would seek industry cost sharing on those contracts involving major hardware activity at a minimum rate of 10 percent. Higher cost-sharing rates would be pursued as technologies advance in development. NASA has recently provided OMB with a preliminary assessment of where in the ACEE program such cost sharing would be pursued and at what level. In this assessment the agency assumed that industry funding would augment (rather than offset) the NASA-budgeted program.

In the FY 1978 budget NASA is requesting funds for (see attached Table 4) (1) continuation of Phase I activities initiated in FY 1977 and, (2) FY 1978 initiation of the following activities:

- Phase I of the Advanced Turboprop program. The proposed Phase I activity would provide for engine definition studies and component design; would require $8 million in funding over three years; and would lead to a decision for FY 1980 initiation of a Phase II activity. Advanced turboprop engines, if successfully developed, have potential application to lower speed aircraft (e.g., anti-submarine warfare, short-haul civilian, and military transport aircraft).

- Phase II of the Energy Efficient Engine program. The proposed Phase II activity would provide for engine components and core engine development, and early engine testing by the two major engine manufacturers; would require $185 million in NASA funding over five years; and would lead to a possible decision for FY 1982 initiation of an experimental engine demonstration program. (The experimental engine demonstration program, while formerly considered a Phase III activity, is now described as a "lower priority" effort.) The Energy Efficient Engine program is designed to provide the technology readiness for commercial development and introduction of the next generation of air transport jet engines.

- Phase II of the Energy Efficient Transport program. The proposed Phase II activity would provide for flight and ground tests of advanced aerodynamics and aircraft controls technology; would require $64 million in NASA funding over five years; and would represent the final phase of this program.

The ten-year ACEE program plan presented for further consideration in the FY 1978 budget includes several significant changes from the original FY 1977 ACEE program plan:

- A restructuring of the Composite Structures program. The Composite Structures program approved in FY 1977, has since then been redirected to place increased focus on near-term acceptance and application of composite structures. As a result, the composite fuselage work, approved in FY 1977, has been deferred for future reconsideration and continued work on other composite structures (e.g., tail, wing, rudder structures) has been redirected so as to place greater emphasis on parallel involvement of the three major airframe manufacturers and also development of early user confidence in the application of composite materials. The program redirection has been achieved without major changes in program run-out cost.

- Acceleration of Phase II of the Energy Efficient Engine program. The current estimated total cost of this proposed activity is $185 million (over five years) as compared to the $60 million estimate in the FY 1977 program plan. The increased cost is for acceleration of technology readiness and for parallel industry involvement through early engine tests. The $125 million increase includes (1) $60 million for what was considered in the FY 1977 program plan to be "lower priority" efforts; (2) $40 million for an additional acceleration and expansion in scope of this program; and (3) $25 million for future inflation (post-FY 1978). The increased funding would provide for additional components work, core engine tests, and early engine tests by the two major domestic engine manufacturers.

- Augmentation of Phase II of the Energy Efficient Transport program. Proposed for initiation in the FY 1978 budget, the total estimated NASA cost for this Phase II activity, as estimated in the FY 1978 program plan, is $64 million as compared to the $40 million estimate in the FY 1977 program plan. The $24 million increase includes (1) $15 million for better program definition, additional technology work, use of contractor-owned aircraft, and parallel involvement of the three major domestic airframe manufacturers; and (2) $9 million for future inflation (post-FY 1978).

NASA argues in support of parallel industry involvement in some R&D programs in order to: (1) identify and define program options leading to selection of a single contractor (or contractor team), (2) provide backup and added reliability in major development programs (e.g., Apollo), and (3) ensure maximum technology transfer to industry and to promote, where appropriate, competitive approaches to the design and testing of future engine and aircraft systems. In the ACEE program, parallel industry involvement in some cases is considered to be justified by NASA on the last criterion. Where such involvement entails major hardware design and testing (e.g., as proposed in Phase II of the Energy Efficient Engine program), considerable Government resources would be required.

Statement of Issue

Should the Administration approve initiation of Phase I of the Advanced Turboprop program, Phase II of the Energy Efficient Engine program, and Phase II of the Energy Efficient Transport program as requested by NASA?

(Note: the following R&D efforts are related , but do not focus on any particular design of a future aircraft. Rather, they are basic technology developments which may be incorporated in future designs for specific aircraft which would be developed by commercial companies.)

Pros.

Advanced Turboprop, Phase II:

-- Potential for a 15-20 percent future fuel saving over current jet engines.

-- Phase I effort would examine technical feasibility and provide basis for future development decisions.

Energy Efficient (Jet) Engine, Phase II:

-- Potential for a 10-15 percent future fuel saving over current jet engines

-- Increased funding of Phase II effort would accelerate achievement of technology readiness.

-- Parallel industry development would contribute to (1) increased technology transfer to the two major companies; (2) development of a broader range of civil engine technologies; and (3) maintenance of superiority of both of the domestic engine manufacturers.

-- Expanded Phase II may eliminate need for Government-supported engine demonstration effort.

Energy Efficient Transport, Phase II:

-- Potential for a 15-20 percent future fuel saving (independent of savings from new engines).

-- Augmentations to Phase II effort would provide for greater emphasis on near-term improvements in the existing wide-body transports of the three major airframe manufacturers.

Cons.

Advanced Turboprop, Phase I:

-- Uncertainty still exists as to whether an advanced turboprop would meet with airline and passenger acceptance.

Energy Efficient Engine, Phase II:

-- It is uncertain whether augmentation of Phase II effort would eliminate the need for Government-supported engine demonstration or whether the proposed acceleration would have a major positive impact in future competition. (Two new commercial jet engines are currently under development by domestic manufacturers, who have limited resources to make such large investments as are required to undertake full scale development of a new jet engine.)

-- Proposed FY 1978 expansion of Phase II efforts follows an already planned large expansion of NASA's propulsion R&D activities.

-- Parallel industry development is a costly approach for achievement of R&D goals. Alternative approaches (e.g, tax credits, sub-contracting) may exist for achievement of technology readiness and maintenance of industry-wide R&D capability.

-- Parallel industry development would eliminate or reduce competition in the R&D phase for single development contracts (i.e., each manufacturer is guaranteed entry).

Energy Efficient Transport, Phase II:

-- Parallel industry development may result in duplication of effort and place too great an emphasis on technology transfer and product improvement rather than traditional technology advancement.

-- There is reason for concern that in certain elements of the ACEE program, by emphasizing relatively near-term development activities, the agency may be doing so to the detriment of its long-standing emphasis on basic and applied research--as the focus of the NASA "mission" in aeronautics.

Alternatives

#1. Approve initiation of the three activities as proposed by NASA (Agency req.).

#2. Defer initiation of the three proposed activities for future reconsideration.

#3. Approve initiation of the three proposed activities, but (1) do not provide funds for further acceleration or parallel involvement in such efforts, (2) reflect reduction in NASA funding due to industry cost-sharing, and (3) do not budget at this time for post-FY 1978 inflation (OMB rec.).

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
Aircraft Energy Efficiency Program:														
Alt. #1 (Agency req.)	10	5	40	25	75	48	121	94	128	121	91	111	46	77
Alt. #2	10	5	40	25	59	42	64	62	44	58	26	38	11	22
Alt. #3 (OMB rec.)	10	5	40	25	65	43	95	78	73	84	32	57	13	31

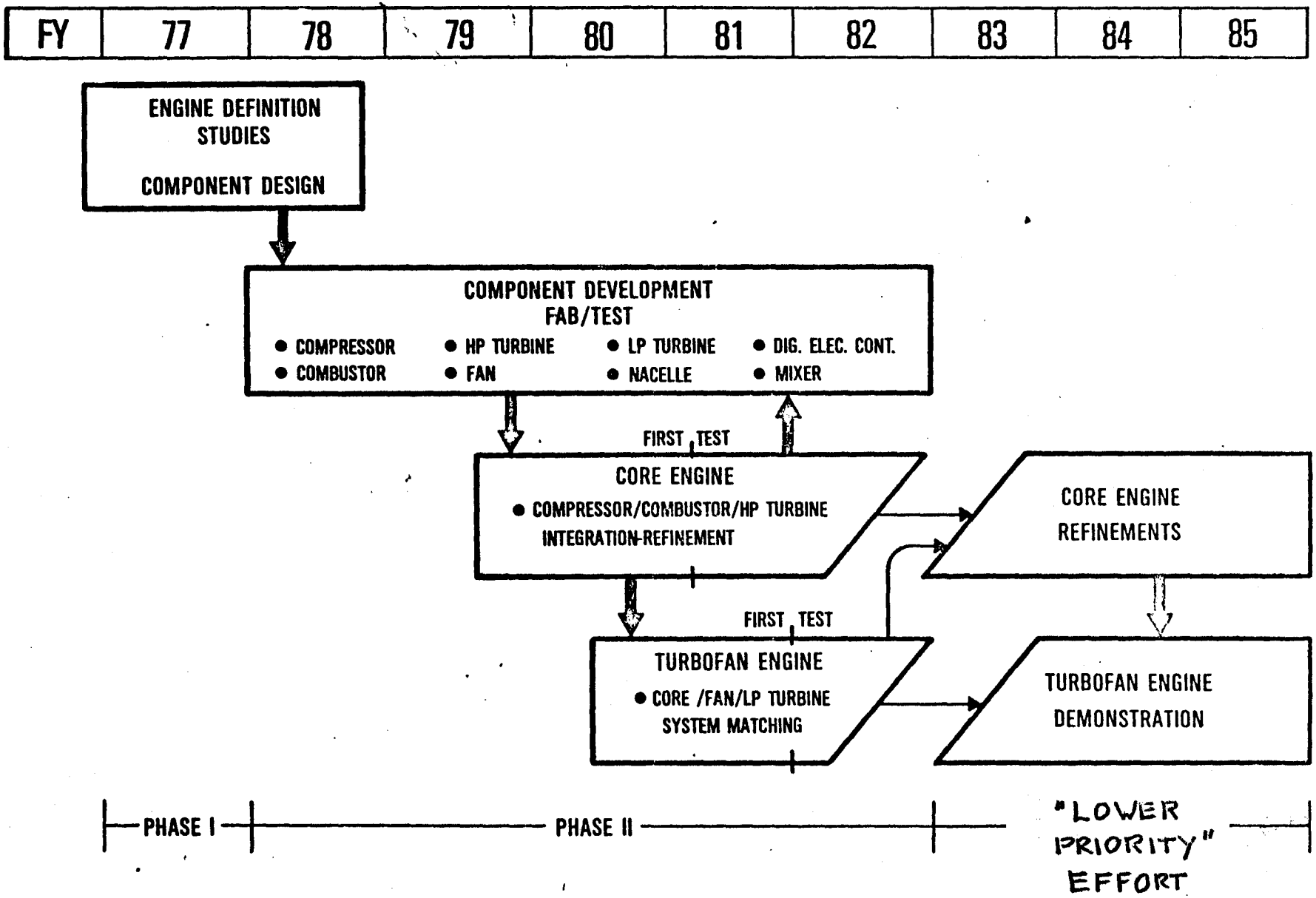
Agency Request

(Difference from Alt. #1 (Agency request)	1978 Outlays	1979 Outlays)
(Alt. #2	-6	-32)
(Alt. #3 (OMB rec.)	-5	-16)

Agency Request: The proposed follow-on phases in the ACEE program and the Lift/Cruise Fan Technology effort (Issue #6) are considered by NASA to be the highest priority new starts in the NASA aeronautical research and technology program. The agency believes that the proposed restructuring and augmentation in the ACEE program was performed with careful deliberations with the industry advisory board and that the proposed acceleration in propulsion R&D is necessary to maintain and enhance the U.S. competitive position for the development and introduction of the next new generation of commercial transports. NASA believes that parallel technology development programs are justified when there are different competitive approaches to the design of future engine and aircraft systems and where such development is necessary to maintain the competitive international stature of the major domestic commercial airframe and engine manufacturers.

OMB Recommendation. OMB staff believe that the funding levels projected for ACEE in the FY 1977 program plan represented a substantial augmentation of NASA's ongoing aeronautical research and technology program. We believe that continuity in the ACEE program where justified, should be maintained, and we recognize that some restructuring of the ACEE program should be expected as new results and priorities develop. We recommend, however, against further cost increases in the newly approved efforts. We are concerned over the cost implications of parallel industry involvement in NASA R&D programs (where such involvement moves from early definition efforts to major hardware testing) and as to whether such parallel involvement represents a cost-effective expenditure of limited Government R&D funds. We are also not convinced that the proposed acceleration of NASA propulsion R&D activities is justified in view of present market conditions and already planned expansion of such NASA activities. We therefore believe that where the proposed cost increases reflect additional technology advancement, acceleration of technology development, or increased parallel involvement of the industry, such increases should be forced to trade off within currently planned funding for the ACEE program--the dollar amounts projected in FY 1977 program plan. While we are not opposed to inflation provisions in major development contracts, we believe that such provisions for post-FY 1978 cost increases can be addressed in the FY 1979 budget. In addition, we firmly believe that industry cost participation in the ACEE program, rather than representing a further augmentation in program effort, should be reflected as cost savings to the Government. Our recommended funding levels reflect these basic principles and considerations.

F URE 1
ENERGY EFFICIENT ENGINE



AIRCRAFT ENERGY EFFICIENCY TECHNOLOGY ACTIVITIES INCLUDED IN AERONAUTICAL RESEARCH AND TECHNOLOGY

FY 1978 NASA Budget Proposal
($ in Millions of BA)

		FY 1976	T.Q.	FY 1977	FY 1978	FY 1979	FY 1980	FY 1981	FY 1982	Total
*	Engine Component Improvement.....	1.5	.4	8.5	10.0	12.0	7.0	---	---	39.4
*	Composite Primary Structures.....	4.0	1.7	14.9	30.1	45.5	36.7	26.1	11.0	170.0
	Turboprops.....	---	---	---	2.0	3.0	3.0	---	---	8.0
**	I Propulsion Aerodynamics.....	---	---	---	2.0	3.0	3.0	---	---	8.0
	Laminar Flow Control.....	.7	1.1	4.0	1.2	---	---	---	---	7.0
*	I Concept Development.....	.7	1.1	4.0	1.2	---	---	---	---	7.0
	Energy Efficient Transport.....	1.2	1.0	5.7	13.4	14.0	26.1	15.0	9.5	85.9
*	I Aerodynamics Development.....	1.2	1.0	5.7	9.0	5.0	---	---	---	21.9
**	II Design Valid. and Flt. Demon...	---	---	---	4.4	9.0	26.1	15.0	9.5	64.0
	Energy Efficient Engine.....	2.1	.7	6.4	18.5	46.2	55.0	50.0	25.0	203.9
*	I Component Development.....	2.1	.7	6.4	8.5	1.2	---	---	---	18.9
**	II Engine Component Development..	---	---	---	10.0	45.0	55.0	50.0	25.0	185.0
	TOTAL.....	9.5	4.9	39.5	75.2	120.7	127.8	91.1	45.5	514.2

*These activities were approved for initiation in the FY 1977 budget.
**Approval is requested for initiation of these activities in the FY 1978 budget.

Issue Paper
National Aeronautics and Space Administration
1978 Budget
Issue #6: NASA/DOD Joint Programs

Background

NASA has proposed initiation of four NASA/DOD Joint Programs. These include:

- Lift/Cruise Fan Technology. If initiated, the proposed program would include development and testing of two VTOL (Vertical Take-off and Landing) research aircraft using lift/cruise fan technology. Successful development of lift/cruise fan technology could lead to development of operational aircraft with vertical take-off and landing capabilities similar to those of helicopters but with increased in-flight performance capabilities (higher speed, longer range, etc.). The most near-term application is expected to coincide with projected Navy deployment of smaller aircraft carriers. The two research aircraft would be jointly funded by NASA ($57 million) and the Navy ($60 million) over a five-year period and each aircraft would utilize a modified airframe of a currently available aircraft. In addition, NASA would fund $32 million in related VTOL technology activities over an estimated six-year period. The objective of the program is to provide for verification of advanced VTOL technologies in support of Navy operational aircraft development and for future civil application. The proposed research aircraft program would precede and provide a basis for a future DOD decision to procede with prototype development of a carrier-based, lift/cruise fan aircraft. A similar joint experimental program was proposed in the FY 1976 budget but deferred due to funding pressures in the NASA budget.

- Hypersonic Research. The proposed program would provide design data for a FY 1980 decision on development of a hypersonic research aircraft. Such a future research aircraft (designated as the X-24C) would provide for testing of a manned high-speed aircraft capable of speeds up to six times the speed of sound or approximately 4500 miles per hour. (The current supersonic Concorde is capable of speeds up to two times the speed of sound or approximately 1500 miles per hour). The objective of a future research aircraft program

would be to provide the United States with the knowledge necessary to pursue future development of both military and commercial hypersonic aircraft--clearly the initial application would be military. The proposed design activity would be jointly funded by NASA ($8 million) and the Air Force ($8 million).

- AMST Experiments. Proposed NASA funds would provide for agency participation in the Air Force's Advanced Medium Short Take-off and Landing (AMST) prototype program. Following selection by the Air Force of a single contractor for full scale development in FY 1977, NASA would expand its use of the existing AMST prototypes to conduct in-flight research with STOL (Short Take-off and Landing) type aircraft for potential civilian application. Total estimated six-year cost for this activity would be $15 million. DOD expenditures on the AMST program through FY 1977 total $236 million.

- 2-D Nozzle Technology. If initiated, the program would develop technology for use of two-dimensional nozzles on combat aircraft leading to possible improvements in maneuverability and survivability, and decrease in cruise drag. The program would include wind tunnel tests on F-15, F-17, and F-111 aircraft models and flight test [illegible] most promising design candidates. The program would be jointly funded by NASA ($15 million) and the Air Force ($15 million) over an estimated six-year period.

The four NASA/DOD joint programs described above are justified by DOD as development activities necessary for the future defense of this country and by NASA as a means for (1) providing the DOD with needed NASA expertise, (2) avoiding duplication in civilian and military-related research and development programs, and (3) furthering NASA's mission in basic aeronautical research. Whereas in such joint programs DOD tends to take a more near-term view focused on future defense requirements, NASA tends to take a longer-range view focused more on providing advances in basic research and base technology for future civilian application. (The DOD review session which also deals with the proposed NASA/DOD joint programs is currently scheduled for November 23, 1976.)

Statement of Issue

Should the Administration approve NASA funding for the four proposed NASA/DOD joint programs?

Pros.

-- The Lift/Cruise Fan Technology initiative and the proposed Aircraft Energy Efficiency program f[illegible]ases (Issue # 5) are considered by NASA to be the two highest priority new starts in the NASA aeronautical research and technology program.

-- The National Aeronautics and Space Act of 1958 directs NASA to make "...the most effective utilization of the scientific and engineering resources of the United States, with close cooperation among all interested agencies...in order to avoid unnecessary duplication of effort..."

-- The Lift/Cruise Fan Technology is important in developing the VTOL aircraft technology required for projected changes in the Navy's future force structure--NASA participation could increase the range and quality of such technology options for the DOD and provide compatible options for future civil application at the same time.

-- NASA and the DOD have traditionally worked together in areas of mutual interest, and have in their view developed effective arrangements for such joint funding.

-- NASA believes that part of its role in aeronautical research and technology deals with providing future technology options even where the requirements or markets (civil and military) for such technologies are still uncertain.

Cons.

-- The National Aeronautics and Space Act of 1958 declares that "... activities peculiar to or primarily associated with the development of weapon systems, military operations, or the defense of the United States (including the research and development necessary to make effective provision for the defense of the United States) shall be the responsibility of, and shall be directed by, the Department of Defense..."

-- Future civil applications and demand for advanced VTOL aircraft are uncertain. (A NASA report on "Outlook for Aeronautics" projected introduction of civil VTOL aircraft by 1995--intrinsically not urgent.)

-- Civil application of V/STOL technology is generally projected on the basis of future requirements for improved short-haul air service in high and medium density population areas. A recent draft GAO report on Federal STOL activities concluded that a divergence of opinion on short-haul transportation has surfaced with NASA generally advocating air transportation and DOT generally placing greater emphasis on multi-mode and ground-mode transportation systems. The report recommended that consideration should be given to the extent to which NASA's present and future STOL activities could be deferred, redirected, or paced to coincide better with DOT's concepts of long-term transportation objectives.

-- The proposed NASA/DOD joint program in 2-D Nozzle Technology may duplicate ongoing development programs within DOD.

-- DOD is currently assessing the status and appropriate direction for hypersonic research and will, in 1977, receive the results of an Institute of Defense analysis study comparing vulnerability of a hypersonic system to that of alternative systems. Approval of a hypersonic research facility design activity at this time may be premature in the absence of such an assessment.

Alternatives

#1. Approve initiation of the four NASA/DOD joint programs as requested by NASA (Agency req.).

#2. Approve only initiation of the Lift/Cruise Fan Technology and AMST effort.

#3. Approve only initiation of the AMST effort (OMB rec.).

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
NASA/DOD Joint Programs: (NASA Funding)														
Alt. #1 (NASA req.)	--	--	--	--	10	6	26	17	32	24	30	30	18	25
Alt. #2	--	--	--	--	7	3	20	11	29	22	26	26	14	21
Alt. #3 (OMB rec.)	--	--	--	--	1	1	3	1	3	3	2	3	3	3

Agency Request

(Difference from Alt. #1 (Agency request)	1978 Outlays	1979 Outlays)
(Alt. #2	-3	-6)
(Alt. #3 (OMB rec.)	-5	-16)

Agency Request: NASA believes that in the area of Lift/Cruise Fan Research Technology, Two-Dimensional Nozzle Technology, and Hypersonic Research the agency has for at least several years conducted basic and applied research that has matured to the point where the proposed activities are meaningful. The involvement of DOD, according to NASA, would bring the initial user into a focussed program and would permit the technologists (NASA) to become aware of the detailed user requirements and the user in turn to become aware of the technologist's approach. In addition, NASA believes that the proposed activities would further the agency's basic and civilian research and technology mission.

OMB Recommendation. OMB staff believe that where a single, clearly identifiable user agency such as DOD exists, development required to support that agency's mission should be funded and traded off in that agency's budget. We believe that NASA's capabilities in VTOL technology are well recognized, but that a major NASA funding role in the further development of such technology is not justified at this time in view of present uncertainties over future civil demand for VTOL technology, as well as other competing funding priorities in the NASA aeronautics programs. We believe that, where appropriate, NASA's capabilities (expertise and facitities) in VTOL technology should be made available to DOD on a cost-reimbursable basis similar to NASA support to ERDA. OMB staff recommends that the proposed Hypersonic Research activity be deferred following better definition of the requirements and direction for future research. OMB staff recommends that no FY 1978 funds be provided to NASA for the 2-D Nozzle activity on the basis that such a program may duplicate ongoing DOD programs. OMB staff recommends that the AMST effort be approved since the proposed use of Air Force prototypes represents a unique and cost-effective, low-cost research opportunity for NASA.

LANDSAT Issue

Overview: Applications of Space Technology

1978 NASA Budget Request
(BA in $ Millions)

	Amount			Distribution		
	FY 1977	1978	1979	1977	1978	1979
Application of Technology	447	492	522	100%	100%	100%
- Basic and Applied Research	165	171	160	37	35	31
- Proof of Concept	64	68	66	14	14	13
- Full Scale Development	218	253	296	49	51	57

Program Objectives

- Conduct research and development on space-related technology, systems and other capabilities which can potentially contribute to practical applications in the private and government sectors of the economy.

- When appropriate, conduct full-scale development and technical demonstrations of new space-based technologies--e.g., LANDSAT remote-sensing satellites.

- Promote the "transfer" of technology developed for the space program to other applications--with principal emphasis on the wide dissemination of technical information which may be of potential value, particularly to organizations in the private sector.

Program Content

Major elements include:

- R&D on remote-sensing Earth Resources Survey satellites (i.e., the LANDSAT program).
- R&D on remote-sensing oceanographic satellites.
- R&D related to weather and climate observation and forecasting (basic research and technology development in support of NOAA's operational mission).
- R&D related to remote-sensing of natural phenomena in such areas as earth dynamics (related to earthquake research), environmental monitoring and materials processing in space (e.g., research directed to producing electronic components and biomedical materials in zero-G).
- Technology utilization programs (principally an information dissemination activity carried out through NASA centers, universities, etc.)

Trends/New Initiatives

Major new items include:

- LANDSAT-D satellite development.
- Initiation of NASA "payloads" to be flown on space shuttle (heavily geared to potential space processing applications on Spacelab).

Rationale for Federal/NASA Role

- The Space Act of 1958 provides for the establishment of NASA as a civilian agency with a broad mandate to conduct aeronautical and space research which will contribute materially to:

- Improvements in the usefulness of space vehicles;

- preserving the role of the United States as leader in the application of space technology;

- promoting cooperation with other nations in peaceful applications of NASA's work; and

- encouraging cooperation among all U.S. agencies in order to avoid unnecessary duplication.

° During the past ten years, NASA's congressional committees have consistently encouraged the agency to take a more active role in developing useful civilian applications of space technology.

° There have been two major transfers of "useful space technology" (from NASA to operational uses in other organizations):

- Meteorological satellites (now funded and operated by NOAA, with continuing R&D support budgeted in NASA for advanced technology development).

- Communications satellites (now funded and operated in the U.S. and internationally by private or quasi-public organizations with very limited continuing R&D support from NASA).

° The NASA applications program is in many respects historically analogous to the civilian nuclear power program of the Atomic Energy Commission:

- In the AEC case, the U.S. Government as a matter of national policy sought to transfer to the civil sector advanced technology developed for military applications (weapons and nuclear submarines). Recall President Eisenhower's "Atoms for Peace" program.

- In the NASA case, the agency is now (largely at congressional urgings) seeking to apply its advanced space technology and capabilities originally developed for largely political reasons (i.e., to "catch up" with the Russians after Sputnik).

° In evaluating NASA "space applications" projects, OMB has in the past:

- expressed concern that NASA should not duplicate development activities carried out in the military space program;

- urged the need to forecast expected future benefits to be realized from the potential application of NASA technology at the beginning of development (i.e., heavy emphasis on cost-benefit studies);

- been concerned that NASA may be "pushing" technology where no real demand "pull" exists for implementation of the technology if it succeeds (heavy emphasis on "user agency" assessments--especially Federal agencies);

- expressed concern that NASA should not develop advanced technology in areas where the private sector might act if the Federal goverment stays out; and

- been concerned that NASA should not assume an operational role because of its fundamental mission as an R&D agency (this has generally resulted in OMB taking a strong position that (1) NASA should not fly more than one satellite of a particular technological vintage and (2) that new development satellites should not be approved unless there is clear evidence that the new program will result in a "significant" increase in the level of technology).

Policy Considerations/Problems (all relate to Issue #7)

° How far is it legitimate for a Federal agency (such as NASA) to go in developing and promoting its technology for civilian applications? (How much "technology push" is acceptable?)

° By what criteria should OMB judge whether NASA applications will "succeed" and at what point in the technology development cycle is it reasonable to apply such criteria?

° How can we improve the process of coordination between technology development agencies (such as NASA) and Federal user agencies (such as DOI, USDA, COE) in such large-scale development efforts as the LANDSAT remote-sensing program?

° How can we improve the process of transition from R&D to operational deployment of such applications technologies as LANDSAT, where:

- the technology is relatively sophisticated and the potential applications are diverse and not completely obvious (fragmented user community); and

- there is no single Federal agency which adequately "represents" the user community (which may extend well beyond Federal users) and could serve as the logical future operator of such a system (and could also objectively "trade off" the value of NASA's technology versus other alternatives); and

- there may be external benefits and national policy consideration which bear upon both the development and the operation of the technology once it is developed (e.g., foreign policy benefits to the U.S. and "sensitivities" of foreign countries).

° How shall we deal with the problem which has been characterized as the "lead-time dilemma" (i.e., the need to decide on next steps in an ongoing R&D program before results are in from the currently approved program)?

° Is it valid to insist on Federal user agency funding as the "acid test" for measuring the actual (and future potential) "value" of NASA-developed technology? At what point in the development cycle is it safe to assume that such a test will give valid answers about the potential value to the nation of the specific applications (including any external benefits)?

° It is frequently assumed (but seldom explicitly stated) by OMB staff that technology development agencies (such as NASA) are so strongly "biased" in favor of their technologies, that they cannot provide useful recommendations on the future potential of such technology. For the purposes of completeness, balance and objective analysis, we have provided a summary on the following page (Table 5), which tries to characterize potential "biases" that might arise in both the development and the user agencies.

Table 5

Summary Assessment of Some Typical Characteristics and Attitudes of Participants in the Technology Development Process

Technology Developers

May tend to:

- Overestimate benefits, utility and potential value
- Underestimate costs, times required to achieve results, practical complexities of user applications and possible negative implications
- Push technology applications unduly for institutional and bureaucratic reasons.

But may be:

- More imaginative with a clearer vision of future possibilities
- More expert in assessing technical problems and how they can be met in actual applications
- Independent of institutional and bureaucratic pressures to resist innovation.

And will generally recognize the importance of making active efforts to derive benefits from scientific and technological advances.

Users

Are usually in a better position to know:

- What is needed, useful, and important
- Which alternative means are preferable (R&D and non-R&D)
- The practical complexities of actual applications
- The broader implications, good and bad, of new technology on related activities.

But may be:

- Less imaginative and innovative
- Subject to institutional or bureaucratic inertia
- Have horizons limited to their own scope of activities
- Unable to respond to new technological opportunities because of external management constraints.

And generally:

- Have no responsibility or interest in technology as such
- Feel obliged to require full demonstration and to minimize their risks before endorsing or committing to a new capability.

Issue Paper
National Aeronautics and Space Administration
1978 Budget
Issue #8: LANDSAT-D Development Proposal

Background

NASA has proposed FY 1978 initiation of development of the fourth experimental earth resources survey satellite, LANDSAT-D.

NASA--in cooperation with Federal user agencies (principally USDA, DOI, and COE) and other potential private and public sector users--has since 1972 conducted an experimental earth resources survey (ERS) satellite program--commonly known as the LANDSAT program. The objective of the program is to test the capability for providing "multispectral" remote sensing data from space and to explore and assess the value to the nation of possible improvements in decision-making and management which could result from the use of earth resources information obtained from a possible operational LANDSAT system.

Two experimental LANDSAT satellites--LANDSATS 1 and 2--are currently providing data; a third satellite, LANDSAT-C, a slight modification of LANDSAT 1 and 2, is currently under development. All three satellites carry a Multispectral Scanner (MSS) instrument which measures light reflected from the Earth in four to five color (or spectral) bands and is capable of separately distinguishing objects larger than 80 meters in length. The three satellites will provide approximately nine years (1972-1981) of continuous LANDSAT data. The NASA proposal could be expected to add an additional three to six years of coverage. A second generation multispectral instrument, the Thematic Mapper, is currently under development and would provide measurements in six to seven spectral bands and would be capable of separately distinguishing objects larger than 30 meters in length. Increased "spatial resolution" has been emphasized as a priority area by LANDSAT data users.

Potential uses being tested with data from LANDSATS 1 and 2 include activities such as measuring and monitoring the world's food, timber and water resources; identifying likely locations for mineral and fossil fuel deposits; and land use inventories. The largest evaluation effort currently underway is the Large Area

Crop Inventory Experiment (LACIE), a test of the feasibility and potential effectiveness of a space-based global wheat inventory system (the largest LANDSAT benefit area according to NASA economic studies). Conducted under a joint agreement between NASA, the Department of Agriculture, and Department of Commerce (NOAA), this three-year effort is scheduled for completion in mid-1978.

Both NASA and the Department of Interior have funded cost-benefit studies to estimate potential economic benefits from LANDSAT. A study sponsored by the Department of Interior, published in 1974, was unable to demonstrate conclusively that an operational LANDSAT satellite system would provide economic benefits exceeding costs. NASA, in contrast, has published three major contract studies to date which have concluded that very large net dollar benefits could potentially be achieved, particularly in the area of improved world-wide crop-forecasting information. OMB, through the National Science Foundation, has obtained an independent outside review of the economic studies which estimate benefits from LANDSAT-based improvements in wheat production forecasts. The outside consultant's conclusions are (1) since the DOI study only dealt with domestic crop forecasts, this study is not applicable to estimation of benefits from possible global forecast improvements, (2) the NASA studies assume capabilities that are not yet demonstrated as feasible, (3) all the economic studies have methodological and statistical deficiencies which make their results inadequate for decision purposes, and (4) one of the NASA studies could, with substantial modification, be used to get credible estimates of benefits. (We have recently learned that some senior officials of USDA are quite skeptical of whether it is possible ever to make objective estimates of the dollar benefits to be obtained from possible improvements of U.S. ability to forecast crops world-wide.) An as yet unpublished survey of policy officials in USDA disclosed that LACIE-based forecasts of foreign production would probably not represent a large enough improvement over existing forecasts to cause them to make different decisions. Nevertheless, all expressed an interest in having the new information.

The LANDSAT-D program <u>as proposed by NASA</u> would be a continuation of the current experimental LANDSAT program providing for 3-6 years of additional LANDSAT data. The LANDSAT-D effort as proposed by NASA includes the following:

- NASA funding requirements for the LANDSAT-D program would be $33 million in FY 1978 and $280 million in total (over 6-7 years).

- LANDSAT-D would be launched in 1981 to provide three additional years of expected data continuity. The launch of LANDSAT-C would be deferred so as to provide data continuity or a minimum data gap between LANDSATS C and D. In addition, LANDSAT-D would be provided with an identical backup on the ground in case of launch or on-orbit failure or for another additional three years of coverage if no early failure occurs.

- LANDSAT-D would use a shuttle refurbishable, multi-mission spacecraft and would carry the Thematic Mapper instrument, currently under development, and the Mutispectral Scanner instrument flown on LANDSAT 1, 2, and C. The procurement of the LANDSAT-D spacecraft would be accompanied by upgrading of the central LANDSAT ground data handling system (principally at the Goddard Space Flight Center) in order to provide for higher data flows expected from the Thematic Mapper instrument and to provide for improved data quality and timeliness. (All new capital investments required for LANDSAT-D data handling would be carried in the NASA budget). EROS Data Center, operated by the USGS, would continue to have principal responsibility for archiving, reproduction, and dissemination of LANDSAT data to public users.

- According to NASA, a deferral of a FY 1978 decision of LANDSAT-D would result in at least a 12 months gap in data assuming LANDSAT-D were approved in FY 1979 and at least a 24 months gap assuming LANDSAT-D were approved in FY 1980. (These estimates assume maximum deferral of launch of LANDSAT-C.)

The NASA proposed LANDSAT-D initiative was prepared with the input of a senior management level Interagency Decision Team on LANDSAT Follow-on. Established and chaired by the NASA Administrator, this ad hoc group included representation from DOI, USDA, USCOE, and AID. This effort culminated in a signed statement by the IDT participants which expressed support for a LANDSAT-D effort and included user agency funding estimates for future LANDSAT-related activities--expected to total $150-160 million for the FY 1978-1982 period. (See attached letter from Dr. Fletcher which includes the recommendations of the interagency group.)

Two activities of possible major significance to the future LANDSAT effort are currently underway. First, Senator Frank Moss and Congressman Olin Teague have recently introduced identical legislation to establish a permanent Earth Resources

Satellite Information System centered around LANDSAT. Congressional authorization committees have generally supported and encouraged the LANDSAT effort. Second, OMB recently received Presidential approval to begin drafting of legislation to consolidate civil mapping, charting, and surveying programs into one Federal organization. If the Federal Survey Administration were to become a reality, it would provide a useful organizational mechanism for: (1) aggregating the market for data products for a wide range of Federal agencies and other civilian users of maps, charts and surveys; and (2) establishing priorities and conducting tradeoff comparisons between various technologies (civil and military) which could possibly be used to satisfy earth resources data requirements of civil users.

OMB testimony on LANDSAT, provided by Frank Zarb before the Senate Committee on Aeronautical and Space Sciences on September 18, 1974 drew the following conclusions: (1) the potential applications and potential benefits of LANDSAT would be substantially increased if the current technology were advanced to achieve significantly better resolution, (2) additional launches of experimental earth resources satellites should be carried out only when such launches can be shown to be the most cost-effective way to achieve a significant advance in the state of the art, and (3) commitments to an operational satellite system should be based on proper understanding of the kind of system which would best meet user needs and maximize benefits and should be done in such a way as to eliminate duplication and inefficiencies in civil earth resources data activities while reflecting the users' priorities (as could be achieved by the establishment of a single civilian mapping, charting, and surveying agency).

Statement of Issue

Should the Administration provide funds in the FY 1978 budget for initiation of a second-generation earth resources survey satellite (LANDSAT-D) as proposed by NASA?

Pros.

-- LANDSAT-D would provide a flight test of a higher performance multispectral instrument (Thematic Mapper), currently under development.

-- LANDSAT-D, as proposed by NASA, would also provide for three more years of continued availability to domestic and foreign users of present-generation LANDSAT data (Multispectral Scanner) as backup to the Thematic Mapper and

to provide a transition period for transfer to use of the Thematic Mapper. Those users currently utilizing such data would continue to have it available.

-- LANDSAT-D would extend the currently planned time period for experimentation with and testing of LANDSAT technology, including improvements in data quality and timeliness. The presence of a backup satellite might attract those operational users currently concerned over a possible interruption in data flow due to satellite failure.

-- This program is considered a high priority new civilian space application by NASA and the Congress, and is widely regarded in the scientific community and the Congress as an emerging technology of major future significance.

-- A significant proportion of current LANDSAT data use (experimental and operational) is by private United States companies who are exploring use of LANDSAT data for identifying likely locations for oil and mineral deposits.

-- LANDSAT data has been made openly available to the foreign community and there are indications of reduced foreign opposition to and growing foreign support for this activity, particularly with respect to lesser developed countries. To date, four foreign countries (Canada, Brazil, Italy, Iran) have in operation or under construction LANDSAT ground stations. Much of the demand among the lesser developed countries has been largely and recently stimulated by AID following an initiative announced by Secretary Kissinger.

-- A preliminary report of a National Research Council Committee on Remote Sensing Programs for Earth Resource Survey (CORSPERS) endorsed the Thematic Mapper as a potentially significant step forward in managing and monitoring our natural resources.

Cons.

-- Extravagant promises have been made as to the potential future benefits which could result from widespread applications of LANDSAT data. However, current indications are that actual usage of such data has not grown at a rate consistent with early promises and in most instances (with the possible exception of the oil and mineral industry) appears to be largely experimental in character.

-- It is unlikely that the current generation of LANDSAT technology would be supported or funded at this time as an operational activity by the private sector or the user agencies (i.e., the current LANDSAT technology most probably would not meet the "acid test" of user acceptance and willingness to fund with the agencies' own resources).

-- The next step in the LANDSAT development program, as proposed by NASA, would be costly (TEC of $280-320 million) as compared to total NASA expenditures to date on LANDSAT of approximately $260 million (not inflated).

-- There are technological uncertainties in the proposed LANDSAT-D development program (e.g., how well will the Thematic Mapper work?), and uncertainties in the future applications of this technology (e.g., will the proposed improvements result in a significant increase in user acceptance and lead to eventual operational application and justification for this technology?).

-- Funding in FY 1978 would commit the Government to three to six years of additional coverage at a total cost of $280-320 million before the LACIE evaluation of the LANDSAT application claimed to have the largest benefits is far enough advanced to reach a meaningful conclusion as to whether use of LANDSAT in a LACIE-type system will succeed.

-- Conventional earth resources information and advanced technology exists which for certain applications is actually or potentially competitive with or superior to use of LANDSAT.

-- NASA funding of LANDSAT-D would represent a continuation of the current situation in which LANDSAT technology development does not have to compete for funding with development of alternative earth resources survey technologies (as could potentially be achieved with a single Federal Survey Administration). Continued NASA operation of the LANDSAT space segment sets a precedent for NASA as the ultimate operator of an operational LANDSAT system (a significant departure from NASA's historical mission as an R&D agency).

-- While technically proposed as a commitment to a three-year experimental program, approval of the LANDSAT-D program could also be interpreted as a de facto 3-6 year commitment to an operational or semi-operational LANDSAT system. (Based on legislation currently introduced by Senator Moss and Congressman Teague, the Congress is likely to press for a formal commitment to a permanent LANDSAT system this coming spring.)

Alternatives

#1. Approve initiation of development of LANDSAT-D in the FY 1978 budget as proposed by NASA (Agency rec.).

#2. Approve initiation of development of LANDSAT-D in the FY 1978 budget, but do not provide any funding for a backup satellite and require "user agencies" to provide funding (within ceiling) for incremental costs related to the flight of the Multispectral Scanner instrument, which would provide for continuing data in the format available from LANDSATS 1, 2, and C.

#3. Approve initiation of development of LANDSAT-D in the FY 1978 budget, but provide only those funds necessary for an R&D test of the Thematic Mapper instrument (the same as alternative #2 but deletes Multispectral Scanner instrument).

#4. Defer initiation of development of LANDSAT-D for reconsideration in FY 1979 or FY 1980, after LACIE evaluations are substantially completed.

#5. Terminate the LANDSAT program at the completion of LANDSAT-C.

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
LANDSAT-D:														
Alt. #1 (Agency req.)	--	--	--	--	33	12	89	53	83	98	37	59	17	31
Alt. #2	--	--	--	--	24	9	61	36	60	71	32	51	14	25
(NASA funds)	--	--	--	--	(22)	(8)	(51)	(30)	(50)	(59)	(29)	(46)	(13)	(23)
(User funds)	--	--	--	--	(2)	(1)	(10)	(6)	(10)	(12)	(3)	(5)	(1)	(2)
Alt. #3	--	--	--	--	22	8	51	30	50	59	29	46	13	23
Alt. #4	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Alt. #5	--	--	--	--	-15	-8	-16	-14	-7	-16	--	-2	--	--

Agency Request

(Difference from Alt. #1 (Agency Request)	(1978 Outlays	1979 Outlays)
(Alt. #2	-3	-17)
(Alt. #3	-4	-23)
(Alt. #4	-12	-53)
(Alt. #5	-20	-67)

Agency Request: Alternative #1. NASA believes that the LANDSAT program represents an "uncompleted experiment" for which LANDSAT-D will provide significant advances in LANDSAT technology and additional time during which to develop a broader experimental base necessary for decisions on future program directions (including the decision whether and when to commit to an operational LANDSAT system). In addition, NASA believes that a continued LANDSAT R&D program: (1) would be supported by Federal user agencies, State and local Governments, and the Congress; (2) is an important element of our foreign policy; and (3) is responsive to growing private sector recognition of the value of LANDSAT data. The agency can be expected to argue strenously (both on programmatic and on political grounds) against a deferral of a LANDSAT-D effort.

SET Division Recommendation: Alternative #2. We strongly believe: (1) that despite the controversy which has surrounded this program in the past, and the intense institutional "skepticism" which OMB has attached to the frequently-extravagant claims of some LANDSAT supporters, the basic technology that NASA is developing in LANDSAT is potentially important, does not duplicate other Federal programs and has substantial promise in its own right; (2) that it is clear that the current generation of LANDSAT satellites will not be "pulled" into operational application on the basis of "economic demands" operating either through the Government or the private sector; (3) that NASA is on the right track in relation to the technology "evolution" now planned for LANDSAT-D; (4) that NASA's institutional drive to "push" this technology should be balanced by a careful assessment of the actual uses and value to users of the LANDSAT data which is now becoming readily available, and much more widely publicized than in the early years of this program (this argues in our minds for a deliberate U.S. policy beginning now to "test" the market elasticity of demand for LANDSAT data by gradually increasing user charges at EROS and for the foreign ground stations now in operation or under construction); and (5) that it may be possible to "tax" the Federal "user agencies" to fund at least the MSS instrument on LANDSAT-D which would be flown for the major purpose of continuing MSS data flow to current LANDSAT users and to ease such users' technical transition to the new generation instrument (Thematic Mapper) which will be tested on LANDSAT-D.

If our recommendation is accepted, we believe that it would be appropriate to request that the interagency task force on LANDSAT-D, established by Dr. Fletcher, be asked to address the problem of arranging interagency funding for the MSS instrument on LANDSAT-D ($2 million in FY 1978; $28 million total concentrated in 3 years) which will involve difficult questions of allocating cost-shares to specific Federal user agencies, and also of seeking some financial support for this purposes from non-Federal users (including foreign countries).

Other OMB Staff Recommendations: SET Division staff solicited inputs on recommended option(s) for the LANDSAT-D issue from the staff of the National Resources Division, NRES Analysis Unit, International Affairs Division, Energy and Food Division (abstained), National Security Division (abstained), and the Commerce Branch (abstained).

The Natural Resources Division recommendation (see attached memorandum from Donald E. Crabill) selects Alternative #4 as the preferred alternative and Alternative #2 as the second-choice alternative (but they would also require user agency funding of the launch vehicle). The Natural Resources Division believes (1) that additional MSS coverage beyond LANDSAT-C cannot be justified, and (2) that the increase in spatial resolution of the Thematic Mapper is likely to be insufficient for that technology to be economically justifiable as an operational system.

The International Affairs Division selects Alternative #4 as the preferred alternative on the basis that (1) the unique benefits of LANDSAT are uncertain (i.e., it is not obvious that the kind of data LANDSAT best obtains are not already available), and (2) that foreign policy implications of deferral or termination of LANDSAT-D would not be severe. Assuming that future LACIE results are favorable, IAD would recommend an option similar to Alternative #2 to achieve more equitable cost-sharing among user agencies.

An NRES Analysis Unit economist, who reviewed LANDSAT economic studies and LACIE progress, selects Alternative #4 as the preferred alternative on the basis that (1) it would provide one more year of experience to assess the potential uses and benefits of LANDSAT (e.g., more information from LACIE), (2) results from LACIE to date indicate substantial uncertainty that LANDSAT technology will be able to significantly improve foreign crop estimates, and (3) a gap in LANDSAT coverage is not a strong argument against a deferral of LANDSAT-D.

Memorandum

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET

TO: Hugh F. Loweth

DATE: Oct. 14, 1976

FROM: Donald E. Crabill

SUBJECT: LANDSAT Proposal

The following is our view on the preferred options for the LANDSAT-D development proposal.

Natural Resources Division believes that additional MSS coverage beyond LANDSAT-C cannot be justified:

- Nine years of experimentation through LANDSAT-C should be more than enough to prove any value MSS data may have.

- After four years of flight by LANDSATS 1 and 2, the likely operational uses for a LANDSAT-D MSS are, in our judgment, not enough to justify its flight.

- Waiting for a fifth year of flight before deciding on LANDSAT-D would make more of the results of the LACIE evaluation available to aid in the decision.

We also suspect that for many potential earth resources applications the operational usefulness of the thematic mapper data could be adequately tested by aircraft at lesser cost than by a space flight. The modest increase in resolution of the thematic mapper is, we believe, likely to be insufficient for that technology to be economically justifiable as an operational system.

For these reasons we recommend alternative #4, defer LANDSAT-D. Our second choice would be alternative #2 with the launch vehicle included in the user agency funding.

We also attach a mark-up of the con section of the draft issue paper.

Attachment

NASA
National Aeronautics and
Space Administration

Washington, D.C.
20546

Office of the Administrator

SEP 15 1976

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

Dear Jim:

As indicated in my transmittal of NASA's budget estimates for FY 1978, I am writing you this separate letter to present in some detail the basis for my recommendations on the Landsat program.

In my letter to the President in June, I emphasized my belief that the Landsat technology, properly exploited, can and will provide an advance of tremendous significance in our worldwide economic and environmental information system. I have every reason to be encouraged by the progress of the Landsat program to date, and am, therefore, this year recommending that the President initiate the next phase in the Nation's civil remote sensing satellite effort. This next step is Landsat D: the use of a refurbishable 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 users of multispectral scanner earth resources survey data. I see this 1981 space mission, which includes a backup spacecraft to guard against the possibility of a failure at launch or early in the mission's orbital life, as an integral part of NASA's multiple responsibilities in the space applications field: to continue advances in technological development, to pursue research in the utility of space systems for terrestrial benefits, and to support the development of a solid experimental base necessary for decisions on future program directions.

Recognizing the high level of interest the Landsat program has generated in your office and throughout the country, I want to elaborate on this recommendation in terms of governmental, commercial, international, and R&D policy interests:

o Governmental

-- As you know, I have been involved in an intensive effort over the past six months with the major Federal user agencies that have significant interests in the Landsat data program. I have personally met with the Secretaries of Agriculture, Commerce, and Interior, and with the Administrator of the Agency for International Development and the Chief of Engineers. The personal representatives of the heads of all these agencies have, as a joint Working Group, developed the five program and policy recommendations enclosed, and I have the assurance of the principals that they strongly support the program I am recommending. Landsat D should therefore be recognized as having a broad interagency role to play in addition to forwarding NASA's R&D mission.

-- In addition to Federal users, there are a large number of State and local governmental interests in Landsat, as evidenced by the voluminous correspondence I have received from all quarters. Some important Landsat data applications for land use planning and resources monitoring are now routine in a number of states. And I am certain you are aware of the strong Congressional interest in a successful Landsat program from both sides of the aisle.

o Commercial

-- The growing industrial recognition of the values of remote sensing data has established a new market for these products, especially in the mineral and petroleum exploration community. A recent survey suggests that these energy companies are achieving substantial savings in the improved efficiency of their exploration operations through use of multispectral scanner data; it may be in such geological applications that the higher resolution thematic mapper data will find its early--and maybe dramatic--commercial exploitation. There will be a considerable research task before us in determining how to use this instrument most effectively for energy exploration alone, and we are relying upon the industry to conduct a substantial portion of those investigations for itself.

o International

-- As an element of foreign policy, Landsat has been extraordinarily successful. It is creating a large international community of regional users reliant upon United States technology. It has served well in the United Nations as the model for technical cooperation without concommitant political costs. The AID sees Landsat as an excellent vehicle for delivery of economic self-help to developing nations without creating financial dependencies abroad. Carrying the multispectral scanner as well as the thematic mapper on Landsat D will foster even greater international involvement than we have today, and under cost-sharing ground rules clearly accepted by the participating nations.

o R&D Policy

-- The Landsat program as a whole represents an uncompleted experiment which I am confident will prove to have been a wise and valuable undertaking. I am, of course, disappointed that the process of demonstrating unequivocal beneficial improvements in global resources is taking longer than we had originally expected. It is understandable, however, that organizations with line responsibilities must be very certain of their ground before committing to a new technology. I am, in fact, very encouraged by the technical progress being made in LACIE, and am confident that within a short time there will be a clear demonstration of the superiority of this technical approach to accurate crop reporting and estimating.

-- I am also convinced that we have a clear-cut research challenge in the area of agricultural information, one we hope to meet with the thematic mapper. With this expanded capability, we will be able to test and evaluate the importance of much higher spatial and spectral resolution in the accurate measurement of small fields which fall below the current measurement threshold, and in unambiguous discrimination among multiple crops.

In summary, I am convinced that Landsat D is the proper decision for the Nation at this stage of development in remote sensing. In keeping with our prior understandings, NASA did not press for a new start in this field last year. I am now recommending that we proceed prudently but expeditiously with the complex but immensely rewarding research program that began with Landsat-1 in 1972.

My staff and I will be glad to discuss FY 1978 Landsat recommendations with you and your associates at your convenience.

Sincerely,

James C. Fletcher
Administrator

Enclosure

INTERAGENCY DECISION TEAM
WORKING GROUP RECOMMENDATIONS

1. Policy recommendation.

a. It is strongly recommended that as part of the FY 1978 budget the United States commit to a test period of three to six years, beginning in 1981, in which to:

1) validate the operational uses of a civil earth resources satellite system by the public, private, and international sector;

2) confirm the extent of the net economic, social, and political benefits of such a system through actual extended use of information derived therefrom;

3) develop and define the most effective institutional arrangements for the management of fully operational earth resources satellite services, taking into account the appropriate roles of local government, the private sector, the international community, and the Federal government.

2. Program recommendation.

a. It is recommended that the FY 1978 budget include provision for a new retrievable (by shuttle)and refurbishable earth resources survey satellite for launch in 1981, and that a backup satellite to assure experiment continuity for at least the three year test period after 1981 (in the event of an early failure of the first satellite) and possibly for a six year test period (in the event of complete success of both satellites).

b. Each satellite would carry an experimental Thematic Mapper instrument (currently under development) as the next step in NASA's continuing research and development effort. The Thematic Mapper will permit experimentation with and assessment of high spatial and spectral resolution data. Each satellite would also carry the five-Channel Multispectral Scanner (to be flown experimentally on Landsat-C in 1978) in order to provide an inherent backup to the experimental Thematic Mapper instrument and to continue to provide data services of known utility to domestic and foreign users.

3. Management recommendations.

a. NASA will be responsible for the development, launch and on-oribt control of the spacecraft and for reception and initial processing of raw satellite data.

b. Department of the Interior, through its facility at Sioux Falls, will continue to have the principal responsibility for the dissemination of processed data products to the public users. This should not, however, preclude other Federal agencies from disseminating data products to their constituencies. New pricing formulae for these products will be implemented to make the dissemination function self-sustaining at an early date, and competitive commercial alternatives to governmental operations will be explored.

c. User Federal agencies will be responsible for any specialized data processing, analysis, information extraction and employment required in the execution of its operational and research functions.

4. Budget recommendation.

a. It is recommended that the budgetary implications of the program proposed below be

considered as an integral whole by the Office of Management and Budget rather than being treated as individual elements within each Department or Agency's budget. Budget summary is included as Table 1.

b. The Department of Agriculture FY 1978 submission includes funding to initiate development of a prototype operational global crop forecasting system that exploits the experience being accumulated in the interagency Large Area Crop Inventory Experiment.

c. The Department of Interior budget submission includes funding for research leading to Landsat Follow-on utilization, cooperative applications projects, and related support items that will be used for processing Landsat Follow-on data. It is planned to make the provision of products and services to the general public self sustaining at an early date.

d. The NASA FY 1978 budget submission includes funding for the initiation of the 1981 earth resources flight mission, its backup, and the ground data handling system for the experimental Thematic Mapper instrument.

d. In addition, the FY 1978 budgets of the USDA, DOI, USCOE, and AID all include funding for appropriate operational and research activities that rely on or employ multispectral scanner data from Landsat I, II, and C.

5. Cost-sharing plans.

a. The initial international cost-sharing program will be expanded in scope over time, within the constraints of foreign policy, so as to return to the U.S. an annual sum commensurate with the values to the international community of the experimental or demonstration satellite services.

b. New and imaginative approaches to cost-sharing with economic beneficiaries of satellite data will be explored (e.g., licensing arrangements with commercial enterprises for certain data processing and distribution functions and information extraction, etc.).

CONCURRENCE:

Dr. Don Paarlberg
Director of Agricultural Economics
Department of Agriculture

Don Paarlberg

Dr. Robert White
Administrator, National Oceanic & Atmospheric Administration
Department of Commerce

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Enclosure

TABLE I

EARTH RESOURCES SATELLITE PROGRAM
BUDGET SUMMARIES IN MILLIONS OF
REAL-YEAR DOLLARS (ESCALATED
AT 6% PER ANNUM)

FY 1978 Budget requests and Estimates for Future Allocations:

1. Currently Identified for ERS Data Use Within Existing Budget Planning Levels.

	FY 78	79	80	81	82
USDA	1.9	2.7	3.8	5.5	6.8
DOI-EROS Program	9.4	10.6	11.2	11.9	12.6
USCOE	1.2	1.8	1.9	2.0	2.1
AID FY 76		30 to 40			

2. Currently Identified New Programs Requiring New Authorization and/or Budget level Increases.

	FY 78	79	80	81	82
USDA-Global Crop Forecast System	3.6	5.2	5.7	7.0	10.3
NASA-Spacecraft, launch Vehicles, Data Processing System	36	89	98	40	15

Other Recommendations

Summary of NASA FY 1978 Budget Recommendations*

($ in Millions)

Research and Development	FY 1977 BA	FY 1977 O	FY 1978 Request BA	FY 1978 Request O	Reduction BA	Reduction O
1. Space Flight	1,641.7	1,616.9	1,738.8	1,735.6	-29.8	-19.5
° STS Upper Stages	3.8	3.0	18.5	16.0	- 5.0	- 3.0
° Development, Test, and Mission Operations	166.9	175.0	178.0	182.1	- 5.0	- 5.0
° Advanced Programs	13.0	12.0	14.0	13.0	- 4.0	- 3.0
° Space Industrialization	--	--	15.0	8.0	-15.0	- 8.0
° Solar Electric Propulsion	--	--	.8	.5	- .8	- .5
° Other (Including Space Shuttle)	1,458.0	1,426.9	1,512.5	1,516.0	--	--
2. Space Science	380.3	398.0	440.8	405.5	-38.6	-21.5
° Physics and Astronomy SRT/Advanced Studies	15.2	15.2	17.5	17.5	- 1.5	- 1.5
° Spacelab Payload Definition and Spacelab Payload Development	10.0	10.0	35.4	31.2	- 6.0	- 5.0
° Explorers	30.2	30.2	36.0	36.0	- 4.0	- 4.0
° Lunar Polar Orbiter	--	--	7.1	3.0	- 7.1	- 3.0
° Mars Follow-on	--	--	20.0	10.0	-15.0	- 5.0
° Life Sciences	14.9	14.0	36.0	31.3	- 5.0	- 3.0
° Other Space Science	310.0	328.6	288.8	276.5	--	--
3. Space Application	198.2	203.3	224.8	210.4	-13.8	-12.2
° LANDSAT-D	--	--	14.0	3.5	- 5.2	- 1.6
° Global Atmospheric Research Program	5.1	6.0	7.0	7.0	- 2.0	- 2.0
° HALOE	--	--	1.5	1.0	- 1.5	- 1.0
° Earth Research ARTD	31.6	31.0	35.4	34.0	- 3.8	- 3.0
° Earth Dynamics ARTD	1.7	1.7	3.5	3.0	- 1.0	- 1.0
° Space Communication ARTD	6.4	6.0	7.9	7.0	- 1.0	- 1.0
° Communication Demo Program	.9	.9	1.6	1.5	- .7	- .6
° Application Shuttle Payloads	2.0	1.3	18.6	13.0	- 3.6	- 2.0
° Other Space Applications	150.5	156.4	135.3	140.4	--	--

*The summary table includes both issue and non-issue reductions.

	FY 1977		FY 1978 Request		FY 1978 Reduction	
	BA	O	BA	O	BA	O
4. Multi-mission Spacecraft	--	--	25.0	13.5	-15.0	- 8.5
5. Aeronautical Research	190.1	177.0	245.6	219.9	-22.6	-12.1
° Research and Technology Base	89.1	80.1	96.0	91.9	- 1.4	- .8
° System Technology Programs	57.2	54.0	79.2	75.0	- 7.9	- 5.4
° Experimental Programs	40.9	40.5	67.4	50.0	-13.3	- 5.9
° Other	2.9	2.4	3.0	3.0	--	--
6. Space Research and Technology	82.0	75.2	115.0	96.9	-21.0	-12.0
° Space R&T Base Systems Studies, and Technology Programs	66.7	65.0	79.0	72.0	- 9.0	- 8.0
° Experimental Programs - Space Shuttle Payloads	7.0	4.0	25.0	15.0	-10.0	- 3.0
° Low Cost Systems	8.3	6.2	11.0	9.9	- 2.0	1.0
7. Tracking and Data Acquisition	255.0	256.0	284.3	276.5	- 2.6	- 2.0
8. Technology Utilization	8.1	7.0	10.0	8.0	- 1.9	- 1.0
9. Energy R&D Programs	6.0	3.5	8.5	6.1	- 2.5	- 1.7
10. Construction of Facilities	118.1	125.1	195.6	135.7	-35.0	- 3.6
° Shuttle Facilities	--	--	75.6	6.4	--	--
° Rehabilitation & Modification	--	--	19.8	2.0	- 2.0	- .2
° Facility Planning & Design	--	--	13.5	1.4	- 3.5	- .4
° 40 X 80 Wind Tunnel	--	--	15.7	1.6	--	- --
° Other Supporting Construction	--	--	71.0	8.3	-29.5	- 3.0
° Prior Year Construction	118.1	125.1	--	116.0	--	--
11. Research and Program Management	813.0	813.1	818.5	818.5	- 5.5	- 5.5
Total NASA	3692.5	3675.1	4106.9	3926.6	-193.3	-99.6

Narrative of Other FY 1978 Budget Recommendations

Program/Project		1977 Current Estimate	1978 Agency Request	1978 OMB Reduction	1978 OMB Recommendation	1979 OMB Recommendation
Research and Development						
1. Space Flight						
° STS Upper Stages	BA	3.8	18.5	-5.0	13.5	19.5
	O	3.0	16.0	-3.0	13.0	13.5

As proposed by NASA, work would continue of upper stages to deliver shuttle-transported payloads into higher orbits, including work with the Air Force on the development of the Interim Upper Stage (IUS) and NASA development of Spinning Solid Upper Stages (SSUS) for delivery to higher orbits of smaller payloads. We are recommending a reduction in FY 1978 funding related to development of the SSUS on the basis that part of the SSUS capability may be developed with private industry funds.

° Development, Tests, and Mission Operations						
	BA	166.9	178.0	-5.0	173.0	165.0
	O	175.0	182.1	-5.0	177.1	171.0

This program provides for contracted institutional capability NASA uses to provide technical support to the major manned R&D programs. We are recommending a general reduction in FY 1978 funding in view of the buildup in shuttle operations funding beginning in FY 1978.

° Advanced Programs	BA	13.0	14.0	-4.0	10.0	10.0
	O	12.0	13.0	-3.0	10.0	10.0

This program provides for feasibility, definition and evaluation studies of possible future space missions and capabilities. We are recommending a general reduction in this area which is consistent with the likely timing of future proposals and commitments for these type of programs.

° Space Industrialization						
	BA	--	15.0	-15.0	--	--
	O	--	8.0	-8.0	--	--

This proposed activity would involve engineering and Phase B definition studies related to a manned Space Construction Base in earth orbit. We are recommending deletion of all funds related to this activity pending better definition of future policy direction for the civilian space program.

		1977	1978			1979
		Current Estimate	Agency Request	OMB Reduction	OMB Recommendation	OMB Recommendation
° Solar Electric Propulsion						
	BA	--	0.8	-0.8	--	--
	O	--	0.5	-0.5	--	--

This activity would involve Phase B definition studies of a Solar Electric propulsion stage which would be used for future planetary and geosynchronous missions. We recommend deferral on the basis that this activity may be redundant to the upper stage propulsion systems currently under development.

2. Space Science

° Physics and Astronomy/Advanced Studies						
	BA	15.2	17.5	-1.5	16.0	16.0
	O	15.2	17.5	-1.5	16.0	16.0

This program provides for supporting research and technology activities in the Physics and Astronomy program. FY 1978 NASA increase is intended to cover inflation and to augment development of instrumentation. We limited growth to six percent to provide for some inflation and high priority research tasks.

° Spacelab Payloads						
	BA	10.0	35.4	-6.0	29.4	48.3
	O	10.0	31.2	-5.0	26.2	35.0

This program provides for Spacelab payload definition and development activities. The program includes both short and long-term development of Spacelab payloads for future Physics and Astronomy missions. We are recommending a reduction in the funding of longer-term development of such payloads on the basis that this level of activity in addition to other Physics and Astronomy missions (e.g. Space Telescope) is too optimistic and should therefore be constrained.

° Explorers	BA	30.2	36.0	-4.0	32.0	32.0
	O	30.2	36.0	-4.0	32.0	32.0

This program provides for development and launch of small spacecraft to provide a low-cost approach to the study of space science. In addition to approved Explorer missions, NASA is requesting funds for FY 1978 initiation of development of three spacecraft. We recommend that NASA initiate one of the proposed Explorer missions and defer the other two for future reconsideration.

	1977	1978			1979
	Current Estimate	Agency Request	OMB Reduction	OMB Recommendation	OMB Recommendation
° Mars Follow-on Study					
BA	--	20.0	-15.0	5.0	--
O	--	10.0	-5.0	5.0	--

NASA has proposed $20 million in BA in FY 1978 to study possible follow-on options to explore Mars after Viking. While we support the proposal to study possible options in this area, we believe our recommended funding level is sufficient for this study effort.

° Life Sciences					
BA	14.9	36.0	-5.0	31.0	36.7
O	14.0	31.3	-3.0	28.3	32.0

This program provides for study of man's physiological behavior in the space environment. NASA has proposed an augmentation of this activity for studies and experimentation related to Spacelab. We recommend that initiation of an Intergrated Life Science payload be deferred ($4 million in BA, $2 million in outlays) on the basis that it may be premature and duplicative in view of ongoing development of other life sciences payloads. A general reduction of $ 1 million in BA and outlays is also recommended.

3. Space Applications

° Global Atmospheric Research Program					
BA	5.1	7.0	-2.0	5.0	5.0
O	6.0	7.0	-2.0	5.0	5.0

The objective of this program is to provide for participation by NASA in a global experiment to better understand the physical processes that affect climate and climatic change. We recommend that the FY 1977 level be maintained.

° Halogen Occultation Experiment (Haloe) Instrument Development					
BA	--	1.5	-1.5	--	--
O	--	1.0	-1.0	--	--

The objective of this proposed activity is to develop instrumentation for global monitoring of atmospheric constitutents related to possible depletion of stratospheric ozone. We recommend deferral of this program on the basis that such instrumentation development should be traded off in the proposed budget of the Office of Space Science Upper Atmospheric program which was established to coordinate NASA scientific and technical activities in upper atmospheric research and monitoring.

	1977	1978			1979
	Current Estimate	Agency Request	OMB Reduction	OMB Recommendation	OMB Recommendation
° Earth Resources ARTD					
BA	31.6	35.4	-3.8	31.6	31.8
O	31.0	34.0	-3.0	31.0	31.0

The objective of the Earth Resources Advanced Research and Technology Development program is to improve the technology related to remote sensing and to development of experimental applications of remote sensing data. Most of the increase in requested funding relates to increased user assistance for LANDSAT data users. We recommend that FY 1977 funding levels be maintained on the basis that such NASA assistance should decrease (rather than increase) with time and should be carried out by private industry and by affected Federal user agencies (EROS).

° Earth Dynamics ARTD					
BA	1.7	3.5	-1.0	2.5	2.5
O	1.7	3.0	-1.0	2.0	2.0

The objective of the Earth Dynamics Advanced Research and Technology Development program is to develop techniques for measuring the earth's gravity and magnetic fields, crustal and polar motions, and other earth dynamics phenomena. The proposed increase is for intercomparison of two NASA-developed techniques for measuring tectonic plate motion. We recommend a more modest increase on the basis that proposed new activity should be traded-off to a greater extent in the base ARTD program.

° Space Communications ARTD					
BA	6.4	7.9	-1.0	6.9	6.8
O	6.0	7.0	-1.0	6.0	6.0

The Space Communications Advanced Research and Technology Development program provides support to advance communications satellite technologies. The proposed increase partly includes $1 million in BA for a Public Service Satellite study. We recommend reducing NASA funding in FY 1978 on the basis that such a study (which would address the current status of acceptance and transfer of public service satellite technology) should be appropriately carried out by user agencies (e.g., HEW) or the OTP.

° Communications Transfer and Demonstration					
BA	0.9	1.6	0.7	0.9	1.0
O	0.9	1.5	0.6	0.9	1.0

The objective of this program is to expedite the transfer and utilization of spacecraft telecommunications and technology. NASA is proposing a joint NASA/users program which would include NASA funding of modifications of facilities of the Public Service Satellite Consortium. We do not believe that NASA should fund user equipment modification and recommend that FY 1977 funding levels be maintained.

	1977 Current Estimate	1978 Agency Request	1978 OMB Reduction	1978 OMB Recommendation	1979 OMB Recommendation
° Applications Shuttle Payloads					
BA	2.0	18.6	-3.6	15.0	27.0
O	1.3	13.0	-2.0	11.0	25.0

The objective of this effort is to define and develop Space Applications payloads to be flown on the early Shuttle Orbital Flight tests and later Spacelab missions. Among the proposed FY 1978 new starts, NASA has proposed initiation of space processing payload equipment (TEC of $34 million). We recommend approval of proposed initiatives but recommend that FY 1978 funding levels be constrained so as to force trade-off within the base program.

4. Multi-Mission Spacecraft

BA	--	25.0	-15.0	10.0	20.0
O	--	13.5	-5.0	8.5	10.0

This program would provide for procurement of a block-buy of six common spacecraft systems for use on future space missions. The objective would be through greater system commonality and block-buys, to reduce the cost of future space missions. While we support the approach taken by NASA we recommend that funding be reduced to provide funding only for procurement of one spacecraft for use in the LANDSAT-D program (cost savings from the NASA approach are quite small).

5. Aeronautical Research

° Research and Technology Base					
BA	89.1	96.0	-1.4	94.6	95.0
O	80.1	91.9	-0.8	91.1	91.0

The objective of this program is to maintain an advance basic and applied research capability in the various disciplines related to aeronautics. We recommend constraint in FY 1978 BA funding to allow only a six percent increase to cover inflation.

° Aerial Applications Technology					
BA	--	1.0	-1.0	--	--
O	--	0.5	-0.5	--	--

The objective of this Systems Technology program would be to improve technology related to aerial application of agricultural fertilizers and pesticides. We recommend against initiation of this activity on the basis it is not of high priority in relation to other proposed initiatives and that the need for a NASA funding role is not sufficiently justified. (This is a small item, but there is likely to be considerable Congressional interest from Senator Moss).

	1977	1978			1979
	Current Estimate	Agency Request	OMB Reduction	OMB Recommendation	OMB Recommendation
6. Space Research and Technology					
BA	66.7	79.0	-9.0	70.0	70.0
O	65.0	72.0	-8.0	64.0	64.0

The objective of this program is to maintain and advance basic and applied research capabilities in space technology in support of ongoing and future space missions. We recommend that NASA's FY 1978 request be reduced because proposed technology efforts related to the Solar Power Satellite Power System duplicate an ongoing activity in NASA's energy R&D program.

° Space Shuttle Payloads					
BA	7.0	25.0	-10.0	15.0	20.0
O	4.0	15.0	-3.0	12.0	15.0

This program seeks to define and develop shuttle payloads to test and demonstrate new space technologies. We recommend that in view of the substantial proposed increase, payload activity funding be constrained.

° Low Cost Systems					
BA	8.3	10.0	-2.0	8.0	8.0
O	6.2	9.9	-1.0	8.9	8.0

The objective of this program is to design standardized subsystems for small spacecraft (e.g., Explorers). We recommend that funding be constrained in view of the trend to larger spacecraft systems as the shuttle enters operation and the recommended deferral of two of the three proposed Space Science explorer missions.

7. Tracking and Data Acquisition					
BA	255.0	284.3	-2.6	281.7	312.8
O	256.0	276.5	-2.0	274.5	305.1

This program provides tracking and data acquisition support for NASA and space missions. We recommend elimination of funding for LANDSAT-C data handling improvements ("rapid" data transmission) on the basis that such improvements should be recovered through user costs and that over-capitalization of the NASA LANDSAT component should be avoided in view of the experimental nature of the program.

	1977	1978			1979
	Current Estimate	Agency Request	OMB Reduction	OMB Recommendation	OMB Recommendation
8. Technology Utilization					
BA	8.1	10.0	-1.9	8.1	8.1
O	7.0	8.0	-1.0	7.0	7.0

The objective of this program is to transfer new aerospace technologies developed in NASA R&D programs to non-aerospace users. We are recommending that FY 1977 funding levels be continued and that proposed initiation of four new transfer centers be deferred pending closer review of the need for such expansions. We further recommend that the Technology Utilization program not be used to disseminate "free" user advice on NASA Space Applications programs pending closer review of the appropriate mechanisms for transferring such information.

9. Energy R&D

° Energy Technology

BA	3.5	5.0	-1.5	3.5	3.5
O	2.0	3.6	-1.0	2.6	2.6

The objective of this program is to identify and define NASA-developed technology which could aid in the development of technology for meeting the nation's energy needs. Most such funds are used to prepare proposals which are considered for reimbursable funding by ERDA. We recommend that the FY 1977 BA funding level be maintained. (Congress added this effort back this year and we believe the best approach is to constrain dollar budget levels.)

° Energy Systems

BA	2.5	3.5	-1.0	2.5	2.5
O	1.5	2.5	-0.7	1.8	1.8

The objective of this program is to define and evaluate the concept of providing energy for use on earth through solar power satellites. We recommend that the FY 1977 BA funding be maintained as part of a joint NASA/ERDA assessment of this option. (We are coordinating review of this program with the appropriate ERDA examiners.)

Construction of Facilities

° Energy Reduction-Related CoF Projects

BA	--	19.6	-14.3	5.3	--
O	--	2.0	-1.5	0.5	4.0

NASA has proposed seven CoF projects to reduce energy consumption at NASA field centers. We are recommending approval of the three highest priority projects.

	1977 Current Estimate	1978 Agency Request	1978 OMB Reduction	1978 OMB Recommendation	1979 OMB Recommendation
° Miscellaneous CoF Projects					
BA	--	20.2	-12.7	7.5	--
O	--	2.0	-1.4	0.6	4.0

NASA has proposed nine miscellaneous construction projects which would maintain current facilties and provide for construction of new facilities at NASA field centers. We recommend approval of six of the CoF projects and deferral of the remaining three projects on the basis of OMB assessed priorities.

° Rehabilitation and Modification					
BA	--	19.8	-2.0	17.8	17.8
O	--	2.0	-0.2	1.8	12.0

These funds provide for facility modifications and improvements which fall below $500,000 in total cost. We are recommending that the FY 1977 funding level for this activity be maintained.

° Facility Planning and Design					
BA	--	13.5	-3.5	10.0	10.0
O	--	1.4	-0.4	1.0	8.0

Under this program NASA conducts master planning for its field centers and prepatory planning for future CoF projects. We are recommend that funding for this activity be constrained to the level for previous years.

Research and Program Management					
BA	813.0	818.5	5.5	813.0	810.0
O	813.1	818.5	5.5	813.0	810.0

These funds provide for the operation and daily maintenance of NASA field centers. We recommend that funding be held level (not including the effect of the October 1976 pay raise).