Document III-8

Document title: Lyndon B. Johnson, Vice President, Memorandum for the President, "Evaluation of Space Program," April 28, 1961.

Source: NASA Historical Reference Collection, History Office, NASA Headquarters, Washington, D.C.

This memorandum, prepared by Edward C. Welsh, the new executive secretary of the National Aeronautics and Space Council, and signed by Vice President Johnson, was the first report to President Kennedy on the results of the review he had ordered on April 20. The report identified a lunar landing by 1966 or 1967 as the first dramatic space project in which the United States could beat the Soviet Union. The vice president identified "leadership" as the appropriate goal of U.S. efforts in space.

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Memorandum for the President

April 28, 1961
Subject: Evaluation of Space Program.

Reference is to your April 20 memorandum asking certain questions regarding this country's space program.

A detailed survey has not been completed in this time period. The examination will continue. However, what we have obtained so far from knowledgeable and responsible persons makes this summary reply possible.

Among those who have participated in our deliberations have been the Secretary and Deputy Secretary of Defense; General Schriever (AF); Admiral Hayward (Navy); Dr. von Braun (NASA); the Administrator, Deputy Administrator, and other top officials of NASA; the Special Assistant to the President on Science and Technology; representatives of the Director of the Bureau of the Budget; and three outstanding non-Government citizens of the general public: Mr. George Brown (Brown & Root, Houston, Texas); Mr. Donald Cook (American Electric Power Service, New York, N.Y.); and Mr. Frank Stanton (Columbia Broadcasting System, New York, N.Y.).

The following general conclusions can be reported:

a. Largely due to their concentrated efforts and their earlier emphasis upon the development of large rocket engines, the Soviets are ahead of the United States in world prestige attained through impressive technological accomplishments in space.

b. The U.S. has greater resources than the USSR for attaining space leadership but has failed to make the necessary hard decisions and to marshal those resources to achieve such leadership.

[2] c. This country should be realistic and recognize that other nations, regardless of their appreciation of our idealistic values, will tend to align themselves with the country which they believe will be the world leader–the winner in the long run. Dramatic accomplishments in space are being increasingly identified as a major indicator of world leadership.

d. The U.S. can, if it will, firm up its objectives and employ its resources with a reasonable chance of attaining world leadership in space during this decade. This will be difficult but can be made probable even recognizing the head start of the Soviets and the likelihood that they will continue to move forward with impressive successes. In certain areas, such as communications, navigation, weather, and mapping, the U.S. can and should exploit its existing advance position.

e. If we do not make the strong effort now, the time will soon be reached when the margin of control over space and over men's minds through space accomplishments will have swung so far on the Russian side that we will not be able to catch up, let alone assume leadership.

f. Even in those areas in which the Soviets already have the capability to be first and are likely to improve upon such capability, the United States should make aggressive efforts as the technological gains as well as the international rewards are essential steps in eventually gaining leadership. The danger of long lags or outright omissions by this country is substantial in view of the possibility of great technological breakthroughs obtained from space exploration.

g. Manned exploration of the moon, for example, is not only an achievement with great propaganda value, but it is essential as an objective whether or not we are first in its accomplishment–and we may be able to be first. We cannot leapfrog such accomplishments, as they are essential sources of knowledge and experience for even greater successes in space. We cannot expect the Russians to transfer the benefits of their experiences or the advantages of their capabilities to us. We must do these things ourselves.

[3] h. The American public should be given the facts as to how we stand in the space race, told of our determination to lead in that race, and advised of the importance of such leadership to our future.

i. More resources and more effort need to be put into our space program as soon as possible. We should move forward with a bold program, while at the same time taking every practical precaution for the safety of the persons actively participating in space flights.

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As for the specific questions posed in your memorandum, the following brief answers develop from the studies made during the past few days. These conclusions are subject to expansion and more detailed examination as our survey continues.

Q.1- Do we have a chance of beating the Soviets by putting a laboratory in space, or by a trip around the moon, or by a rocket to land on the moon, or by a rocket to go to the moon and back with a man. Is there any other space program which promises dramatic results in which we could win?

A.1- The Soviets now have a rocket capability for putting a multi-manned laboratory into space and have already crash-landed a rocket on the moon. They also have the booster capability of making a soft landing on the moon with a payload of instruments, although we do not know how much preparation they have made for such a project. As for a manned trip around the moon or a safe landing and return by a man to the moon, neither the U.S. nor the USSR has such capability at this time, so far as we know. The Russians have had more experience with large boosters and with flights of dogs and man. Hence they might be conceded a time advantage in circumnavigation of the moon and also in a manned trip to the moon. However, with a strong effort, the United States could conceivably be first in those two accomplishments by 1966 or 1967.

[4] There are a number of programs which the United States could pursue immediately and which promise significant world-wide advantage over the Soviets. Among these are communications satellites, and navigation and mapping satellites. These are all areas in which we have already developed some competence. We have such programs and believe that the Soviets do not. Moreover, they are programs which could be made operational and effective within reasonably short periods of time and could, if properly programmed with the interests of other nations, make useful strides toward world leadership.

Q.2- How much additional would it cost?

A.2- To start upon an accelerated program with the aforementioned objectives clearly in mind, NASA has submitted an analysis indicating that about $500 million would be needed for FY 1962 over and above the amount currently requested of the Congress. A program based upon NASA's analysis would, over a ten-year period, average approximately $1 billion a year above the current estimates of the existing NASA program.

While the Department of Defense plans to make a more detailed submission to me within a few days, the Secretary has taken the position that there is a need for a strong effort to develop a large solid-propellant booster and that his Department is interested in undertaking such a project. It was understood that this would be programmed in accord with the existing arrangement for close cooperation with NASA, which Agency is undertaking some research in this field. He estimated they would need to employ approximately $50 million during FY 1962 for this work but that this could be financed through management of funds already requested in the FY 1962 budget. Future defense budgets would include requests for additional funding for this purpose; a preliminary estimate indicates that about $500 million would be needed in total.

[5] Q.3- Are we working 24 hours a day on existing programs? If not, why not? If not, will you make recommendations to me as to how work can be speeded up?

A.3- There is not a 24-hour-a-day work schedule on existing NASA space programs except for selected areas in Project Mercury, the Saturn C-1 booster, the Centaur engines and the final launching phases of most flight missions. They advise that their schedules have been geared to the availability of facilities and financial resources, and that hence their overtime and 3-shift arrangements exist only in those activities in which there are particular bottlenecks or which are holding up operations in other parts of the programs. For example, they have a 3-shift 7-day-week operation in certain work at Cape Canaveral; the contractor for Project Mercury has averaged a 54-hour week and employs two or three shifts in some areas; Saturn C-1 at Huntsville is working around the clock during critical test periods while the remaining work on this project averages a 47-hour week; the Centaur hydrogen engine is on a 3-shift basis in some portions of the contractor's plants.

This work can be speeded up through firm decisions to go ahead faster if accompanied by additional funds needed for the acceleration.

Q.4- In building large boosters should we put our emphasis on nuclear, chemical or liquid fuel, or a combination of these three?

A.4- It was the consensus that liquid, solid and nuclear boosters should all be accelerated. This conclusion is based not only upon the necessity for back-up methods, but also because of the advantages of the different types of boosters for different missions. A program of such emphasis would meet both so-called civilian needs and defense requirements.

[6] Q.5- Are we making maximum effort? Are we achieving necessary results?

A.5- We are neither making maximum effort nor achieving results necessary if this country is to reach a position of leadership.

Lyndon B. Johnson

Document III-9

Document title: Wernher von Braun to the Vice President of the United States, April 29, 1961, no pagination.

Source: NASA Historical Reference Collection, History Office, NASA Headquarters, Washington, D.C.

Of all those consulted during the presidentially mandated space review, no one had been thinking longer about the future in space than Wernher von Braun. Even when he had led the development of the V-2 rocket for Germany during World War II, von Braun and his associates had been planning future space journeys. After coming to the United States after World War II, von Braun was a major contributor to popularizing the idea of human spaceflight. As he stressed in his letter, von Braun had been asked to participate in the review as an individual, not as the director of NASA's Marshall Space Flight Center. Von Braun told the vice president in his letter that the United States had "an excellent chance" of beating the Russians to a lunar landing.

This is an attempt to answer some of the questions about our national space program raised by The President in his memorandum to you dated April 20, 1961. I should like to emphasize that the following comments are strictly my own and do not necessarily reflect the official position of the National Aeronautics and Space Administration in which I have the honor to serve.

Question 1. Do we have a chance of beating the Soviets by putting a laboratory in space, or by a trip around the moon, or by a rocket to land on the moon, or by a rocket to go to the moon and back with a man? Is there any other space program which promises dramatic results in which we could win?

Answer: With their recent Venus shot, the Soviets demonstrated that they have a rocket at their disposal which can place 14,000 pounds of payload in orbit. When one considers that our own one-man Mercury space capsule weighs only 3900 pounds, it becomes readily apparent that the Soviet carrier rocket should be capable of

- launching *several* astronauts into orbit simultaneously. (Such an enlarged multi-man capsule could be considered and could serve as a small "laboratory in space".)

- soft-landing a substantial payload on the moon. My estimate of the maximum soft-landed net payload weight the Soviet rocket is capable of is about 1400 pounds (one-tenth of its low orbit payload). This weight capability is *not* sufficient to include a rocket for the *return flight* to earth of a man landed on the moon. But it is entirely adequate for a powerful radio transmitter which would relay lunar data back to earth and which would be *abandoned* on the lunar surface after completion of this mission. A similar mission is planned for our "Ranger" project, which uses an Atlas-Agena B boost rocket. The "semi-hard" landed portion of the Ranger package weighs 293 pounds. Launching is scheduled for January 1962.

The existing Soviet rocket could furthermore hurl a 4000 to 5000 pound capsule *around* the moon with ensuing re-entry into the earth atmosphere. This weight allowance must be considered marginal for a one-man round-the-moon voyage. Specifically, it would not suffice to provide the capsule and its occupant with a "safe abort and return" capability, a feature which under NASA ground rules for pilot safety is considered mandatory for all manned space flight missions. One should not overlook the possibility, however, that the Soviets may substantially facilitate their task by simply waiving this requirement.

A rocket about ten times as powerful as the Soviet Venus launch rocket is required to land a man on the moon and bring him back to earth. Development of such a super rocket can be circumvented by orbital rendezvous and refueling of smaller rockets, but the development of this technique by the Soviets would not be hidden from our eyes and would undoubtedly require several years (possibly as long or even longer than the development of a large direct-flight super rocket).

Summing up, it is my belief that

a) we do *not* have a good chance of beating the Soviets to a manned "*laboratory in space.*" The Russians could place it in orbit this year while we could establish a (somewhat heavier) laboratory only after the availability of a reliable Saturn C-1 which is in 1964.

b) we *have* a sporting chance of beating the Soviets to a soft-landing of a radio *transmitter station on the moon.* It is hard to say whether this objective is on their program, but as far as the launch rocket is concerned, they could do it at any time. We plan to do it with the Atlas-Agena B-boosted Ranger #3 in early 1962.

[3] c) we have a sporting chance of sending a 3-man crew *around the moon* ahead of the Soviets (1965/66). However, the Soviets could conduct a round-the-moon voyage earlier if they are ready to waive certain emergency safety features and limit the voyage to one man. My estimate is that they could perform this simplified task in 1962 or 1963.

d) we have an excellent chance of beating the Soviets to the *first landing of a crew on the moon* (including return capability, of course). The reason is that a performance jump by a factor 10 over their present rockets is necessary to accomplish this feat. While today we do not have such a rocket, it is unlikely that the Soviets have it. Therefore, we would not have to enter the race toward this obvious next goal in space exploration against hopeless odds favoring the Soviets. With an all-out crash program I think we could accomplish this objective in 1967/68.

Question 2. How much additional would it cost?

Answer: I think I should not attempt to answer this question before the exact objectives and the time plan for an accelerated United States space program have been determined. However, I can say with some degree of certainty that the necessary funding increase to meet objective d) above would be well over $1 Billion for FY 62, and that the required increases for subsequent fiscal years may run twice as high or more.

Question 3. Are we working 24 hours a day on existing programs? If not, why not? If not, will you make recommendations to me as to how work can be speeded up.

Answer: We are *not* working 24 hours a day on existing programs. At present, work on NASA's Saturn project proceeds on a basic one-shift basis, with overtime and multiple shift operations approved in critical "bottleneck" areas.

During the months of January, February and March 1961, NASA's George C. Marshall Space Flight Center, which has systems management for the entire Saturn vehicle and develops the large first stage as an in-house project, has worked an average of 46 hours a week. This includes all administrative and clerical activities. In the areas critical for the Saturn project (design activities, assembly, inspecting, testing), average working time for the same period was 47.7 hours a week, with individual peaks up to 54 hours per week.

Experience indicates that in Research & Development work longer hours are not conducive to progress because of hazards introduced by fatigue. In the aforementioned critical areas, a second shift would greatly alleviate the tight scheduling situation. However, additional funds and personnel spaces are required to hire a second shift, and neither are available at this time. *In this area, help would be most effective.*

Introduction of a *third* shift *cannot* be recommended for Research & Development work. Industry-wide experience indicates that a two-shift operation with moderate but not excessive overtime produces the best results.

In industrial plants engaged in the Saturn program the situation is approximately the same. Moderately increased funding to permit greater use of premium paid overtime, prudently applied to real "bottleneck" areas, can definitely speed up the program.

Question 4. In building large boosters should we put our emphasis on nuclear, chemical or liquid fuel, or a combination of these three?

Answer: It is the consensus of opinion among most rocket men and reactor experts that the future of the nuclear rocket lies in deep-space operations (upper stages of chemically-boosted rockets or nuclear space vehicles departing from an orbit around the earth) rather than in launchings (under nuclear power) from the ground. In addition, there can be little doubt that the basic technology of nuclear rockets is still in its early infancy. The nuclear rocket should therefore be looked upon as a promising means to extend and expand the scope of our space operations in the years beyond 1967 or 1968. It should not be considered as a serious contender in the big booster problem of 1961.

The foregoing comment refers to the simplest and most straightforward type of nuclear rocket, viz. the "heat transfer" or "blow-down" type, whereby liquid hydrogen is evaporated and superheated in a very hot nuclear reactor and subsequently expanded through a nozzle.

There is also a fundamentally different type of nuclear rocket propulsion system in the works which is usually referred to as "ion rocket" or "ion propulsion." Here, the nuclear energy is first converted into electrical power which is then used to expel "ionized" (i.e., electrically charged) particles into the vacuum of outer space at extremely high speeds. The resulting reaction force is the ion rocket's "thrust." It is in the very nature of nuclear ion propulsion systems that they cannot be used in the atmosphere. While very efficient in propellant economy, they are capable only of very small thrust forces. Therefore they do not qualify as "boosters" at all. The future of nuclear ion propulsion lies in its application for low-thrust, high-economy cruise power for interplanetary voyages.

As to "chemical or liquid fuel" The President's question undoubtedly refers to a comparison between "solid" and "liquid" rocket fuels, both of which involve chemical reactions.

At the present time, our most powerful rocket boosters (Atlas, first stage of Titan, first stage of Saturn) are all liquid fuel rockets and all available evidence indicates that the

Soviets are also using liquid fuels for their ICBM's and space launchings. The largest solid fuel rockets in existence today (Nike Zeus booster, first stage Minuteman, first stage Polaris) are substantially smaller and less powerful. There is no question in my mind that, when it comes to building very powerful booster rocket systems, the body of experience available today with liquid fuel systems greatly exceeds that with solid fuel rockets.

There can be no question that larger and more powerful solid fuel rockets can be built and I do not believe that major breakthroughs are required to do so. On the other hand it should not be overlooked that a casing filled with solid propellant and a nozzle attached to it, while entirely capable of producing thrust, is not yet a rocket ship. And although the reliability record of solid fuel rocket *propulsion units*, thanks to their simplicity, is impressive and better than that of liquid propulsion units, this does not apply to *complete rocket systems*, including guidance systems, control elements, stage separation, etc.

Another important point is that booster performance should not be measured in terms of thrust force alone, but in terms of total impulse; i.e., the product of thrust force and operating time. For a number of reasons it is advantageous not to extend the burning time of solid fuel rockets beyond about 60 seconds, whereas most liquid fuel boosters have burning time of 120 seconds and more. Thus, a 3-million pound thrust solid rocket of 60 seconds burning time is actually not more powerful than a 1½-million pound thrust liquid booster of 120 seconds burning time.

[Paragraph excised during declassification review]

My recommendation is to substantially increase the level of effort and funding in the field of solid fuel rockets (by 30 or 50 million dollars for FY 62) with the immediate objectives of

- demonstration of the feasibility of very large segmented solid fuel rockets. (Handling and shipping of multi-million pound solid fuel rockets become unmanageable unless the rockets consist of smaller individual segments which can be assembled in building block fashion at the launching site.)

- development of simple inspection methods to make certain that such huge solid fuel rockets are free of dangerous cracks or voids

- determination of the most suitable operational methods to ship, handle, assemble, check and launch very large solid fuel rockets. This would involve a series of paper studies to answer questions such as

a. Are clusters of smaller solid rockets, or huge, single poured-in-launch-site solid fuel rockets, possibly superior to segmented rockets? This question must be analyzed not just from the propulsion angle, but from the operational point of view for the total space transportation system and its attendant ground support equipment.

b. Launch pad safety and range safety criteria (How is the total operation at Cape Canaveral affected by the presence of loaded multi-million pound solid fuel boosters?)

c. Land vs. off-shore vs. sea launchings of large solid fuel rockets.

d. Requirements for manned launchings (How to shut the booster off in case of trouble to permit safe mission abort and crew capsule recovery? If this is difficult, what other safety procedures should be provided?)

Question 5. Are we making maximum effort? Are we achieving necessary results?

Answer: No, I do *not* think we are making maximum effort.

In my opinion, the most effective steps to improve our national stature in the space field, and to speed things up would be to

- identify a few (the fewer the better) goals in our space program as objectives of highest national priority. (For example: Let's land a man on the moon in 1967 or 1968.)

- identify those elements of our present space program that would qualify as immediate contributions to this objective. (For example, soft landings of suitable instrumentation on the moon to determine the environmental conditions man will find there.)

- put all other elements of our national space program on the "back burner."

- add another more powerful liquid fuel booster to our national launch vehicle program. The design parameters of this booster should allow a certain flexibility for desired program reorientation as more experience is gathered.

Example: Develop in addition to what is being done today, a first-stage liquid fuel booster of twice the total impulse of Saturn's first stage, designed to be used in clusters if needed. With this booster we could

a. double Saturn's presently envisioned payload. This additional payload capability would be very helpful for soft instrument landings on the moon, for circumlunar flights and for the final objective of a manned landing on the moon (if a few years from now the route via orbital re-fueling should turn out to be the more promising one.)

b. assemble a much larger unit by strapping three or four boosters together into a cluster. This approach would be taken should, a few years hence, orbital rendezvous and refueling run into difficulties and the "direct route" for the manned lunar landing thus appears more promising.

[Paragraph excised during declassification review]

Summing up, I should like to say that in the space race we are competing with a determined opponent whose peacetime economy is on a wartime footing. Most of our procedures are designed for orderly, peacetime conditions. I do not believe that we can win this race unless we take at least some measures which thus far have been considered acceptable only in times of a national emergency.

Yours respectfully,
Wernher von Braun

Document III-10

Document title: "Vice President's Ad Hoc Meeting," May 3, 1961.

Source: NASA Historical Reference Collection, History Office, NASA Headquarters, Washington, D.C.

As the space review progressed in early May, Vice President Lyndon Johnson called together many of those participating in the review to meet with Senator Robert Kerr (D-OK), who was the new chairman of the Senate Committee on Aeronautical and Space Science, and Senator Styles Bridges (R-NH), the committee's ranking minority member. The point of the meeting was to let these key senators know what was being discussed within the executive branch and to solicit their support for an acceleration of the space program. Evident in the notes of the meeting is some tension between Vice President Johnson, who was pushing for a strong recommendation to the president, and NASA Administrator James Webb, who was not yet sure that a program of the magnitude that the vice president wanted was technically or politically feasible.

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[1]

Vice President's Ad Hoc Meeting

May 3 - Room 210 - With Senators

Vice President: This meeting is to get the benefit of remarks and ideas from the Senators and others for Mr. Webb, the Department of Defense, the President, and the Space Council members. We haven't gone far enough or fast enough. We need a new look, and to know how much it will cost. Mr. Webb has a comprehensive program. It would add $500 million more or less to the current budget. The Department of Defense also has need for about $100 million more. Everyone is requested to give suggestions and recommendations. We are grateful for the participation of the senior Senators. This is not a partisan matter. We are all Americans doing the best job we can for America. In taking a new look, we will call first on Senator Kerr.

Senator Kerr: After all that has gone on, and considering particularly things that have happened recently, we can see that the budget of the outgoing Administration was not adequate to do what the President and others have in mind. The establishment of the Space Council is the most progressive thing that has yet been done. One of the first things they must do is to look at requirements, costs, and come up with a budget, either on an annual or project basis, that will fix the agency of responsibility. We have some [2] great men leading the program.

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We need to agree on objectives, the timing of those matters, get a decision from the President on what he needs in the budget, and after these preliminary steps, the matter comes to us in the Congress. We need some cold-blooded decisions, but the Senate can be counted on in the end to face up to whatever is required. Senator Bridges is an indispensable man in the matter of getting started and getting the right answer from the Senate.

Senator Bridges: Concurred with the remarks of Senator Kerr. The Vice President will remember the trials and frustrations of 1958 that came with the development of the Space Act. Now we face a new situation. What are our short and long range objectives? We have been attempting to maintain a balance between the military necessity and the scientific desires. A coordination between them has been maintained. It certainly is necessary to attain the highest possible scientific use and to maintain the glory of the United States and its prestige, but basic to the whole matter is the security of the United States. These things have to be in tune. It is a tremendous challenge. The Space Committee of the Senate will cooperate, but it wants to be informed, it wants the truth, and it will carry its share of the load and more.

[3] Vice President: I am asking Mr. Webb to review the high points of his short and long range objectives and his budget needs. He has a paper covering ten or eleven points, and this seems to be a good way to cover the ground.

Mr. Webb: When the amendment to the Space Act was recently passed, the Vice President asked for our views on the subject just announced. These were put together very fast. They start from a basic estimate that we can arrange for a manned lunar landing in 1967 or 1968. Before that can be done, science must have found plenty of new answers or ideas, and much more must be found and understood before we can either put three men in an orbit round the moon or make a soft landing. Before we get to that objective, we have some other things we can do along that path. Some new shots will advance meteorology. We will have communications satellites and a system set up which will serve both military and commercial needs.

In order to answer the first question asked by the President, "Do we have a chance of beating the Soviets?", I have assigned the best 25 scientists on each one of the five projects the task of analyzing the possibilities and probabilities to cover each part of [4] the question. There is a great deal that must be done before the Vice President will be in a position to make recommendations and the President be ready to go to the Congress and ask for the large sums which will be necessary, so we've got to be very careful now. The magnitudes are something like this–$1.7 billion for next year, $3 billion one year later, and $4.4 billion the following year.

The Vice President: Do you feel that you will not be prepared to give me answers for a month? You should be making your recommendations as early as you can. You were desperate for $308 million two weeks ago. You didn't get all of that. Is it going to take you a month to make the decisions necessary to arrive at good targets? I am not trying to rush you. But you must not wait a month or Congress will have gone home.

Webb: There are some overall policy guidances with which we ought to be provided to make a proper start in our estimates.

In the last two weeks we have actually had a new invention. It amounts to a combination of solid and liquid propellants in boosters. If this process is feasible, we can make a national decision –

Vice President: I thought you said you would have your answers in a month. What you are now talking about will take longer than a month, won't it?

[5] Webb: If our top men decide the psychological and military necessities, and that these things require a lunar shot in 1967, then the budget for the first year would be $1.7 billion for NASA in 1962.

Senator Kerr: Does this mean that you will want to adjust your figures and your justification for the recent appropriation increases requested?

Webb: Although there would not be a big change in spending, there would be a considerable problem having to do with long range commitments. There is a real question as to whether a request for $33 billion for these objectives is proper at this time.

Vice President: We want to keep clear here our need for recommendations on next year and on a ten-year total. It seems that your best "horseback" guess was a need for $509 million. (The Vice President then read from paper titled "Major Items in Accelerated Program Requiring Additional Funds for Fiscal 1962." The amount needed for each of the eleven points was read. Total $509 million.)

[6] Now my question is, do you want to change that $509 million figure?

Webb: Our new idea on boosters will force us to change some of these figures, just how much I do not know, because DOD has now decided that they need big boosters and they may take over some or all of this one project cost.

Dryden: Speaking as a technician, I would recommend that we try for the moon as soon as possible, but national policy has other significant guidance factors and we're fishing for some of that guidance in order to know what kind of support we would get for some of our ideas.

Vice President: I don't want anyone here to feel that we are putting him on the spot. We'll wait a month if necessary for people to get guts enough to make solid recommendations. Our purpose today is to have these important Senators get the benefit of consultation and for us to have the benefit of consulting them and we want to consult everyone who can make a contribution.

Dryden: In terms of the overall national interest and objectives, we find ourselves in a pretty narrow part of that, i.e., the space program.

[7] When it comes to its relationship to the USSR, someone else has to tell us how we fit into the overall scheme of things and what we should do to carry our part of the burden.

Webb: We can only do our share – we can't carry the burden of all of those who have responsibility.

Vice President: What we want to know is what would you do if you were President?

Webb: Since we don't know enough about his other problems, we can't judge what we would do if we were President. I think I would be for a moon shot in 1967.

Vice President: In other words, you take the same position that you recommended two weeks ago [4/19/61]. Will your figures be way off?

Dryden: It will take a month to work out our program and its justification to a point which will satisfy the Bureau of the Budget, and until then we can't really tell the Senators much about figures.

Senator Kerr: If the objectives discussed here have the President's backing, NASA and Senator Kerr will share the burden of that load. If the President [8] has not been convinced, Kerr backs out.

Vice President: The President will stand behind the recommendations from the Space Council which will be based on recommendations from Webb and the other members.

Webb: We need a national commitment to defined objectives. If Congress would give us a commitment for big increments to our program in future years, we could do a better job of planning. It would be a national disgrace if we were to start now a big program and then have to stop because of lack of appropriation in future years.

Vice President: You can't get any more than a one-year appropriation but Congress will give you annual appropriations as they do in the case of a big dam. Let's not try to do the impossible. On the other hand, let's hope that you can go on year after year persuading reasonable men and explain the changes as they take place. We got $126 million when we asked for $308 million, but the President explained his reasons and he is ready to listen to new recommendations with an open mind.

Webb: The President did give us our needs for a big booster and he paved the way for more. We need more experience on life in space with men and [9] with animals. We will have to reschedule the use of our $509 million plan. The $182 million we have asked for would actually level out lower if our big booster hopes work out, but we will need more now as we see greatly increased costs coming up later. There are four major booster developments in our program which were not in the budget which went to the President. We need $509 million now, instead of the $182 million we asked the President for. If our new idea of the marriage of the types of boosters is feasible, we will have some new costs and one of those will be $105 million for launching pads. We need new types of space crafts for meteorological work and for communications work.

Senator Bridges: Based on intelligence resources, how does your program compare with the achievements which are to be expected from the USSR?

Webb: They will be ahead until 1967 or 1968.

Senator Bridges: Should we be planning to do less than we know they are doing?

Webb: We can't help it. We can't do more during that period. They have been using an 800,000 lb. thrust and are ready to make the next jump in size, which may be double or more. On the other hand, we are about to jump our size ten times, and there are lots of unsolved problems involved. [10]

Senator Bridges: Who decided on the publicity which has been given this shot that was cancelled the other day? [Shepard]

Webb: The plan for this shot was in existence when we took over. One of the first things we did was to cancel out some arrangements which had been made between the astronauts and commercial publicists. Although there was a half million dollars involved, we came to some pretty firm conclusions and in spite of the important commercial interests, we fixed some limitations. Although there are reports of 500 newsmen down at Cape Canaveral, they are not in the way. They have been eased out of the blockhouse and any other area where they have in the past interfered. This whole problem needs more attention, but with things like a House Committee investigating me and others pressing me every minute, I haven't had time.

Dryden: It's true that the basic decisions were made by the last Administration and these are some of the reasons Cape Canaveral can't be cut off from public view. Photographs can be taken with long lenses and misleading information provided, based on those photographs, so it was decided to brief the press on scheduled events weeks in advance and cut down the scuttlebutt. There are all kind of activities at the base which will give intelligent people benchmarks and ways to judge what is going on.

[11] The recent shot is a case in point. NASA has never announced a date but the press watches Navy ships go to stations and astronauts' wives shifting to other quarters, and they come to conclusions which we are forced to agree to by maintaining silence.

Senator Bridges: Did we ever think of moving?

Dryden: Cape Canaveral belongs to Defense. We have test operations at Wallops Island for small shots. We have considered other locations, but moving in remote areas multiplies the costs, and they are prohibitive.

Senator Bridges: If we fail in this coming shot with publicity as tremendous as it has been, the results will be tragic.

Rubel: (Defense) Defense is working very closely with NASA. The plans which are being developed are the best which can be expected from several points of view. There are many elements in the Department of Defense which are involved, such as the R&D in DOD, Aerospace Corporation (AF), Englewood, California, and the military staff of the Air Force. They all have notions. We all have to put our heads together, and we're almost sure of our position now. [12]

Vice President: In your last report you promised more complete information by April 28th. I hope we can have that soon, and that it will tell us what the Department of Defense will need and will do.

Rubel: It should be ready by Monday, and very little will be omitted from the things we hoped to provide. About $100 million will be needed for 1962. This is the same as we estimated on April 20th but we now have the problem of justifying it for the BOB.

Vice President: (He gave a summary of previous executive meetings for the benefit of the Senators.) Boiled down, it appears that the President should be asked to expand the total program from an estimated $22 billion to be spent in ten years to $33 billion in ten years. As a part of this, $509 million would be added for FY 1962. The Eisenhower budget provided for $2.015 billion for all purposes. The Kennedy add-ons amount to $308 million, a total of $2.323 billion, with a new request for about $600 million, The new total for FY 1962 will be about $3 billion. Now quickly we must get our figures necessary on the recommendations we wish to make on a national effort and then let the BOB decide what part of it is justifiable in the light of overall national needs. [13]

Brown (AEC): He was in total agreement with NASA, and hoped that the $509 million estimate would include the AEC tie-in agreements on their targets with NASA, but he learned that this portion of the $182 million requested of the President had been turned down without prejudice to reconsideration later. He considered it most important to get target dates fixed for these major efforts. The present budget does not provide AEC with what it needs for any new targets. For that purpose we would have to put back in what AEC needed in the $308 million request. Their needs are not reflected in the $509 million request.

Webb: The figures we have show the principal use by AEC of funds after FY 1970. The AEC budget would need to be reconsidered only if we want to go ahead all across the board. Frankly, in order to get some of the other things done on new schedules, perhaps we can't handle the AEC request.

Vice President: We may have to come to that but let's come to that later. This meeting is not for the purpose of making such decisions. The last decision by the President involved a bite which he could take, chew, and swallow at that time. He might now be ready for the next bite, and it's up to us to be prepared with the facts and the estimate. [14]

Webb: It doesn't appear that we can do everything at the same time and to the extent that we find a conflict of objectives, these must be resolved in the national interest.

Vice President: We won't be able to set national objectives until you are sure and you make recommendations. The President won't be able to act for more than a month if that's when you will be ready to advise him. If the program that is ultimately devised is astronomical in cost, we can be sure that it will have to be tailored.

Hansen (BOB): If we all work together in the development of space plans and projects, we can approach them with confidence. The BOB can be depended upon to stay with you and accept and approve budget plans that are justified, in the overall national interest.

Senator Bridges: While the things you are talking about may all be true, if we were to have a war, things would just have to be different. We can start on the basis that we are here to discuss them, but we must realize that war would mean a complete reorganization of the national plans and space programs. [15]

Cook: The agencies here represented know what they are doing and they know that they have to have the right people doing the proper jobs. And like all good soldiers, having made recommendations, we have to take the decision and work with it all together. First a program should be laid out in terms of objectives, then the policy determination should be made, the funds provided and schedules fixed and adhered to.

Vice President: In order to catch up on what has been going on recently, it is suggested that everyone here obtain copies of the testimony which Dr. Welsh in hearings before the Space Committees of the House and the Senate on the amendment to the NASA Act. In reading this testimony along with the changes, one can get a good understanding of the new responsibilities of the new Space Council and also obtain an insight on Dr. Welsh's plans for the Space Council staff and staff activities.

Stanton (CBS): Setting aside for a moment comments on publicity about the imminent space shot and the public image –

With ignorance as to policy needs and further need for briefing on scientific and military requirements, it's difficult for a businessman to [16] set aside his desire to go ahead and get things done. There are times, however, when the scientists want to go deeper into the problem before they start concrete action, and it creates the need for critical examination of the whole problem in the national interest.

Vice President: Do the NASA scientists want to go into this matter to a point that would increase the $509 million estimate?

Dryden: Yes. This, however, is principally in field centers where they usually want more than we in the national office consider reasonable in the interest of program direction.

Stanton: Our interest in the future depends upon being first in science. If a moon shot is judged to be expedient, we should press on. We don't have to be concerned about national support if wise men have decided upon the action necessary in the national interest.

Dryden: To do a moon shot will tax everyone involved to the limit and all along the way there will have to be trial, error, and correction.

Stanton: To get national support, we must give now consideration to this matter of the "goldfish bowl." This was the highlight of the President's [17] talk to the American Newspaper Publishers Association. We can't go on doing as we have in the past. We must be particularly careful about publicizing failures that have the effect of dropping national support. Every good laboratory has its failures, but this isn't generally understood by the public, and there are times when it is far better that we keep quiet.

Hansen: We know now that the USSR is going to be ahead of us for a time. Therefore anything that we do they will attempt to ridicule. We must give our people the best information we have because the absence of complete information is worse when you have some failures and your people are not prepared for them. It is far better to be frank if you want to get full support. We need some aggressive leadership to sell the people that we are going about this in the right way.

Webb: This is really a new frontier. We are up against some hostile voices in the unknown. We really need 50 shots to try things out in an orderly way, but we have to boil this all down to a lot fewer and if we announce each of them, a lot will be riding on every test. Mr. Stanton can help by keeping the focus on our accomplishments, but we certainly ought to avoid broadcasting our objectives. [18]

Stanton: It would be most desirable to put all of the information in the right frame in order properly to get public support and keep public opinion moving in the direction you want it to follow.

(Senators and members of the Committee staffs left at this point.)...

[19] Webb: This whole issue is made complicated by a great many different factors. We mustn't forget that there are many foreign people involved. We have networks of stations all over the free world and they all have to know what we're doing and when we're doing it. Then there are the scientists. It's hard to control the minds of such men. As a matter of fact, we have to remember that we are fighting for men's minds.

Farley: (State) State is somewhat concerned both about the public reaction at home, and foreign reaction. There must be some way that we could cut down publicity and make it all look like a bleacher stunt. There are many things we can do to build up our dignity. We're developing a program to meet the USSR all around the world. By 1967 or 1968 we must get out of second place. If in the meantime we can do some thing that is concrete like the establishment of a communications network by means of satellites and show the free world a program from which they will benefit, we will advance U.S. interests all along the line. We ought to set our goals as soon as possible for the communications network and the supply of weather information from our satellites just as soon as possible. It appears that the communications network is the best short range target.

George Brown: Experience proves that when one pinpoints a long range program, you get things done all along the way. The products that come out at short [20] range are automatic. We shouldn't forecast each of our steps for the USSR. When we do, we can be sure that they will find some way to cover or blank out our desired publicity.

Webb: The previous Administration asked for bids on the communications satellite. Seven were received and we are taking two weeks to evaluate them. We understand that Bell is going ahead with its plans whether or not it gets the award. FCC has a big part of the control in this project. It started its hearings on the 1st of May and promised to give a ruling within 4 to 6 weeks. There are certain military requirements and therefore some reservations about the use of these communications satellites. The expense of this project is somewhat in doubt and the House is calling for hearings before we are ready to talk. Nevertheless we ought to be ready to run an experiment across the Atlantic by mid-1962. We have the Tiros now and the Nimbus to come in 1962. If the AT&T is successful, they have stated that they would have an operational prototype ready by Christmas and be ready to shoot early next year.

Cook: Isn't it better for the public to know what it has to face? Isn't it possible that spoon-feeding and disclosures of something less than full frankness will result in casting doubts on the leadership of the program? [21]

Vice President: Serious consideration is being given to having the President in a message put this whole matter right out on the table and explain it, but before he does this we will see that all of the pros and cons are taken into account.

Each of the men at this conference is requested to prepare a page or a page and a half paper on what our nation space effort should be. Let's define the goals. Your judgment and what you will have to say will not be charged against you. If you will each use your brains [and others theirs] we will add the ideas all together and get a good product. In other words, let's have a short paper by Monday to tell me what you think. Our objectives should be, what we should do [I don't need it from Webb. I have his.]

I assume that Webb will be burning the midnight oil to firm up the outlines of two weeks ago and get the BOB to agree. The President has read the interim memo and asked questions about it. He is keeping in very close touch with changing events. Everyone involved should get details to the BOB and get their justifications confirmed because June 30th is coming and we've got to have it all done. We have to try all sorts of things and in doing that, we'll get something like we want on each of them.

Should we give some thought to having the President enlist peoples' support in our program honestly explaining that there will [22] be limited information? Can we put emphasis on the announcements of our success and in doing so, call it "running gear" and then say that we need $500 million more to use that "gear?" No one is going to be pinned down when he expresses his best judgment. We must hope for the best, but be ready to accept the inevitable. So far NASA has gotten everything it has asked for. I want them to plan and dream big enough to get us out ahead. (Story of electricity for rural Texas). I want to know what the national effort should be in your judgment. By working together, we will achieve the national goal.

Document III-11

Document title: James E. Webb, NASA Administrator, and Robert S. McNamara, Secretary of Defense, to the Vice President, May 8, 1961, with attached: "Recommendations for Our National Space Program: Changes, Policies, Goals."

Source: NASA Historical Reference Collection, History Office, NASA Headquarters, Washington, D.C.

This memorandum is the charter for Project Apollo and for an across-the-board acceleration of U.S. space efforts. It was the hurried product of a weekend of work following the successful suborbital flight of the first U.S. astronaut on Friday, May 5, 1961. The urgency was caused by the vice president's desire to get recommendations to the president before he left on a rapidly arranged inspection tour to Southeast Asia. NASA, the Department of Defense, and the Bureau of the Budget staffs and senior officials met on Saturday and Sunday at the Pentagon to put together the memorandum, which the vice president approved without change and delivered to the president on Monday, May 8. On that same day, Alan Shepard came to Washington for a parade down Pennsylvania Avenue and a White House ceremony with President Kennedy.

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8 May 1961

Dear Mr. Vice President:

Attached to this letter is a report entitled "Recommendations for Our National Space Program: Changes, Policies, Goals", dated 8 May 1961. This document represents our joint thinking. We recommend that, if you concur with its contents and recommendations, it be transmitted to the President for his information revised and expended objectives which it contains.

Very respectfully,
James E. Webb
Administrator
National Aeronautics and
Space Administration
Robert S. McNamara
Secretary of Defense...

[1] **Introduction**

It is the purpose of this report (1) to describe changes to our national space efforts requiring additional appropriations for FY 1962; (2) to outline the thinking of the Secretary of Defense and the Administrator of NASA concerning U.S. status, prospects, and policies for space; and (3) to depict the chief goals which in our opinion should become part of Integrated National Space Plan. These matters are covered in Sections I, II, III, respectively.

Three appendices (Tabs A through C) support these sections. Tab A highlights the Soviet space program. The bulk of this Tab (Attachment A) is separated from this report since it bears a special security classification. Tab B includes a description of major U.S. space projects and elements. Tab C provides financial summaries of the present programs, the proposed add-ons, and future costs of the program.

The first joint report contains the results of extensive studies and reappraisals. It is a first and not our last report and does not, of course, represent a complete or final word about our space undertakings.

[2] I. **RECOMMENDATIONS FOR FY-1962 ADD-ONS**

Our recommendations for additional FY 1962 NOA for our space efforts are listed below. They total $626 Million of which all but $77 million is for NASA. Certain of these additions will accelerate projects which need to be accomplished more quickly if national space goals are to be reached on time. Other additions augment projects or programs to afford greater likelihood of success or to acquire concurrently data needed to implement long range goals for which we would otherwise have had to wait. Some of the additions, especially those for rocket engine, booster, and upper stage developments, support parallel programs to insure that the failure or delay in a single launch vehicle development will not place our long range goals in jeopardy. It is our belief that it is feasible to accomplish those objectives of acceleration, augmentation and greater certainty of success through the application of the funds specified. The general objectives of acceleration, augmentation and greater certainty of success through the application of the funds specified. The general objectives and their implementation in each particular case are amply supported by the investigations and assessments of qualified scientific and technical people intimately familiar with our space undertakings in detail and in the large.

These FY 1962 additions represent a vital first stage funding toward implementing longer range goals, including the objective of manned lunar exploration in the latter part of this decade, specified in Section III. They will, we believe, prove to be consistent with the objectives and policies set forth in Section II.

a. **Spacecraft for Manned Lunar Landing and Return**

To achieve the goal of landing a man on the moon and returning him to earth in the latter part of the current decade requires immediate initiation of an accelerated program of spacecraft development.

The program designated Project Apollo includes initial flights of a multi-manned orbiting laboratory to qualify the [3] spacecraft, and manned flights around the moon before attempting the difficult lunar landing.

The additional funds required will be used to extend tests with the Mercury spacecraft to learn more about the behavior of man during longer duration flights in space, to study the biomedical problems encountered in outer space, to investigate the problems of reentering the earth's atmosphere from lunar return speeds, to initiate the development of the multi-manned spacecraft for the mission, and for ground tracking and other facilities.

	APPROVED BUDGET	RECOMM. BUDGET	ADD'AL
FUNDS:	29.5M	240.0M	210.5M

b. **Launch Vehicle Development**

1. *For the manned lunar landing*

The advanced goal of manned landing on the moon requires the development of a launch vehicle (Nova) with a thrust of about six times greater then that of the largest vehicle now under development (Saturn). The funds requested are to accelerate the development of 1 1/2 million pounds thrust liquid fueled rocket engine now under development; for design, engineering, and component development of the Nova vehicle; and to initiate the construction of necessary facilities required in support of the vehicle development and test.

	APPROVED BUDGET	RECOMM. BUDGET	ADD'AL
FUNDS:	42.7M	155.2M	112.5M

2. *Solid propellant parallel approach*

To assure a high degree of success in achieving the manned lunar landing goal a parallel approach to the development of a first stage for the large launch vehicle (NOVA) must be undertaken. In addition to the use of liquid fuels for this purpose we must also undertake the immediate development of large solid rocket launch vehicles. When developments in both liquid fueled and solid fueled rockets have [4] progressed to a stage where one or the other can be shown to be the superior approach, it will be pursued as the principal launch vehicle development. Certain elements of the solid rocket development are also believed to have future military importance. The DoD will be responsible for this development, being fully responsive to NASA requirements.

	APPROVED BUDGET	RECOMM. BUDGET	ADD'AL
FUNDS (DoD):	-0-	62M	62M

c. **Development of An Upper Stage for Titan II**

The Atlas-Agena combination is the most powerful launch vehicle available to the

U.S. until the Atlas-Centaur becomes operational in 1963. The Atlas-Agena cannot place more then 5,000 pounds in the 300-miles orbit. The Atlas-Centaur, if successful, will be capable of launching as much as 8,500 pounds.

Because of an urgent need by both DoD and NASA of a vehicle with the performance of Atlas-Centaur, a back-up for this launch vehicle is considered essential. Therefore it is proposed to initiate development of an upper stage for Titan II which will then provide a strong back-up for the Atlas-Centaur. The Titan II upper stage development will be terminated if the timely success of Atlas-Centaur becomes apparent.

	APPROVED BUDGET	RECOMM. BUDGET	ADD'AL
FUNDS (DoD):	-0-	15M	15M

d. **Unmanned Lunar Exploration**

Before attempting a manned lunar landing, it is essential to learn more about the phenomena that exist in space near the moon and about the nature of the characteristics of the moon's surface. The programs now underway, designated Ranger and Surveyor, are designed to provide this information. With additional funds, the number of fights in these programs will be increased and the program will be accelerated to provide timely information and greater assurance.

[5]

	APPROVED BUDGET	RECOMM. BUDGET	ADD'AL
FUNDS:	71.67M	134.67M	63.0M

e. **Scientific Experiments on Space Environment**

Knowledge of the space environment through which man must travel to the moon is now still very meager. The nature and characteristics of the radiation emanating from the sun and from outer space must be thoroughly studied and understood. Man's ability to survive in outer space and on the surface of the moon depends on this knowledge. The additional funds will augment and expedite current programs that will provide this information.

	APPROVED BUDGET	RECOMM. BUDGET	ADD'AL
FUNDS:	72.2M	87.2M	15.0M

f. **Satellite Communications Systems**

With the launching of the Echo and Courier communications satellites, the United States achieved a position of leadership in the use of satellites for worldwide communications. Studies by many qualified organizations have shown the potential economic, political and military value of these systems. The funding requested will accelerate the developments, lead to a much earlier availability of an operational system, and maintain the United States position of leadership

	APPROVED BUDGET	RECOMM. BUDGET	ADD'AL
FUNDS:	44.6M	94.6M	50.0M

g. **Meteorological Satellites for Worldwide Weather Prediction***

The outstanding success demonstrated by the U.S. Tiros weather satellite in worldwide weather prediction will enable the U.S. to exploit this technology for the benefit of

*The Department of Commerce is considering the request of an additional 53.5M in FY62 to initiate an operational meteorological satellite system.

all mankind. [6] Developments are now under way which will lead to operational systems. To assure success of an operational system at the earliest time it is necessary to augment the funding of this program by the amount shown below.

	APPROVED BUDGET	RECOMM. BUDGET	ADD'AL
FUNDS:	28.2M	50.2M	22.0M

h. **Nuclear Rocket Development***

Nuclear rocket development (Rover) must be carried out on an accelerated basis because of its great potential for even more difficult missions than landing a man on the moon. This program faces many difficult technological problems which will require substantial support over a number of years for their solution. The funding will provide for augmented research and development and essential facilities for the conduct of the program.

	APPROVED BUDGET	RECOMM. BUDGET	ADD'AL
FUNDS:	17.5M	40.5M	23.0M

i. **Supporting Research and Technology**

The successful accomplishment of the accelerated program goals requires immediate expansion of basic researches and advances in technology in many fields. For the conduct and management of this major effort some additional increase in the NASA staff will also be required. Requirements for the additional research, advancement of technology and support of personnel and plant are shown below.

	APPROVED BUDGET	RECOMM. BUDGET	ADD'AL
FUNDS:	393.5M	446.5M	53.0M

[7] II. **NATIONAL SPACE POLICY**

The recommendations made in the preceding Section imply the existence of national space goals and objectives toward which these and other projects are aimed. Major goals are summarized in Section III. Such goals must be formulated in the context of a national policy with respect to undertakings in space. It is the purpose of this Section to highlight our thinking concerning the direction that such national policy needs to take and to present a backdrop against which more specific goals, objectives and detailed policies should, in our opinion, be formulated.

a. **Categories of Space Projects**

Projects in space may be undertaken for any one of four principal reasons. They may be aimed at gaining scientific knowledge. Some, in the future, will be of commercial or chiefly civilian value. Several current programs are of potential military value for functions such as reconnaissance and early warning. Finally, some space projects may be undertaken chiefly for reasons of national prestige.

The U.S. is not behind in the first three categories. Scientifically and militarily we are ahead. We consider our potential in the commercial/civilian area to be superior. The Soviets lead in space spectaculars which bestow great prestige. They lead in launch vehicles needed for such missions. These bestow a lead in capabilities which may some day become important from a military point of view. For these reasons it is important that we take steps to insure that the current and future disparity between U.S. Soviet launch

*The Atomic Energy Commission has requested an additional 7M in FY62 to support the reactor portion of the Nuclear Rocket Development Program.

capabilities be removed in an orderly but timely way. Many other factors however, are of equal importance.

b. **Space Projects for Prestige**

All large scale space projects require the mobilization of resources on a national scale. They require the development and successful application of the most advanced technologies. They call for skillful management, centralized control and unflagging pursuit of long range [8] goals. Dramatic achievements in space, therefore, symbolize the technological power and organizing capacity of a nation.

It is for reasons such as these that major achievements in space contribute to national prestige. Major successes, such as orbiting a man as the Soviets have just done, lend national prestige even though the scientific, commercial or military value of the undertaking may by ordinary standards be marginal or economically unjustified.

This nation needs to make a positive decision to pursue space projects aimed at enhancing national prestige. Our attainments are a major element in the international competition between the Soviet system and our own. The non-military, non-commercial, non-scientific but "civilian" projects such as lunar and planetary exploration are, in this sense, part of the battle along the fluid front of the cold war. Such undertakings may affect our military strength only indirectly if at all, but they have an increasing effect upon our national posture.

c. **Planning**

It is vital to establish specific missions aimed mainly at national prestige. Such planning must be aimed at both the near-term and at the long range future. Near-term objective alone will not suffice. The management mechanisms established to implement long range plans must be capable of sustained centralized direction and control. An immediate task is to specify long-range goals, to describe the missions to be accomplished, to define improved management mechanisms, to select the launch vehicles, the spacecraft, and the essential building blocks needed to meet mission goals. The long-term task is to manage national resources from the national level to make sure our goals are met.

It is absolutely vital that national planning be sufficiently detailed to define the building blocks in an orderly and integrated way. It is absolutely vital that national management be equal to the task of focusing resources, particularly scientific and engineering manpower [9] resources, on the essential building blocks. It is particularly vital that we do not continue to make the error of spreading ourselves too thin and expect to solve our problems through the mere appropriation and expenditure of additional funds.

d. **Feasibility**

It is technically feasible to match and surpass the Soviets in all areas of national space competition whether scientific, commercial, military or in the area of national prestige. Certain steps need to be undertaken right away. Those requiring additional appropriations in FY 1962 were described in Section I.

Additional important actions have also been defined. They include the necessity to specify standardized "work horse" building block combinations to support our space efforts for the long pull. It is particularly important to define building block combinations of boosters and upper stages for each major class of payload and mission. Conversely, it is important to avoid wherever possible the creation of complex and costly launch vehicles and other equipments optimized for and largely limited in application to a single project or mission. This principle has been recognized and applied to portions of our launch-vehicle developments. It has not been applied to all. It must govern all our efforts in the future. Major sub-elements including guidance systems, control systems, power supplies, telemetry, recovery and other basic system elements must also be standardized and used repetitively to the maximum possible degree.

After fully adequate study we must specify the minimum family of launch vehicle systems that will enable us to accomplish both near term (such as communication satellites) and long range missions (such as lunar or planetary exploration) which will comprise our national space goals.

If properly conceived and designed the vehicles will be used for many years in dozens and perhaps hundreds of costly missions. Their development and procurement will involve the expenditure of billions of [10] dollars over a period of a decade or more. It is essential that we set out [our] foot on the correct path kneading to the future. The decisions made in the beginning will define that path. Once embarked upon it, we cannot turn back or turn aside without losing time which can never be regained.

e. **Background Information Bearing on the Problem**

These words would not be written and this report would not be called for if we were satisfied with our status and our prospects for the future in space. We are not satisfied. We are behind in important ways and it is not clear that we are catching up. In reading the balance of this report, it is important to have in mind some of the highlights of space history, of our posture today, and of our prospects for the future. It is important to realize that more money is not the only answer. While considerable additional effort will be called for, a principal problem is how better to harness, not merely how further to expand, the human and physical resources already at hand.

It is important to note that the recent Soviet attainments are the result of a program planned and executed at the national level over a long period of time. The decisions which led to the current successes were, for the most part, made many years ago. Many of them, in fact, must have been made in the early part of the 1950-1960 decade.

That decade has witnessed a great expansion in U.S. government-sponsored research and development, especially for large-scale defense programs. Enormous strides have been made, particularly in our space efforts and in the development of related ballistic missile technology on a "crash" basis. We have, however, incurred certain liabilities in the process. We have over-encouraged the development of entrepreneurs and the proliferation of new enterprises. As a result, key personnel have been thinly spread. The turnover rate in U.S. defense and space industry has had the effect of removing many key scientific engineering personnel from their jobs before the completion of the projects for which they were employed. Strong concentrations of technical talent needed for the best [11] work on difficult tasks have been seriously weakened. Engineering costs have doubled in the past ten years.

These and other trends have a strong adverse effect on our capacity to do a good job in space. The inflation of costs has an obvious impact and they are still rising at the rate of about seven per cent per year. This fact alone affects forward planning. It has often led to project stretch-outs, and may again in future years. The spreading out of technological personnel among a great many organizations has greatly slowed down the evolution of design and development skills at the working level throughout the country. Precisely the opposite is true in the USSR, where the turnover rate is very low and where skilled cadres of development personnel remain in existence for a great many years.

It is not suggested that we apply Soviet type restrictions and controls upon the exercise of personal liberty and freedom of choice. It is suggested, however, that our American system can be and must be better utilized in the future than in the past.

Our space efforts, like many of our military weapons developments, have suffered because of our tendency to "improve" and to embellish our designs. We have allowed ourselves to strive for the optimum solution to nearly every problem project-by-project. We have often tried to "integrate" very complex system elements at minimum weight and with very little margin for safety or for error. Many have come to think that such techniques are the natural and obvious way to get jobs done. They are not, they will not succeed and they must be changed.

We must address ourselves to these problems more effectively in the future than in the past. We must create mechanisms to lay out and to insist upon achievement, not mere improvement. We must stress performance, not embellishment. We must insist from the top down, that, as the Russians say, "the better is the enemy of the good."

[12] f. **Summary**

Clearly, then, the future of our efforts in space is going to depend on much more than this year's appropriations or tomorrow's new idea. It is going to depend in large measure upon the extent to which this country is able to *establish and to direct* an "Integrated National Space Program."

True, it will be necessary to support our space efforts at a higher funding level than recommended before. Such support will have to be backed by the Administration, by the Congress, and by the American people. If, however, the application of more money leads to still further cost increases and still further thinning out of technical manpower and technical supervision, it is likely that the Russians will be ahead of us ten years from now just as they are today.

It will be necessary, therefore, to find a way to formulate and apply plans and policies aimed at insuring the success of an Integrated National Space Program. Top level scientific and policy direction must be forthcoming from the top management echelon. The mere statement of broad objectives will not be good enough. Periodic budget reviews and their intensification in the spring of each year will not suffice. It will be necessary to impose policy and management actions which will alter many of the trends of the past ten years, particularly in the management of research and engineering resources on a national scale. It will be necessary to impose actions which may involve painful cancellations and redirections.

These and other policies, too, must be supported by the Administration, by the Congress, and by the American people to insure success for the long pull ahead.

Our joint efforts are addressed to the creation of management tools to deal with these and other problems we will face in the years ahead.

[13] III. **MAJOR NATIONAL SPACE GOALS**

It is the purpose of this section to outline some of the principal goals, both long range and short range, toward which our national space efforts should, in our opinion, be directed. It is not the intent to specify all of the goals or even all of the major goals of importance to a National Space Plan. We wish to stress five principal objectives which in our opinion have not been adequately formulated or accepted in the past and which we believe should be accepted as a basis for specific project undertakings in the years ahead.

a. **Manned Lunar Exploration**

We recommend that our National Space Plan include the objective of manned lunar exploration before the end of this decade. It is our belief that manned exploration to the vicinity of and on the surface of the moon represents a major area in which international competition for achievement in space will be conducted. The orbiting of machines is not the same as the orbiting or landing of man. It is man, not merely machines, in space that captures the imagination of the world.

The establishment of this major objective has many implications. It will cost a great deal of money. It will require large efforts for a long time. It requires parallel and supporting undertakings which are also costly and complex. Thus, for example, the RANGER and SURVEYOR Projects and the technology associated with them must be undertaken and must succeed to provide the data, the techniques and the experience without which manned lunar exploration cannot be undertaken.

The Soviets have announced lunar landing as a major objective of their program. They may have begun to plan for such an effort years ago. They may have undertaken important first steps which we have not begun.

It may be argued, therefore, that we undertake such an objective with several strikes against us. We cannot avoid announcing not only our general goals but many of our specific plans, and our successes [14] and our failures along the way. Our cards are and will be face up—their's are face down.

Despite these considerations we recommend proceeding toward this objective. We are uncertain of Soviet intentions, plans or status. Their plans, whatever they may be, are not more certain of success than ours. Just as we accelerated our ICBM program we have accelerated and are passing the Soviets in important areas in space technology. If we set our sights on this difficult objective we may surpass them here as well. Accepting the goal gives us a chance. Finally, even if the Soviets get there first, as they may, and as some think they will, it is better for us to get there second than not at all. In any event we will have mastered the technology. If we fail to accept this challenge it may be interpreted as a lack of national vigor and capacity to respond.

b. **Worldwide Operational Satellite Communication Capability**

It is our belief that advances in technology will make it possible to set up an operational satellite-based telecommunications capability within a few years. It is too early to be sure what kind of capability we should create.

We *are* certain, however, that at least one of several current possibilities is very likely to prove successful and practical. We are also confident that an operational communication satellite capability can have far reaching applications and implications for the U.S.

Many commercial enterprises in this country have displayed great interest in this subject. It is virtually certain that communication satellites will have commercial utility in future years. The Department of Defense is keenly interested in view of its large use of commercial capacity and is also undertaking the development (Project ADVENT) of a satellite aimed principally at fulfilling military requirements.

Finally and perhaps most important of all, communication satellites uniquely provide a way of relaying information from one point [15] to another over great distances. A successful global satellite-based communication system may be looked upon somewhat as an overhead cable thousands of miles in the air to which users all over the world may make connections by means of invisible radio beams.

Accordingly, we have recommended that the NASA Communication Satellite effort be expanded in FY 1962. Within the next few years this country which is already the world's leader in communications of all kinds will be able to deploy a worldwide satellite-based communication capability.

c. **Worldwide Operational Satellite Weather Prediction System**

The TIROS I meteorological satellite operated for several months, transmitting pictures of cloud cover around the world. TIROS II, launched last November, is still transmitting cloud pictures and infra-red data. The Weather Bureau, the NASA, and other interested governmental agencies are closely coordinating their interests with respect to TIROS and follow-on meteorological satellites. A worldwide system of such satellites will be of great value to people in every country, to public and private interests in the U.S., and to our military forces, particularly those at sea and in the air. The addition of $22 million in FY 1962 will accelerate the early attainment of preliminary operational capability.

d. **Scientific Investigation**

Fundamental to and underlying all progress in the exploration and application of space is the knowledge to be gained from the space sciences. It is essential that the national space sciences program be broad and comprehensive both in content and in participation by the scientific community of the world.

Before man can explore in the vast and hostile regions of space more knowledge is required on the effects of hard vacuum, weightlessness, and radiation.

The broad program that is recommended includes the following objectives:

[16] — To understand the nature of the sun and its influence on the earth.

— To investigate the solar system, its nature, and its history.

— To search for life in the solar system.

— To study cosmology, the history and nature of the universe.

Researchers in government laboratories, universities, industry, and other scientific organizations must participate in the space sciences effort and the space science program should support not only the existing talent but also the development of new talent. This requires support of universities in the education of the young scientists who are inspired by the challenge of space and who will strengthen the program with their vitality and new ideas.

For the fiscal year 1962 we recommend adding fifteen million dollars to the program to assure success of these objectives.

e. **Large Scale Boosters for Potential Military Use**

Space technology is in its infancy. The first U.S. satellite was launched only 3-1/2 years ago. Vast resources are presently devoted to this field in the Communist world and in our own. The future potentialities and capabilities that space technology will afford cannot be foreseen. Their military potential and implications are largely unknown. It is certain, however, that without the capacity to place large payloads reliably into orbit, our nation will not be able to exploit whatever military potential unfolds in space.

We believe it is important, therefore, to insure that large scale boosters are made available. They should, of course, form part of a family of launch vehicles applicable to many missions and thoroughly integrated with NASA developments and with characteristics suitable for NASA needs.

We have agreed jointly in recommending the addition of $62 million for the DoD in FY 1962 to undertake the development of large scale solid propellant rocket motors.

[17] TAB A: **THE SOVIET PROGRAM AND CAPABILITIES**

Attachment A depicts the Soviet space program in considerable detail. It is separated from this report for security reasons, but it should be read by the key policy makers concerned with the U.S. space program. It should be read not only because of what it tells about the Soviet program in space, but for what it reveals concerning the caliber of the competition we are up against in this important arena of the cold war.

Attachment A reveals a set of Soviet undertakings and achievements of enviable simplicity and unmatched success. With the possible exception of the first two launchings, a single ICBM booster has been used on all Soviet space shots. A small family of intermediate and final stages has been combined to form a total of only three different configurations. The Soviets have placed only 14 space craft into orbit around the earth, the moon, or elsewhere in the planetary system.

The Soviets have employed a single launch complex for all ICBM and space launchings. All shots have been made in the same direction whether for ICBM testing, earth-orbit missions (including man in space), or lunar and deep space missions. These features of the Soviet program evidence long-range planning which in all probability began early in the 1950-1960 decade.

The U.S. did not undertake a corresponding planning effort at the national level until much later. Space was not recognized as an area of importance to be planned for and pursued until after Sputnik I. Great efforts were then made to utilize the tools at hand to enter the space arena. Early projects were undertaken on a crash basis. New governmental and industrial organizations were formed and expanded under pressure and in haste. For several years it was necessary to "make do" with too-small boosters and launch vehicles employing devices developed and deployed with unusual urgency. However dedicated or effective such efforts were, they were not the product of a deliberate effort adhering to preplanning schedules and objectives.

[18]The U.S. space program in the past three years reflects this situation in many ways. We have been forced to design with inadequate margins for error or deficiencies in thrust. We have been forced to develop elaborate and often unreliable new ways to cram complex equipments in a very small space. Our results have, despite many excellent achievements, been disappointing in many important ways. Nearly half of our attempted launchings failed to achieve orbit. Certain programs achieved success, real success, on fewer than a third of all attempts. To a large degree, though not entirely, of course, these disappointments are symptoms of the lack of adequate national planning and guidance for the long pull.

It is possible, of course, that the Soviet program is not actually the result of careful planning toward long range goals. It may only appear that way in retrospect. It is possible, too, that Soviet management and decision making is not as excellent as it appears to date. Perhaps the poverty of their resources forced concentration on a brute force approach which paid off not as the result of initiative and forethought but through the force of circumstances which left no other choice. Perhaps luck played an important part at an early stage and the Soviets were wise enough and swift enough to exploit it far beyond any initial long range plan.

These are conjectures. The evidence points dramatically to the existence of long range planning and competent and flexible technical decision making and managerial direction. It is prudent to suppose that the next decade will be marked with Soviet achievements in space which will be well planned, well directed, and executed with deliberateness and skill.

Attachment A indicates the manner in which we can estimate key milestones of the future of the Soviet program by extrapolating our present knowledge. Doubtless, the Soviet plan is not irrevocably fixed and includes options and decision points which will enable them to pace their achievements in relation to ours and to Soviet national objectives....

[27] Tab C

SPACE ACTIVITIES OF THE UNITED STATES GOVERNMENT
New Obligational Authority/Program Basis—in millions

Historical Summary and Proposed 1962 Add-ons

	NASA[1]	Defense[2]	AEC[3]	NSF[4]	WB[5]	Total
1955	$ 56.9	$ 3.0	-	-	-	$ 59.9
1956	72.7	30.3	$ 7.0	$7.3	-	117.3
1957	78.2	71.0	21.3	8.4	-	178.9
1958	117.3	205.6	21.3	3.3	-	347.5
1959	338.9	489.5	34.3	-	-	862.7
1960	523.6	560.9	43.3	.1	-	1,127.9
1961	964.0	751.7	62.7	.6	-	1,779.0
1962 Budget . .	1,109.6	846.9	55.1	1.6	$2.2	$2,015.4
Budget amendments	125.7	159.0	23.5	-	-	308.2
Total present 1962 Budget	1,235.3	1,005.9	78.6	1.6	2.2	2,323.6
Proposed 62 Add-ons	549.0	77.0	7.0[6]	-	53.0[7]	686.0
Total 1962 Proposals	$1,784.3	$1,082.9	$85.6	$1.6	$55.2	$3,009.6

1. National Aeronautics and Space Administration amounts are totals for all activities of NASA and include totals for NACA prior to establishment of NASA.

2. Department of Defense amounts are based on identifiable Defense funding for space and space-related effort and do *not* include substantial amounts for (1) construction and operation of the national missile ranges with regard to space programs, (2) the cost of developing missiles such as Thor and Atlas which are also used in space programs, or (3) supporting research and development (such as bio-medical research) which is more or less mutually applicable to programs other than "space."

3. Atomic Energy Commission amounts are those identifiable with ROVER nuclear rocket and SNAP atomic power source projects.

4. National Science Foundation amounts are those identifiable with VANGUARD and with the NSF space telescope project.

5. Weather Bureau amounts are those identifiable with the meteorological satellite program.

6. AEC add-on for ROVER corresponding to the $23 million included in proposed NASA add-ons.

7. Add-on for initiation of operational NIMBUS system under consideration by Department of Commerce.

[28]

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
FY 1962 BUDGET AND PROPOSED ADD-ONS

(In Millions)

	Original 1962 Budget	1962 Budget Amendment	Present 1962 Budget	Proposed 1962 Add-ons	Total 1962 Proposed
I. Major Vehicle & Propulsion Dev. Projects					
A. Centaur	$ 49.8	$ 25.6	$ 75.4	-	$ 75.4
B. Saturn	212.8	73.0[1]	285.8	-	285.8
C. Rover (NASA only)	13.5	4.0	17.5	$ 23.0[4]	40.5
D. F-1 Engine and Nova Vehicle	33.4	9.3	42.7	112.5	155.2
E. Large Solid Boosters	2.0	-	2.0	-	2.0
F. Other Projects	6.6	-	6.6	-	6.6
II. Major Space Flight Programs					
A. Mercury	74.2	-	74.2	-	74.2
B. Other Manned Space Flight	29.5	-	29.5	210.5	240.0
C. Meteorology	28.2	-	28.2	22.0	50.2
D. Communications	34.6	10.0	44.6	50.0	94.6
E. Scientific Satellites & Sounding Rockets	72.2	-	72.2	15.0	87.2
F. Unmanned Lunar Exploration	71.7	-	71.7	63.0	134.7
G. Unmanned Planetary Exploration	32.2	-	32.2	-	32.2
III. Supporting Development and Operations					
A. NASA Development Centers & Launch Operations	164.0	3.0[2]	167.0	28.0[5]	195.0
B. Tracking and Data Acquisition	60.2	-1.0	59.2	-	59.2
C. Other Supporting Development	57.7	-	57.7	25.0	82.7
IV. Aeronautical and Space Research	142.7	1.3[3]	144.0	-	144.0
V. Program Direction	24.3	.5	24.8	-	24.8
Total NASA	$1,109.6	$125.7	$1,235.3	$549.0	$1,784.3

[1] Total of $78 million identified with Saturn C-2 includes $5 million of supporting costs on line III-A.

[2] Consists of $5 million for support identified with Saturn C-2 less $2 million adjustment in other supporting costs.

[3] Consists of $2 million identified with the supersonic transport less $.7 million adjustment on a vivarium construction project.

[4] Would require corresponding add-on of $7 million for AEC.

[5] Part of this amount may be applied to IV and V.

[29]

DEPARTMENT OF DEFENSE SPACE AND RELATED PROGRAMS[1] FY 1962 BUDGET AND PROPOSED ADD-ONS

	Original 1962 Budget	1962 Budget Amendment	Present 1962 Budget	Proposed 1962 Add-ons	Total 1962 Proposed
DISCOVERER	$ 24.9	$ 30.0	$ 54.9	-	$ 54.9
SAMOS	282.2	-	282.2	-	282.2
MIDAS	147.6	60.0	207.6	-	207.6
TRANSIT	22.4	-	22.4	-	22.4
ADVENT	57.0	15.0	72.0	-	72.0
SAINT	12.0	14.0	26.0	-	26.0
SPACETRACK	34.0	-	34.0	-	34.0
SPASUR	4.3	-	4.3	-	4.3
BLUE SCOUT	5.0	10.0	15.0	-	15.0
WESTFORD	4.3	-	4.3	-	4.3
X-15	7.0	-	7.0	-	7.0
DYNASOAR (Step I)	76.5	30.0	106.5	-	106.5
Component development/ Applied Research/Other	169.7	-	169.7	-	169.7
Large Solid Booster	-	-	-	62.0	62.0
CENTAUR BACKUP	-	-	-	15.0	15.0
TOTAL DOD Space and Related Programs	$846.9	$159.0	$1,005.9	$77.0	$1,082.9

1. Covers identifiable DOD funding for space and space-related effort; does *not* include substantial amounts for (1) construction and operation of the national missile ranges with regard to space programs, (2) supporting research and development (such as bio-medical research) which is more or less mutually applicable to programs other than "space," and (3) the cost of developing missiles such as ATLAS and THOR which are also used in space programs.

[30] ESTIMATED PROJECTIONS OF N.A.S.A. and DEFENSE SPACE PROGRAMS (Excludes A.E.C., Weather Bureau, and N.S.F.)

New Obligational Authority/Program Basis—In Millions

	1962	1963	1964	1965	1966
BASE PROJECTIONS (Includes only (1) continuing programs and (2) major projects currently underway or approved for initiation in the amended 1962 Budget):					
N.A.S.A.	1235	1390	1275	1215	1070
Defense	1006	1300	1360	1475	1675
Total	2241	2690	2635	2690	2745
OTHER CURRENT PLANS (Projects which would be initiated in 1963 or later Budgets under current agency plans):					
N.A.S.A.	—	799	1051	1520	1595
Defense	************** NOT AVAILABLE **************				
Total	—	799	1051	1520	1595
TOTAL PROJECTIONS OF CURRENT AGENCY PROGRAMS:					
N.A.S.A.	1235	2189	2326	2735	2665
Defense	1006	1300	1360	1475	1675
Total	2241	3489	3686	4210	4340
INCREASED FUNDING REQUIREMENTS RESULTING FROM PROPOSED ADD-ONS:					
N.A.S.A.	549	785	1917	1917	1959
Defense	77	150	160	125	100
Total	626	935	2077	2042	2059
TOTAL PROJECTIONS OF PROPOSED PROGRAMS:					
N.A.S.A.	1784	2974	4243	4652	4624
Defense	1083	1450	1520	1600	1775
Total	2867	4424	5763	6252	6399

Document III-12

Document title: John F. Kennedy, Excerpts from "Urgent National Needs," Speech to a Joint Session of Congress, May 25, 1961.

Source: NASA Historical Reference Collection, History Office, NASA Headquarters, Washington, D.C.

This is the section of President Kennedy's "reading text" of his address to a Joint Session of Congress in which he called for sending Americans to the Moon "before this decade is out." President Kennedy in his own hand modified the prepared text of his remarks. The text as written, modified, and ultimately delivered varies considerably. Kennedy ad-libbed three additional paragraphs near the end of his speech.

Handwritten additions to the text are contained in brackets. Portions of the text that Kennedy crossed out are contained in parentheses.

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[63] IX. **Space**

Finally, if we are to win the battle for men's minds, [64] the dramatic achievements in space which occurred in recent weeks should have made clear to us all [as did the Sputnik in 1957] the impact of this new frontier of human adventure. Since early in my term, our efforts in space have been under review. With the advice of the Vice President [who is Chairman of the National Space Council] we have examined where we are strong and where we are not, where we may succeed and where we may not. Now it is time to take longer strides — time for a great new American enterprise — time for this nation to take a clearly leading role in space achievement [which in many ways may hold the key to our future on earth].

[65] I believe we possess all the resources and all the talents necessary. But the facts of the matter are that we have never made the national decisions or marshalled the national resources required for such leadership. We have never specified long range goals on an urgent time schedule, or managed our resources and our time so as to insure their fulfillment.

Recognizing the head start obtained by the Soviets with their large rocket engines, which gives them many months of lead-time, [66] and recognizing the likelihood that they will exploit this lead for some time to come in still more impressive successes, we nevertheless are required to make new efforts. For while we cannot guarantee that we shall one day be first, we can guarantee that any failure to make this effort will find us last. We take an additional risk by making it in full view of the world — but as shown by the feat of astronaut Shepard, this very risk enhances our stature when we are successful. But this is not merely a race. [67] Space is open to us now; and our eagerness to share its meaning is not governed by the efforts of others. We go into space because whatever mankind must undertake, *free* men must fully share.

I therefore ask the Congress, above and beyond the increases I have earlier requested for space activities, to provide the funds which are needed to meet the following national goals:

First, I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to earth. [68] No single space project in this period will be more (exciting or) impressive [to mankind as it makes its judgement of whether the world is free] or more important for the long-range exploration of space; and none will be so difficult or expensive to accomplish. (Including necessary supporting research, this objective will require an additional $531 million this year and still higher sums in the future.) We propose to accelerate development of the appropriate lunar space craft. We propose to develop alternate liquid and solid fuel boosters much larger than any now being developed, until certain which is superior. [69] We propose additional funds for other engine development and for unmanned explorations —explorations which are particularly important for one purpose which this nation will never overlook: the survival of the man who first makes this daring flight. But in a very real sense, it will not be one man going to the moon — it will be an entire nation. For all of us must work to put him there.

Second, an additional $23 million, together with $7 million already available, will accelerate development of the ROVER nuclear rocket. [70] This (is a technological enterprise in which we are well on the way to striking progress, and which) gives promise of some day providing a means for even more exciting and ambitious exploration of space, perhaps beyond the moon, perhaps to the very ends of the solar system itself.

Third, an additional $50 million will make the most of our present leadership by accelerating the use of space satellites for world-wide communications. When we have put into space a system that will enable people in remote areas of the earth to exchange messages, hold conversations, [71] and eventually see television programs, we will have achieved a success as beneficial as it will be striking.

Fourth, an additional $75 million — of which $53 million is for the Weather Bureau —will help give us at the earliest possible time a satellite system for world-wide weather observation. (Such a system will be of inestimable commercial and scientific value; and the information it provides will be made freely available to all the nations of the world.)

Let it be clear that I am asking the Congress and the country to accept a firm commitment to a new course of action — [72] a course which will last for many years and carry very heavy costs [531 million dollars this year] — an estimated $7-9 billion additional over the next five years. If we were to go only halfway, or reduce our sights in the face of difficulty, it would be better not to go at all. [this is the choice and finally you and the American public must decide for itself.]

Let me stress also that more money alone will not do the job. This decision demands a major national commitment of scientific and technical manpower, material and facilities, and the possibility of their diversion from other important activities where they are already thinly spread. It means a degree of dedication, [73] organization and discipline which have not always characterized our research and development efforts. It means we cannot afford undue work stoppages, inflated costs of material or talent, wasteful interagency rivalries, or a high turnover of key personnel.

New objectives and new money cannot solve these problems. They could, in fact, aggravate them further—unless every scientist, every engineer, every serviceman, every technician, contractor, and civil servant involved gives his personal pledge that this nation will move forward, with the full speed of freedom, in the exciting adventure of space.

Document III-13

Document title: Director, Bureau of the Budget, Memorandum for the President, Draft, November 13, 1962, with attached: "Space Activities of the U.S. Government."

Source: NASA Historical Reference Collection, History Office, NASA Headquarters, Washington, D.C.

This memorandum summarized the results of a special review of the space program carried out by the Bureau of the Budget, NASA, and the Department of Defense in the second half of 1962. The assessment was in response to President's Kennedy's request for "an especially critical review" of the total national space efforts. Other factors justifying the review included NASA's decision to adopt the lunar orbital rendezvous approach to the lunar mission and a subsequent upward revision in the budget estimates for Apollo; a suggestion by Brainard Holmes, the individual in charge of the Apollo program, that the target date for the first landing attempt be moved up from late 1967 to late 1966; and the lack of evidence that the Soviet Union was itself carrying out a lunar landing program.

[1] Memorandum for the President

This memorandum is to report the status and results to date of the special review of space programs which we have been conducting with the National Aeronautics and Space Administration and the Department of Defense, and to present two policy questions on which your guidance is needed at this time:

1. The pace at which the manned lunar landing program should proceed, in view of the budgetary implications and other considerations; and
2. The approach that should be taken to other space programs in the 1964 budget, i.e., should they as a matter of policy be exempted from or subjected to the restrictive budgetary ground rules applicable in 1964 to other programs of the Government.

Decisions on specific programs, and the final amounts to be included in the 1964 budget can wait. However, advance decisions on the above two policy questions are essential to guide the preparation of refined estimates and specific recommendations, especially in the case of NASA.

The special space review

A special space review was begun last summer in response to your request that the space programs of all agencies be given an especially critical review and be presented to you as a whole. As a part of the 1964 budget preview process we arranged to have the tentative 5-year space programs of NASA, Defense, the Atomic Energy Commission, and the Weather Bureau, as they stood last August, laid out on a comparable basis in considerable detail for consideration and [2] review. Subsequently the agencies have made some significant revisions in the programs and cost estimates—notably an upward revision in the cost estimates for the NASA manned lunar landing program—and the agencies and the Bureau of the Budget have developed a variety of higher and lower alternative programs, have reviewed the more important individual programs, and have given special consideration to areas where the programs and interests of the agencies overlap.

The 1964 budget estimates of the agencies now under consideration reflect many of the results of the special review, and serve as a useful basis for the consideration of the various policy alternatives outlined below. A more detailed table is attached as an appendix.

Current Agency Estimates

New obligational authority - in billions

	1962	1963	1964	1965	1966	1967
Manned lunar landing program	$1.3	$2.7	$4.6	$3.4	$2.6	$1.8
All other NASA	.5	1.0	1.6	2.6	3.4	4.2
Total, NASA	1.8	3.7	6.2	6.0	6.0	6.0
Department of Defense	1.1	1.6	1.6	1.6*	1.6*	1.6*
AEC and Weather Bureau	.2	.3	.4	.4	.5	.5
Total NOA, all space programs	3.1	5.6	8.2	8.0	8.1	8.1
Total expenditures, all space programs	2.3	3.9	6.5	8.0	8.1	8.1

*Illustrative amounts; current estimates not yet projected by DOD

Manned lunar landing program

The question of the pace and budget level of the manned lunar landing program revolves around (1) the acceptability of both the schedule and funding [3] requirements of the program currently proposed by NASA; (2) the desirability, cost, and practical feasibility of measures that might be taken to accelerate the program, which have been set forth in a letter by Mr. Webb in reply to your question on the possibility of acceleration; and (3) the merits of lower alternatives which would delay the program to some degree but would ease the burden on the 1964 budget. There are three recent significant developments relating to the manned lunar landing program. One is that a firm decision has been reached to proceed with the "lunar orbit rendezvous" approach. As you know, Dr. Wiesner and his advisory committees have had strong reservations with respect to this approach and advocated further studies and reconsideration of other alternatives. After the latest round of studies and discussions, however, Dr. Wiesner has now agreed that while it might have been better to have concentrated on the earth orbit rendezvous or a 2-man direct ascent approach from the start, in the present circumstances the NASA decision to proceed with the LOR approach is appropriate and offers the best possibility for accomplishing the mission at the earliest practicable date. It is, however, desirable to continue the studies of the 2-man direct mode.

A second development is that NASA's latest estimates, based on the details of the LOR approach as they have now been worked out, indicate that substantially higher amounts would be required in 1963 and 1964 to keep the entire program on an optimum schedule–over $400 million in 1963 above the amounts now appropriated and about $550 million in 1964 above the initial LOR estimates last August. These revised estimates, reflected in the [4] alternatives below, accentuate the budgetary problem, and illustrate once again the tendency for repeated increases in estimated costs of large and complex development projects, while there are reasons to believe that the present estimates are much firmer than previous ones, we cannot with any confidence say that there will not be still further increases in this, without doubt, the largest and most complex single development project the nation has ever undertaken. Third, our understanding of the latest intelligence estimates is that there is no evidence yet that the Russians are actually developing either a larger booster of the size required for a manned lunar landing attempt or rendezvous techniques of the sort that would be required to assemble a manned lunar landing vehicle in earth orbit using their available boosters. While not conclusive, this suggests that extreme measures to advance somewhat our own target dates may not be necessary to preserve a good possibility that we will be first.

The range of possible alternatives is as follows. As indicated in the explanations, all of the alternatives are not equally feasible and have not been worked out in the same detail. In all of the alternatives the "schedule" is to be understood as the target date established for program planning and estimating purposes, not as a forecast of when the first manned lunar landing attempts would actually be made. Experience has shown that on a realistic basis slippage of as much as a year must be anticipated.

[5]

Manned Lunar Landing Program

	MLL target date	NOA in billions 1963	1964	1965	1966	1967
Alternative I	late 1967	$2.7	$4.6	$3.4	$2.6	$1.8
Alternative 2	mid-1967	3.1	4.6	3.2	2.4	1.8
Alternative 3	late 1966	3.6	5.4	3.9	3.0	1.0
Alternative 4	late 1968	2.7	3.7	3.5	2.7	2.1

Alternative 1. Assumes no 1963 supplemental and a late 1967 target date, which is regarded as the earliest feasible without a 1963 supplemental. It is included in NASA's current 1964 budget estimates as the alternative preferred by NASA on the basis of current policy guidance, recognizing the practical problems involved in getting timely approval of a 1963 supplemental authorization and appropriation. This alternative involves a sharp peaking of fund requirements in 1964, because the normal funding curves for all of the principal subprojects Gemini, Apollo, Advanced Saturn, etc.—have to peak in the same year—in order to meet the assumed schedule. (There is some doubt whether the requirements in 1965 will drop as much as present estimates indicate.)

Alternative 2. Assumes a 1963 supplemental of about $425 million with approval to proceed immediately on a deficiency basis in anticipation of the supplemental, and a mid-1967 target date. This is the "optimum" schedule referred to above. This alternative, which might accelerate the schedule by about 6 months, would require a strong presidential endorsement and the concurrence of congressional leaders and the appropriations committees with the decision to proceed on a deficiency basis. Because of the practical problems, it is not strongly advocated by Mr. Webb as the appropriate course for the administration to take.

[6] Alternative 3. Assumes a 1963 supplemental of $900 million, approval to proceed on a deficiency basis in 1963, and a decision to proceed on an all-out "crash" basis. NASA estimates that these measures of maximum acceleration might advance the date of a first attempt by as much as one year. This alternative would also require strong Presidential endorsement and congressional concurrence. It would create enormous additional management problems, and in NASA's view and ours would not appear to offer enough assurance of actually advancing the date of a successful attempt to be worth the cost and other problems involved.

Alternative 4. This is an estimate of the minimum amount ($3.7 billion) that could be provided in 1964 and still accommodate a program based on a target date about one year later than alternative l. A new detailed program would have to be worked out under these dollar and schedule assumptions, and there would be considerable dislocations in activities now underway in 1963. This alternative is significant as indicating probably about the lowest 1964 estimate under which the first actual manned lunar landing might still be expected to occur during this decade, after a realistic allowance for slippage. As such it could be regarded as being in accord with the announced administration policy of achieving a manned lunar landing before the end of this decade. It would also represent an approach to the manned lunar landing program more closely corresponding to the restrictive approach we are taking with respect to other parts of the 1964 budget.

I agree with Mr. Webb that alternative 1, the NASA recommendation, is probably the most appropriate choice at this time to press forward to achieve a manned lunar landing ahead of the Russians. While it will be criticized [7] in some quarters as representing slightly less than a maximum effort, I believe that practical as well as budgetory considerations make a more accelerated program, like alternatives 2 or 3, inadvisable....

Other NASA programs

The special attention give to the manned lunar landing program has sometimes obscured the other program objectives being pursued by NASA. Perhaps the most important are the programs for scientific investigations in space, in which the United States has from the start been the recognized world leader, which have important intrinsic value, which have been the focus of significant programs of international cooperation, and which in some cases, for example if the Mariner spacecraft succeeds in its voyage to Venus, can provide spectacular achievements with some of the same popular appeal as manned space flights. Less costly, but most important, are the programs directed at developing practical applications of space technology, chiefly in the meteorological and communications fields. Finally, there is the continuing research and development effort required to lay the technical foundation for and begin the development of engines and other components, space vehicles, and techniques for future manned and unmanned space flight.

There is no disagreement that work in all of these areas should continue and move forward on a progressive basis, with appropriate decisions and coordination of the specific projects and areas of effort. The policy issue relates to the scale of effort and relative priority of the work.

There are essentially two alternatives, indicated by the following figures:

Other NASA Programs

(Exclusive of amounts supporting manned lunar landing program)

1964 NOA - in billions

	NASA proposal	Illustrative alternate
Scientific investigations in space	$.6	$.4
Applications (communications & meteorology)	.2	.2
Future capabilities & supporting research & development	.8	.7
Total	1.6	1.3

NASA takes the view that the importance of maintaining the proposed general level of effort in the "other" areas is so great that if any reduction were to be made in the $6.2 billion budget request, it should be applied at least in part to the manned lunar landing program, in order to maintain a "balanced" total program. The Administrator and his principal assistants are fearful that the appeal and priority of the manned lunar landing program may turn NASA into a "one program agency" with loss of leadership and standing in the scientific community at home and abroad, and with inadequate provision [9] for moving ahead with developments required for future capabilities in apace. They point to the fact that to some extent the MLL and other programs are mutually supporting in a technical sense, although all scientific investigations and supporting research directly required for the manned lunar program have been identified and provided for in that program.

While recognizing the force of these arguments, it seems to me that (1) as in other research and development programs, the level of effort to be carried forward is, within limits, essentially a matter of degree, and (2) the decision to proceed with the manned lunar landing program as a matter of high urgency has been a unique sort of national decision which does not automatically endow other space objectives and programs with a special degree of urgency. Rather, it seems to me the appropriate national policy is to attempt to maintain a reasonable degree of balance between the very costly space programs, and research and development programs in other fields. Under the policies being applied to the 1964 budget, this would mean that the estimates for NASA programs other than the manned lunar landing should be treated on their merits in the same restrictive fashion as other programs. I feel that a restrictive approach is especially appropriate in 1964 in view of the tremendous peaking in 1964 fund requirements that will occur if alternative 1 is approved for the manned lunar landing program.

The practical effect on the 1964 budget of this policy difference is about $300 million in NOA and about $150 million in expenditures. While these amounts seem small compared to the totals for the space program, they are large compared to most of the other possibilities of adjustment in the 1964 [10] budget. The difference is not greater because NASA's proposals had already deferred to 1965 or later years initiation of most of the major new development projects under consideration, largely for reasons of technical feasibility, partly in recognition of the major effort required in 1964 on the manned lunar landing program. Our recommendation should not be equated with a "no new starts" policy, since even under the restrictive approach we feel would be appropriate, the program would include initiation of additional satellites of types currently available, new types of experiments, and some new development projects, as well as continuation of work already underway.

Defense and other space programs

The space programs of Defense, AEC, and the Weather Bureau do not present policy issues requiring resolution in advance of the final 1964 budget decisions. In the case of Defense, the Secretary and his assistants have taken a restrictive approach in their reviews, based on the conclusion that there are no valid new military requirements which justify at this time a major expansion in the military space programs. Special attention is being given in the budget reviews to the necessity for proceeding with the Titan III and Dynasoar projects, and to the approach that should be taken in the development of communications satellite systems. The communications satellite problem is complex, involving NASA, Defense, and prospectively the new corporation authorized at the last session of Congress. The alternatives and our recommendations on this matter will be presented to you at a later date.

[11] **Financial summary**

The financial effect on the 1964 budget of the policy alternatives that appear most pertinent on the basis of the foregoing discussion are summarized below. It should be recognized that all estimates shown are subject to further adjustment when the regular budget review is completed.

Fiscal Year 1964 - in billions

	Current agency estimates	Current BOB estimates
New Obligational Authority		
Manned lunar landing	$4.6	$4.6
Other NASA	1.6	1.3
Total NASA		
Defense space programs	1.6	1.6
AEC and Weather Bureau	.4	.4
Total NOA	8.2	7.9
Expenditures		
Manned lunar banding	3.4	3.4
Other NASA	1.2	1.0
Total NASA	4.6	4.4
Total Defense and other	1.9	1.9
Total expenditures	6.5	6.3

In closing, I should point out that under any alternative we will be faced with a large built-in further increase in expenditures in 1965 which we now tentatively estimate at about $1.3 billion.

Director

Attachment
[12]

SPACE ACTIVITIES OF THE U. S. GOVERNMENT
Based on agency estimates as of November 9, 1962 - Subject to change as budget reviews proceed

	New Obligational Authority - in millions				
	1963	1964	1965	1966	1967
National Aeronautics and Space Administration					
Manned Lunar Landing Program					
Spacecraft Development and Operations (Mercury, Gemini, Apollo, etc.)	$703	$1,536	$1,101	$978	$666
Launch Vehicle and Engine Development (Saturn, Advanced Saturn, and their engines)	660	1,028	796	579	361
Engineering Support (Systems engineering, integration, and checkout; aerospace medicine; launch operations)	72	244	207	173	165
Supporting Scientific Investigations in Space (Unmanned lunar exploration, orbiting solar observatories, radiation and bioscience satellites, etc.)	291	411	356	299	216
Other Support (Supporting research and development; tracking networks; NASA personnel and operation of installations)	397	609	569	517	316
Construction (Launch, ground test, laboratory, and support fac.)	586	785	343	91	51
Total, MLL Program	2,709	4,613	3,372	2,637	1,775
Other NASA Programs					
Other space sciences programs (Geophysical and astronomical satellites and unmanned exploration of Venus and Mars)	353	590	629	655	522
Applications programs (Development of meteorological and communications satellites)	129	186	144	108	102
Developments required for advanced manned space flight (Advanced engine development, nuclear rocket project, and studies of advanced manned space vehicles)	299	485	685	913	982
Other supporting research (General space technology, aeronautical research, and research grants and facilities for universities)	203	343	359	394	430
Provision for unspecified new programs	-	-	811	1,293	2,189
Total, Other NASA Programs	984	1,604	2,628	3,363	4,225
Total, NASA	3 693	6,217	6,000	6,000	6,000
Department of Defense					
Navigation satellite development and operation	45	35	*	*	*
Communications satellite development	95	76	*	*	*
Dynasoar manned space flight experiments	130	125	*	*	*
Dynasoar support at Vela nuclear weapons test detection experiments	26	26	*	*	*
Discoverer program	130	79	*	*	*
Titan III launch vehicle development	261	330	153	29	3
Large solid rocket development	40	34	*	*	*
Atlantic Missile Range (portion estimated as applicable to space activities)	80	88	*	*	*
Space tracking & detection systems	33	57	*	*	*
Minor projects, supporting research & development, laboratory operations, and miscellaneous	651	706	*	*	*
Total, Defense space activities	1,631	1,646	1,600	1,600	1,600

Atomic Energy Commission					
Nuclear rocket development (Rover)	105	170	172	180	170
Space nuclear power development	95	128	187	214	204
Supporting activities	12	21	24	29	29
Total, AEC apace activities	212	319	383	423	403
Weather Bureau					
Operational meteorological satellite system & related meteorological research	43	41	60	60	60
TOTAL, all space activities	5,579	8,223	8,043	8,083	8,063

* Current estimates not yet projected for all items by Defense; total shown is illustrative only.

Document III-14

Document title: James E. Webb, Administrator, NASA, to the President, November 30, 1962.

Source: NASA Historical Reference Collection, History Office, NASA Headquarters, Washington, D.C.

In November 1962, a controversy had arisen between NASA Administrator James Webb and the man he had selected to manage the Apollo program, Associate Administrator for Manned Space Flight R. Brainard Holmes, over the priority to be assigned to the Apollo program. Holmes argued that Apollo should be carried out on a crash basis and, if necessary, should be funded at the expense of other NASA programs. Webb, in contrast, believed that Apollo was just a part, albeit a very important part, of a balanced space effort aimed at across-the-board preeminence in space. In a November 21 meeting with President Kennedy and in this follow-up letter, Webb forcefully argued his position. Kennedy accepted the argument, and soon after Holmes left NASA. This letter presents a comprehensive overview of James Webb's concept of the space program that he was attempting to execute.

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[1] At the close of our meeting on November 21, concerning possible acceleration of the manned lunar landing program, you requested that I describe for you the priority of this program in our overall civilian space effort. This letter has been prepared by Dr. Dryden, Dr. Seamans, and myself to express our views on this vital question.

The objective of our national space program is to become preeminent in all important aspects of this endeavor and to conduct the program in such a manner that our emerging scientific, technological, and operational competence in space is clearly evident.

To be preeminent in space, we must conduct scientific investigations on a broad front. We must concurrently investigate geophysical phenomena about the earth, analyze the sun's radiation and its effect on earth, explore the moon and the planets, make measurements in interplanetary space, and conduct astronomical measurements.

To be preeminent in space, we must also have an advancing technology that permits increasingly large payloads to orbit the earth and to travel to the moon and the planets. We must substantially improve our propulsion capabilities, must provide methods for delivering large amounts of internal power, must develop instruments and life support systems that operate for extended periods, and must learn to transmit large quantities of data over long distances.

To be preeminent in operations in space, we must be able to launch our vehicles at prescribed times. We must develop the capability to place payloads in exact orbits. We must maneuver in space and rendezvous with cooperative spacecraft and, for knowledge of the military potential with uncooperative spacecraft. We must develop techniques for landing on the moon and the planets, and for re-entry into the earth's atmosphere at increasingly high velocities. Finally, we must learn the process of fabrication, inspection, assembly, and check-out that will provide vehicles with life expectancies in space measured in years rather than months. Improved reliability is required for astronaut safety, long duration scientific measurements, and for economical meteorological and communications systems.

[2] In order to carry out this program, we must continually up-rate the competence of Government research and flight centers, industry, and universities, to implement their special assignments and to work together effectively toward common goals. We also must have effective working relationships with many foreign countries in order to track and acquire data from our space vehicles and to carry out research projects of mutual interest and to utilize satellites for weather forecasting and world-wide communications.

Manned Lunar Landing Program

NASA has many flight missions, each directed toward an important aspect of our national objective. The manned lunar landing program requires for its successful completion many, though not all, of these flight missions. Consequently, the manned lunar landing program provides currently a natural focus for the development of national capability in space and, in addition, will provide a clear demonstration to the world of our accomplishments in space. The program is the largest single effort within NASA, constituting three-fourths of our budget, and is being executed with the utmost urgency. All major activities of NASA, both in headquarters and in the field, are involved in this effort, either partially or full time.

In order to reach the moon, we are developing a launch vehicle with a payload capability 85 times that of the present Atlas booster. We are developing flexible manned spacecraft capable of sustaining a crew of three for periods up to 14 days. Technology is being advanced in the areas of guidance and navigation, re-entry, life support, and structures—in short, almost all elements of booster and spacecraft technology.

The lunar program is an extrapolation of our Mercury experience. The Gemini spacecraft will provide the answers to many important technological problems before the first Apollo flights. The Apollo program will commence with earth orbital maneuvers and culminate with the one-week trip to and from the lunar surface. For the next five to six years there will be many significant events by which the world will judge the competence of the United States in space.

The many diverse elements of the program are now being scheduled in the proper sequence to achieve this objective and to emphasize the major milestones as we pass them. For the years ahead, each of these tasks must be carried out on a priority basis.

[3] Although the manned lunar landing requires major scientific and technological effort, it does not encompass all space science and technology, nor does it provide funds to support direct applications in meteorological and communications systems. Also, university research and many of our international projects are not phased with the manned lunar program, although they are extremely important to our future competence and posture in the world community.

Space Science

As already indicated, space science includes the following distinct areas: geophysical, solar physics, lunar and planetary science, interplanetary science, astronomy, and space biosciences.

At present, by comparison with the published information from the Soviet Union, the United States clearly leads in geophysics, solar physics, and interplanetary science. Even here, however, it must be recognized that the Russians have within the past year launched a major series of geophysical satellites, the results of which could materially alter the balance. In astronomy, we are in a period of preparation for significant advances, using the Orbiting Astronomical Observatory which is now under development. It is not known how far the Russian plans have progressed in this important area. In space biosciences and lunar and planetary science, the Russians enjoy a definite lead at the present time. It is therefore essential that we push forward with our own programs in each of these important scientific areas in order to retrieve or maintain our lead, and to be able to identify those areas, unknown at this time, where an added push can make a significant breakthrough.

A broad-based space science program provides necessary support to the achievement of manned space flight leading to lunar landing. The successful launch and recovery of manned orbiting spacecraft in Project Mercury depended on knowledge of the pressure, temperature, density, and composition of the high atmosphere obtained from the nation's previous scientific rocket and satellite program. Considerably more space science data are required for the Gemini and Apollo projects. At higher altitudes than Mercury, the spacecraft will approach the radiation belt through which man will travel to reach the moon. Intense radiation in this belt is a major hazard to the crew. Information on the radiation belt will determine the shielding requirements and the parking orbit that must be used on the way to the moon.

[4] Once outside the radiation belt, on a flight to the soon, a manned spacecraft will be exposed to bursts of high speed protons released from time to time from flares on the sun. These bursts do not penetrate below the radiation belt because they are deflected by the earth's magnetic field, but they are highly dangerous to man in interplanetary space.

The approach and safe landing of manned spacecraft on the moon will depend on more precise information on lunar gravity and topography. In addition, knowledge of the bearing strength and roughness of the landing site is of crucial importance, lest the landing module topple or sink into the lunar surface.

Many of the data required for support of the manned lunar landing effort have already been obtained, but as indicated above there are many crucial pieces of information still unknown. It is unfortunate that the scientific program of the past decade was not sufficiently broad and vigorous to have provided us with most of these data. We can learn a lesson from this situation, however, and proceed now with a vigorous and broad scientific program not only to provide vital support to the manned lunar landing, but also to cover our future requirements for the continued development of manned flight in space, for the further exploration of space, and for future applications of space knowledge and technology to practical uses.

Advanced Research and Technology

The history of modern technology has clearly shown that preeminence in a given field of endeavor requires a balance between major projects which apply the technology, on the one hand, and research which sustains it on the other. The major projects owe their support and continuing progress to the intellectual activities of the sustaining research. These intellectual activities in turn derive fresh vigor and motivation from the projects. The philosophy of providing for an intellectual activity of research and an interlocking cycle of application must be a cornerstone of our National Space Program.

The research and technology information which was established by the NASA and its predecessor, the NACA, has formed the foundation for this nation's preeminence in aeronautics, as exemplified by our military weapons systems, our world market in civil jet airliners, and the unmatched manned flight within the atmosphere represented by the X-15.

[5] More recently, research effort of this type has brought the TFX concept to fruition and similar work will lead to a supersonic transport which will enter a highly competitive world market. The concept and design of these vehicles and their related propulsion, controls, and structures were based on basic and applied research accomplished years ahead. Government research laboratories, universities, and industrial research organizations were necessarily brought to bear over a period of many years prior to the appearance before the public of actual devices or equipment.

These same research and technological manpower and laboratory resources of the nation have formed a basis for the U.S. thrust toward pre-eminence in space during the last four years. The launch vehicles, spacecraft, and associated systems including rocket engines, reaction control systems, onboard power generation, instrumentation and equipment for communications, television and the measurement of the space environment itself have been possible in this time period only because of past research and technological effort. Project Mercury could not have moved as rapidly or as successfully without the information provided by years of NACA and later NASA research in providing a base of technology for safe re-entry heat shields, practical control mechanisms, and life support systems.

It is clear that a preeminence in space in the future is dependent upon an advanced research and technology program which harnesses the nation's intellectual and inventive genius and directs it along selective paths. It is clear that we cannot afford to develop hardware for every approach but rather that we must select approaches that show the greatest promise of payoff toward the objectives of our nation's space goals. Our research on environmental effects is strongly focused on the meteoroid problem in order to provide information for the design of structures that will insure their integrity through space missions. Our research program on materials must concentrate on those materials that not only provide meteoroid protection but also may withstand the extremely high temperatures which exist during re-entry as well as the extremely low temperatures of cryogenic fuels within the vehicle structure. Our research program in propulsion must explore the concepts of nuclear propulsion for early 1970 applications and the even more advanced electrical propulsion systems that may become operational in the mid 1970's. A high degree of selectivity must be and is exercised in all areas of research and advanced technology to ensure that we are working on the major items that contribute to the nation's goals that make up an over-all preeminence in space exploration. Research and technology must precede and pace these established goals or a stagnation of progress in space will inevitably result.

[6]

Space Applications

The manned lunar landing program does not include our satellite applications activities. There are two such program areas under way and supported separately: meteorological satellites and communications satellites. The meteorological satellite program has developed the TIROS system, which has already successfully orbited six spacecraft and which has provided the foundation for the joint NASA-Weather Bureau planning for the national operational meteorological satellite system. This system will center on the use of the Nimbus satellite which is presently under development, with an initial research and development flight expected at the end of 1963. The meteorological satellite developments have formed an important position for this nation in international discussions of peaceful uses of space technology for world benefits.

NASA has under way a research and development effort directed toward the early realization of a practical communication satellite system. In this area, NASA is working with the Department of Defense on the Syncom (stationary, 24-hour orbit, communications satellite) project in which the Department of Defense is providing ground station support for NASA's spacecraft development; and with commercial interests, for example, AT&T on the Telstar project. The recent "Communications Satellite Act of 1962" makes NASA responsible for advice to and cooperation with the new Communications Satellite

Corporation, as well as for launching operations for the research end/or operational needs of the Corporation. The details of such procedures will have to be defined after the establishment of the Corporation. It is clear, however, that this tremendously important application of space technology will be dependent on NASA's support for early development and implementation.

University Participation

In our space program, the university is the principal institution devoted to and designed for the production, extension, and communication of new scientific and technical knowledge. In doing its job, the university intimately relates the training of people to the knowledge acquisition process of research. Further, they are the only institutions which produce more trained people. Thus, not only do they yield fundamental knowledge, but they are the sources of the scientific and technical manpower needed generally for NASA to meet its program objectives.

In addition to the direct support of the space program and the training of new technical and scientific personnel, the university is uniquely qualified to bring to bear the thinking of multidisciplinary [7] groups on the present-day problems of economic, political, and social growth. In this regard, NASA is encouraging the universities to work with local industrial, labor, and governmental leaders to develop ways and means through which the tools developed in the space program can also be utilized by the local leaders in working on their own growth problems. This program is in its infancy, but offers great promise in the working out of new ways through which economic growth can be generated by the spin-off from our space and related research and technology.

International Activity

The National Space Program also serves as the base for international projects of significant technical and political value. The peaceful purposes of these projects have been of importance in opening the way for overseas tracking and data acquisition sites necessary for manned flight and other programs which, in many cases, would otherwise have been unobtainable. Geographic areas of special scientific significance have been opened to cooperative sounding rocket ventures of immediate technical value. These programs have opened channels for the introduction of new instrumentation and experiments reflecting the special competence and talent of foreign scientists. The cooperation of other countries – indispensable to the ultimate achievement of communication satellite systems and the allocation of needed radio frequencies—has been obtained in the form of overseas ground terminals contributed by those countries. International exploitation and enhancement of the meteorological experiments through the synchronized participation of some 35 foreign nations represent another by-product of the applications program and one of particular interest to the less developed nations, including the neutrals, and even certain of the Soviet bloc satellite nations.

These international activities do not in most cases require special funding; indeed, they have brought participation resulting in modest savings. Nevertheless, this program of technical and political value can be maintained only as an extension of the underlying on-going programs, many of which are not considered part of the manned lunar landing program, but of importance to space science and direct applications.

Summary and Conclusion

In summarizing the views which are held by Dr. Dryden, Dr. Seamans, and myself, and which have guided our joint efforts to develop the National Space Program, I would emphasize that the manned lunar landing [8] program, although of highest national priority, will not by itself create the preeminent position we seek. The present interest of the United States in terms of our scientific posture and increasing prestige, and our future interest in terms of having an adequate scientific and technological base for space activities beyond the manned lunar landing, demand that we pursue an adequate, well-balanced space program in all areas, including those not directly related to the manned lunar landing. We strongly believe that the United States will gain tangible benefits from such a total accumulation of basic scientific and technological data as well as from the greatly increased strength of our educational institutions. For these reasons, we believe it would not be in the nation's long-range interest to cancel or drastically curtail on-going space science and technology development programs in order to increase the funding of the manned lunar landing program in fiscal year 1963.

The fiscal year 1963 budget for major hardware development and flight missions not part of the manned lunar landing program, as well as the university program, totals $400 million. This is the amount which the manned space flight program is short. Cancellation of this effort would eliminate all nuclear developments, our international sounding rocket projects, the joint U.S.-Italian San Marcos project recently signed by Vice President Johnson, all of our planetary and astronomical flights, and the communication and meteorological satellites. It should be realized that savings to the Government from this cancellation would be a small fraction of this total since considerable effort has already been expended in fiscal year 1963. However, even if the full amount could be realized, we would strongly recommend against this action.

In aeronautical and space research, we now have a program under way that will insure that we are covering the essential areas of the "unknown." Perhaps of one thing only can we be certain; that the ability to go into space and return at will increases the likelihood of new basic knowledge on the order of the theory that led to nuclear fission.

Finally, we believe that a supplemental appropriation for fiscal year 1963 is not nearly so important as to obtain for fiscal year 1964 the funds needed for the continued vigorous prosecution of the manned lunar landing program $4.6 billion) and for the continuing development of our program in space science ($670 million), advanced research and technology ($263 million), space application ($185 million), and advanced manned flight including nuclear propulsion ($485 million).

[9] The funds already appropriated permit us to maintain a driving, vigorous program in the manned space flight area aimed at a target date of late 1967 for the lunar landing. We are concerned that the efforts required to pass a supplemental bill through the Congress, coupled with Congressional reaction to the practice of deficiency spending, could adversely affect our appropriations for fiscal year 1964 and subsequent years, and permit critics to focus on such items as charges that "overruns stem from poor management instead of on the tremendous progress we have made and are making.

As you know, we have supplied the Bureau of the Budget complete information on the work that can be accomplished at various budgetary levels running from $5.2 billion to $6.6 billion for fiscal year 1964. We have also supplied the Bureau of the Budget with carefully worked out schedules showing that approval by you and the Congress of a 1964 level of funding of $6.2 billion together with careful husbanding and management of the $3.7 billion appropriated for 1963 would permit maintenance of the target dates necessary for the various milestones required for a final target date for the lunar landing of late 1967. The jump from $3.7 billion for 1963 to $6.2 billion for 1964 is undoubtedly going to raise more questions than the previous year jump from $1.8 billion to $3.7 billion.

If your budget for 1964 supports our request for $6.2 billion for NASA, we feel reasonably confident we can work with the committees and leaders of Congress in such a way as to secure their endorsement of your recommendation and the incident appropriations. To have moved in two years from President Eisenhower's appropriation request for 1962 of $1.1 billion to the approval of your own request for $1.8 billion, then for $3.7 billion for 1963 and on to $6.2 billion for 1964 would represent a great accomplishment for your administration. We see a risk that this will be lost sight of in charges that the costs are skyrocketing, the program is not under control, and so forth, if we request a supplemental in fiscal year 1963.

However, if it is your feeling that additional funds should be provided through a supplemental appropriation request for 1963 rather than to make the main fight for the level of support of the program on the basis of the $6.2 billion request for 1964, we will give our best effort to an effective presentation and effective use of any funds provided to speed up the manned lunar program.

With much respect, believe me
Sincerely yours,
James E. Webb
Administrator

Document III-15

Document title: John F. Kennedy, Memorandum for the Vice President, April 9, 1963.

Source: NASA Historical Reference Collection, History Office, NASA Headquarters, Washington, D.C.

Criticism of the priority assigned to the space program, and particularly Project Apollo, increased in 1963. As he had the previous year, President Kennedy asked for a careful review of the program. This time, however, unlike in 1962, Kennedy asked the vice president and the Space Council, rather than the Bureau of the Budget, to carry out the review. This increased the likelihood of an assessment generally favorable to the program as it then stood.

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[1] In view of recent discussions, I feel the need to obtain a clearer understanding of a number of factual and policy issues relating to the National Space Program which seem to arise repeatedly in public and other contexts. With this objective in mind, I would appreciate having the Space Council give consideration, and replies, to the following questions:

1. What are the salient differences, as to planned technical and scientific accomplishments, between the NASA program as projected on January 1, 1961 for the years 1962 through 1970, and the NASA programs as redefined by the present Administration? What are the differences in the intended levels of funding, year by year, for the two projections? The costs of which new major projects, or what reestimates in the costs of projects appearing in both projections, are responsible for the year-by year differences in funding between them? What would be the differences in accomplishments assuming the two programs were successful?

2. What specifically are the principal benefits to the national economy we can expect to accrue from the present, greatly augmented program in the following areas: scientific knowledge; industrial productivity; education, at the various levels beginning with high school; and military technology? Please estimate in dollar terms the portion of the annual expenditure that will result in contributions in each of these areas, from the present NASA program, and from its predecessor.

[2] 3. What are some of the major problems likely to result from continuation of the national space program as now projected in the fields of industry, government and education? In particular, will research and development in the industrial and consumer products segments of the national economy suffer because of diversion of technical manpower away from it, and/or from increasing costs of such research and development?

4. To what extent could the program be reduced, beginning with FY 1964, in areas not directly affecting the Apollo program (and therefore not compromising the timetable for the first manned lunar landing)? What are these areas, and the dollar amounts

involved? Specifically, what would be the consequences in science, industrial productivity, education and in other areas, if such reductions were imposed? Conversely, where would you judge that the present projection merits expansion and, specifically, what kind of benefits, in what areas, would ensue from such increases?

5. Are we taking sufficient measures to insure the maximum degree of coordination and cooperation between NASA and the Defense Department in the areas of space vehicles development and facility utilization?

I would appreciate receiving your report concerning the above by May 15, 1963.

I have sent a copy of this memorandum to Mr. Webb, with the request that he assist in preparing the material needed for this review.

John F. Kennedy

Document III-16

Document title: Lyndon B. Johnson, Vice President, to the President, May 13, 1963, with attached report.

Source: NASA Historical Reference Collection, History Office, NASA Headquarters, Washington, D.C.

The vice president transmitted with this letter the results of the review requested by President Kennedy on April 9. The review compared NASA's 1962 plans with the 1960 NASA Long Range Plan. The report noted that the program accelerations that President Kennedy had announced in his May 1961 speech would require a budget over $30 billion greater during the 1960s than had been anticipated at the end of the Eisenhower administration.

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[1] Dear Mr. President:

Your memorandum of April 9 to me asked that the Space Council give consideration and responses to five groups of questions regarding the National Space Program. Since most of the questions were directed toward NASA's participation in that program, major attention of the responses is also pointed in that direction.

In the process of preparing the attached reply, consultations were held with and inputs received from all agencies whose executive heads are members of the Council. Because of the detail involved, the written contributions from NASA and Defense accompany this report as reference Appendices A and B, respectively. Staff papers from State and AEC appear in Appendix C.

To assist in orderly and brief response, the five groups of questions in your memorandum were identified and numbered as follows: (1) Comparisons of current NASA program with that of previous Administration; (2) Benefits to national economy from NASA program; (3) Problems resulting from Space Program; (4) Reductions and expansions in NASA program, without affecting lunar project; (5) Coordination and cooperation between NASA and Defense.

All members of the Council, as well as the Executive Secretary, have concurred in this report.

Sincerely,
Lyndon B. Johnson...

[1 of Report]

I. Comparison of NASA Program with That of Previous Administration

Current and Projected NASA Budgets
(millions of dollars)

FY	1961	1962	1963	1964	1965	1966
Long-range Plan of Previous Administration (Tentative)	922	1159	1577	1674	1825	1931
Long-range Plan (1962) as Suggested by NASA	964	1822	3688	5712	5900	6000

FY	1967	1968	1969	1970	Total for Decade
Long-range Plan of Previous Administration (Tentative)	2056	2258	2239	2276	17,917
Long-range Plan (1962) as suggested by NASA	6000	6000	6000	6000	48,086

1. The major distinctions between the present NASA program and that of the previous Administration involve:

a. The lunar project.
b. Breadth of scientific endeavor.
c. Expansion of space applications.
d. Sense of urgency.

2. The operational plan of the previous Administration terminated with the 3-orbit MERCURY flight, and there was no continuation beyond that with the exception of studies, unsupported by any commitment to the necessary hardware and facilities, pointing to a landing on the Moon at an unspecified time after 1970, The plan of the present Administration is marshalling resources required for a round trip to the Moon in the 1967-68 period.

3. The previous plan proposed, but did not have Presidential approval, to commit $4.76 billion to manned space flight. The current plan would add $15.88 billion to this, bringing the cost of the manned and unmanned aspects of the lunar project to approximately $20 billion.

4. The extra money would buy major capital investments in facilities at Houston; Michoud, Mississippi Test Center; Cape Canaveral; and the [2] worldwide tracking network in direct support of the lunar project. In addition, the money is:

a. Buying a strengthened support program in unmanned survey of the Moon, study of bioscience, and investigation of solar phenomena and space radiation.

b. Giving us more support in advance technology as backup for APOLLO and a lead time for future missions to keep this country in front, such as the nuclear rockets.

c. Aiding the universities to add at least as many scientists and engineers to the national supply as the space program will draw from the pool.

5. The long-range plan of the previous Administration covering all NASA programs, amounted to $17.9 billion for the period 1961-70. It soon had to be re-estimated at $22.2 billion. The long-range plan of the present Administration came to $42.5 billion. NASA judgments, coupled with a projection of no annual budget in excess of $6 billion, would bring the total to $48 billion for the decade.

6. Over the 10-year period, the NASA program as now conceived:
a. Will run fairly consistently at 2-1/2 times that of the 1961 tentative long-range plan.
b. Would run about 4 times more in manned space flight costs.
c. Would run about double in applications and tracking costs.
d. Would run more than 1-1/2 times greater in space sciences and research and technology.

7. In over-all terms, the basic difference between the two programs is that the plan of the previous Administration represented an effort for a second place runner and the program of the present Administration is designed to make this country the assured leader before the end of the decade. This is not taking the narrow view that the project is just a race to reach the Moon first. Instead, it is an over-all coordinated program designed to return benefits to the economy and to the national security on a broad front. [3]

II. Benefits to National Economy from NASA Space Programs

1. It cannot be questioned that billions of dollars directed into research and development in an orderly and thoughtful manner will have a significant effect upon our national economy. No formula has been found which attributes specific dollar values to each of the areas of anticipated developments, However, the "multiplier" of space research and development will augment our economic strength, our peaceful posture, and our standard of living.

2. Even though specific dollar values cannot be set for these benefits, a mere listing of the fields which will be affected is convincing evidence that the benefits will be substantial. The benefits include:
a. Additional knowledge about the earth and the Sun's influence on the earth, the nature of interplanetary space environment, and the origin of the solar system as well as of life itself.
b. Increased ability and experience in managing major research and development efforts, expansion of capital facilities, encouragement of higher standards of quality production.
c. Accelerated use of liquid oxygen in steelmaking, coatings for temperature control of housing, efficient transfer of chemical energy into electrical energy, and wide-range advances in electronics.
d. Development of effective filters against detergents; increased accuracy (and therefore reduced costs) in measuring hot steel rods; improved medical equipment in human care; stimulation of the use of fiberglass refractory welding tape, high energy metal forming processes; development of new coatings for plywood and furniture; use of frangible tube energy absorption systems that can be adapted to absorbing shocks of failing elevators and emergency aircraft landings.
e. Improved communications, improved weather forecasting, improved forest fire detection, and improved navigation.
f. Development of high temperature gas-cooled graphite moderated reactors and liquid metal cooled reactors; development of radio-isotope power sources for both military and civilian uses; development of [4] instruments for monitoring degrees of

radiation; and application of thermoelectric and thermionic conversion of heat to electric energy.

g. Improvements in metals, alloys, and ceramics.

h. An augmentation of the supply of highly trained technical manpower.

i. Greater strength for the educational system both through direct grants, facilities and scholarships and through setting goals that will encourage young people.

j. An expansion of the base for peaceful cooperation among nations.

k. Military competence. (It is estimated that between $600 and $675 million of NASA's FY 1964 budget would be needed for military space projects and would be budgeted by the Defense Department, if they were not already provided for in the NASA budget.)

III. Problems Resulting from the Space Program

1. The introduction of a vital new element into an economy always creates new problems but, otherwise, the nation's space program creates no major complications. The program has, to a lesser magnitude, the same problems which Defense budgets and programs have been creating for several years.

2. Despite claims to the contrary, there is no solid evidence that research and development in industry is suffering significantly from a diversion of technical manpower to the space program. NASA estimates that:

a. The nation's pool of scientists and engineers was 1,400,000 as of January 1, 1963.

b. NASA programs employed 42,000 of these scientists and engineers—only 9,000 directly on NASA payrolls.

c. On this basis, the NASA space program currently draws upon only 3% of the national pool of scientists and engineers. [5]

d. Taking into account anticipated expansion, NASA programs are not expected to absorb more than 7% of our country's total supply of scientists and engineers.

3. The majority of the technical people working for NASA fall in the category of engineering. However, NASA's education programs are designed to help the universities train additions to the nation's technical manpower needs.

4. NASA has undertaken to support the annual graduate training of 1000 Ph.D.'s $^1/_4$ of the estimated overall shortage of 4,000 per year. This program would more than replace those drawn upon by the agency.

5. In overall terms, NASA finds that diversion of manpower and resources is not a major problem arising from the space program. A major problem, however, is the need to minimize waste and inefficiency. To help meet this challenge, turnover of top level Government talent should be reduced and compensation more in line with responsibilities would contribute to this objective.

IV. Reductions and Expansions in the NASA Program Without Affecting the Lunar Project

1. The fiscal 1964 NASA budget is divided between $4.4 billion for the manned lunar landing program and $1.3 billion for a multi-project scientific, research, and technology development and applications effort. Therefore, only 23% of the total budget is unrelated to the manned lunar landing program.

2. There are approximately 60 programs, projects and activities within this 23% of the budget. Examples include geodesy, orbiting observatories, planetary and interplanetary probes, international satellites, university program, advanced propulsion, and communications and meteorological developments.

3. It is pertinent under this heading to recall that the NASA budget requests for fiscal 1964 were reduced from $6.2 billion to $5.7 billion before the presentation to Congress. Further reductions would:

a. Lessen the quantity and quality of benefits to the economy.

b. Give additional ammunition to those who criticize the major funding weight given to the lunar program on the grounds that it diverts money from other programs. [6]

c. Disrupt manpower teams, delay the realization of goals, and ultimately lead to increased costs to the stretchout process.

4. Growth of the present favorable international attitude toward our space programs would be inhibited if the lunar program were favored through a reduction or elimination of projects which promote international cooperation or promise actual or potential benefits to foreign governments.

5. In light of current conditions, it is not considered practicable to increase the size of the program. However, in considering future budgets, attention should be directed toward such developments as:

a. NASA/DOD space station competence.

b. Nuclear rocket propulsion and auxiliary power.

c. Interplanetary exploration.

V. Coordination and Cooperation Between NASA and Defense

1. The difficulties of assuring a single National space program have been recognized from the beginning, NASA and the Department of Defense carry the major burdens, but the program touches widely divergent agencies of government. In order to assist in coordination and in avoiding duplication, the following steps have been taken:

a. The National Aeronautics and Space Council has been authorized and activated to advise and assist the President in coordinating the entire program.

b. The Aeronautics and Astronautics Coordinating Board (and its six panels) has been organized for high-level managerial coordination to integrate major Space projects in the early stages of their development.

c. Within the agencies, a number of coordinating arrangements operate at various levels.

d. More than 50 joint written agreements have been worked out between NASA and DOD spelling out lines of action in such fields as development of launch vehicles and spacecraft, administration of range facilities, and planning for communication satellites.

[7] 2. However, it is inevitable that controversies will continue to arise in any field as new, as wide ranging, and as technically complicated as space. Areas in which cooperation could be further improved are:

a. Coordination in joint planning of advanced projects to insure that divergent views are not prematurely curtailed and that unwarranted duplication between NASA and DOD is avoided in the initial development of these projects.

b. Further strengthening of cross-fertilization in the areas of research and technology to insure that NASA research is available for the solution of critical military problems and that military research is available for the solution of NASA problems.

3. It must be kept in mind that no mechanical application of a formula will insure maximum cooperation and coordination and a minimum of duplication and waste. Continuous monitoring at a high level is essential at every stage of the development of the space program. The Space Council will continue to function on the premise that no relaxation of its efforts is possible.

Conclusion

There is one further point to be borne in mind. The space program is not solely a question of prestige, of advancing scientific knowledge, of economic benefit or of military development, although all of these factors are involved. Basically, a much more fundamental issue is at stake—whether a dimension that can well dominate history for the next few centuries will be devoted to the social system of freedom or controlled by the social system of communism.

The United States has made clear that it does not seek to "dominate" space and, in fact, has led the way in securing international cooperation in this field. But we cannot close our eyes as to what would happen if we permitted totalitarian systems to dominate the environment of the earth itself. For this reason our space program has an overriding urgency that cannot be calculated solely in terms of industrial, scientific, or military development. The future of society is at stake.

Document III-17

Document title: NASA, *Summary Report: Future Programs Task Group*, January 1965.

Source: NASA Historical Reference Collection, History Office, NASA Headquarters, Washington, D.C.

In the last year of the Kennedy administration, the Bureau of the Budget and the White House Office of Science and Technology shifted focus from whether or not to go forward with Apollo to what programs NASA was likely to propose to follow the lunar landing program. After Kennedy's assassination, President Johnson asked NASA Administrator Webb on January 30, 1964, to identify future objectives for the civilian space program. Webb was quite reluctant to identify NASA's goals and priorities in advance of any expression of political support, a position he had taken even during the debates preceding the decision to go to the Moon; he preferred that NASA identify a variety of paths it *could* take, and then have top policymakers choose the option they wished to pursue.

This is the approach NASA took in response to the president's request. Webb appointed a Future Programs Task Group, headed by Frank Smith of the Langley Research Center, to prepare an overview of the capabilities that NASA was developing during the 1960s and the uses to which they might be applied. The group's summary report, completed in January 1965 (several months late) and not released publicly until April, set no priorities and made no recommendation, except to continue a "balanced" program in all areas of space activity. Some figures have been omitted from the excerpt printed here.

[ii]

Foreword

This summary report of the Future Programs Task Group, directed by Francis B. Smith of Langley Research Center, presents the results of studies made during 1964 to answer inquiries made by President Johnson as to criteria and priorities for space missions to follow those now approved for the decade of the 1960's.

The President's request was for a review of space objectives in relation both to what we have learned from our space efforts and to the most important emerging concepts of missions needed for scientific purposes and for advances in technology. The President requested that our evaluation be made in relation to estimates of time and funds required to complete programs already approved and under way.

The Future Programs Task Group was established to develop materials to meet the President's request. It has studied: (1) the capability being created in the present aeronautical and space effort; (2) next-step or intermediate space missions that could use or extend this capability; and (3) a number of long-range missions which deserve serious attention. This summary report, resulting from these studies, provides a source of information on accomplishments to date and indicates the general time periods within which we can assume or forecast the availability of further scientific and technical knowledge. It is, in addition to providing a review for the President, a timely and valuable working document for use within NASA and other agencies as a foundation for further analysis and discussion looking toward decisions that can be based on a broad consensus as to values and timing.

A major concern of the Task Group has been to identify the areas and levels of technology required to accomplish the most likely future missions and to provide a basis for informed decisions relating to the allocation of resources and timing for those which may be approved. Considerable attention has been given to steps we need to take to insure that these areas and levels or technology are available as needed.

The long range developments section of this report contains a discussion of the technology development programs which are under way in NASA and a number which should be given careful consideration in making future plans. Many of these programs are broadly based, but are also essential to provide optional means to accomplish the minimum under study and also provide a strong basis for judgments bearing on the value, time and cost elements.

James E. Webb
Administrator...

[1] Summary Report: Future Programs Task Group

I. Introduction

The successful flight of Sputnik I, in its most fundamental aspect, meant that man had taken the first step toward the exploration of a new environment by means of a new technology. It also meant that in the USSR, which accomplished this first step, new horizons were opened and there was a surge of national pride and accomplishment. An internal drive was created that changed the posture of Soviet society and lifted it above many of the frictions and tensions of the existing status. Horizons were widened. Internationally, the leadership and image of the Soviet Union were vastly enhanced. The flights of Gagarin and other Soviet Cosmonauts added impetus to a marked degree.

In the United States and in the Free World, as we all know, the immediate effects were quite the opposite. However, since then, we have made tremendous progress under a broad based and balanced program aimed at achieving preeminence in aeronautics and space.

Down through the course of history, the mastery of a new environment, or of a major new technology, or of the combination of the two as we now see in space, has had profound effects on the future of nations; on their relative strength and security; on the relations with one another; on their internal economic, social and political affairs; and on the concepts of reality held by their people. From the elements of each such new situation which history records, all or most of the developments listed in Figure 1 have materialized.

The long-range effects of man's entry into space, in person and by instruments and machines, can be best forecast in terms of these considerations. As a new environment, space may well become as important to national security and national development as the land, the oceans and the atmosphere; rockets and spacecraft as important as automobiles, trucks, trains, ships, submarines and aircraft. The foreseeable returns from scientific advances, technical advances, and practical uses compare favorably with the returns yielded

Fig. 1

Developments Which Generally Follow a Nation's Mastery of a New Environment and Technology

I. An increase in power and position through:
   A. The prestige of being first in new accomplishments; of being in control or sharing control of the new environment; and of possessing new knowledge and technology.
   B. The establishment of strategic international positions for traffic, communications, and trade.
   C. Wide use of new resources.
   D. Military capability through use of the new environment and technology.
   E. An increase in initiative, pride and drive toward accomplishment in all walks of life.
II. The appearance of new developments in the relations among nations: by negotiation, by cooperation, or by conflict.
III. Changes within national societies as a result of the forces listed above; of actions taken to compete in the new environment and to develop and use the new technology; and of the interplay of new knowledge, new thought, increased resources, and changed social relations.

Fig. 2

Basic NASA Aeronautical and Space Objectives

I. The scientific measurement and understanding of the space environment.

II. The development of a broad-based national capability for manned and unmanned operations in space and close cooperation with the Department of Defense and other agencies having current or potential needs related to such capabilities.

III. The development of the practical uses of space.

IV. Continued advancement in all areas of aeronautics in order to maintain world leadership in this field.

V. An adequate level of research and development to support other government agencies with needs or interests in aeronautics and space.

VI. The bringing together of government, industry, and university capabilities into an effective national system for meeting the needs of space exploration and use.

VII. The maintenance of a technological base in aeronautics and space adequate to meet all non-military needs.

VIII. The strengthening and efficient utilization of the nation's aeronautical and space-related resources in science, engineering and technology.

IX. The maximum utilization of the scientific and technical results of the space effort for non-space purposes.

X. The use of space for further international cooperation and understanding and for the good of all mankind.

by the most vigorous past periods of exploration of newly opened segments of man's expanding frontier.

[2] If these larger considerations of the space effort are to be adequately dealt with in terms of national policy, they must be translated into brood objectives in order that particular programs and missions can be defined and evaluated. For the United States,

these objectives relate aeronautics to space and are contained in the Space Act of 1958. They are outlined in Figure 2.

Under the Space Act, NASA bears the general responsibility for continuously providing an adequate underlying aeronautical and space capability and cooperating with the military services and other agencies which have, or anticipate, specific missions and uses. In 1958, and again in 1961, two major periods of wide debate and assessment brought decisions to undertake missions and programs which accelerated our progress toward the achievement of these objectives. The capability which has been created through the work thus begun and now under way will be the basis for this analysis.

First, however, we need to understand that we face certain conditions and constraints....

[7] **III. Major Capabilities Existing and Under Development**

The broad categories of capabilities which have been developed during the past 6 years, or are to be developed in current programs, are shown in Figure 4. The major categories are Aeronautics, Satellite Applications, Unmanned Exploration, Manned Operations, Launch Vehicles, and Technology.

Fig. 4

Major Capabilities Existing or Under Development

Aeronautics
- R&D hypersonic airplanes
- Operational supersonic military airplanes
- Commercial supersonic airplanes
- Improved subsonic aircraft including V/STOL

Satellite Applications
- Satellite pictures of Earth weather
- Intercontinental communications (including TV)

Unmanned Exploration
- Near-Earth exploration
- Solar effects
- Planetary and interplanetary probes
- Lunar probes and landers
- Biosatellites

Manned Operations
- Man in Earth orbit (1 to 2 weeks)
- Maneuver & rendezvous
- Lunar orbiting, landing and return

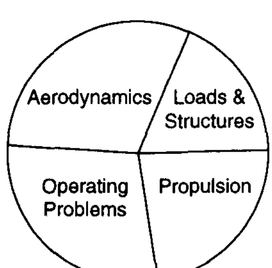
Launch Vehicles
- Up to 125 tons in Earth orbit
- Up to 47.5 tons to escape

Technology
- Power supplies of increased power and lifetime and decreased weight
- More accurate guidance and control
- Increased communications capability
- More accurate stabilization
- Life support for long periods
- Improved landing control systems
- Increased reliability

Fig. 5

FY 1965 In-House Aeronautical Research Effort

505 Professional Man Years



Aeronautics

The aeronautical program of NASA represents a continuation of a pattern of research activity developed by the National Advisory Committee for Aeronautics (NACA) over a period of more than 40 years. The in-house effort of this program is primarily basic and applied research activity at four NACA centers which were in existence in 1958 (the Langley Research Center, the Lewis Research Center, the Ames Research Center, and the Flight Research Center). This consists of in house and contracted-out work aimed at practical solutions of advanced problems of flight, but excludes the development of complete aircraft. Over many years the latter has been the responsibility of industry and other branches of the government with whom the NACA and now the NASA has developed effective working relations of collaboration and support.

For a number of years, the major portion of the NASA aeronautics effort has been in two areas. First, a basic research program in atmospheric flight. Three significant areas have received increasing attention—major increases in maximum flight speed, major decreases in minimum flight speed, and major increases in operational flexibility. Second, a continuing research and technology program in support of military and other government agencies and industry has pointed to continued evolutionary improvement of existing aircraft types.

Figure 5 shows the aeronautical research effort of NASA classified by broad areas and gives an idea of the size and distribution of the effort for Fiscal Year 1965. In-house effort is carried on by about 500 research professionals supported by 1500 additional in-house personnel. In addition to the costs of these personnel, $35.2 million of R&D funding for contracted-out research and development supports this effort....

Satellite Applications

[9] Significant successes have been achieved in NASA's applications satellite program during the past 6 years and the results are now being used to establish operational systems.

In the area of meteorology, nine TIROS satellites, launched since 1960, and one Nimbus satellite, launched in August 1964, have demonstrated the feasibility and value of Earth weather research and observation from satellites in orbit. One of the primary uses of the pictures returned by the TIROS satellite has been the identification and tracking of weather storms, including some 70 hurricanes and typhoons.

Based on NASA research and development success with TIROS, the United States Weather Bureau has adopted a modified TIROS system for its operational satellite system. This is expected to be ready during the winter of 1965-1966.

In the meantime, while we work toward operational systems, data from NASA's experimental TIROS weather satellites are used routinely by the Weather Bureau in the preparation of daily forecasts as well as for analysis in the area of climatology. The DOD also uses these data in the preparation of local forecasts in remote areas.

The Nimbus research and development weather (meteorological) satellite shown in Figure 9 is a significant advance over TIROS. Through three-axis stabilization and Earth orientation, continuous data on the Earth's weather is provided throughout its orbit. Its solar cells provide over 400 watts of power (10 times that of TIROS), and it can carry numerous types of meteorological experiments now emerging from our research program.

In addition to its television transmission system, the first Nimbus carried an Automatic Picture Transmission (APT) system and a High Resolution Infra-Red (HRIR) system. The APT system permits read-out of local cloud cover pictures by inexpensive ground stations, as shown by Figure 10, and will provide weather information to Department of Defense installations and the numerous foreign countries that have purchased or built, or plan to build, ground stations.

[10] A most significant achievement of Nimbus was demonstration of the capability and value of the HRIR system, illustrated in Figure 11. This system enables us to obtain for

the first time, in pictorial format and on a real time basis, cloud cover information from the dark side of the Earth. Cloud cover pictures such as these are reconstructed from measurements taken at night, and give an indication of cloud height as well as area coverage.

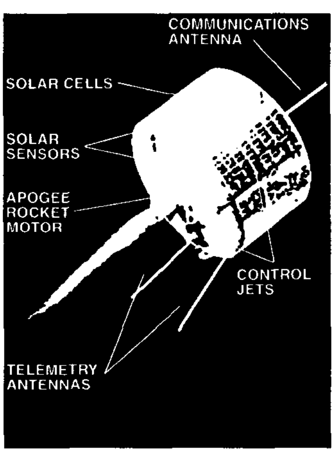
As illustrated in Figure 12, in the field of communications, the Echo passive satellite, and the Telstar, Relay and Syncom active satellites have experimentally proved out the technology for reliable, long-range point-to-point transmission of radio, television, telephone, teletype and facsimile via satellite. As a result, the Communications Satellite Corporation is now undertaking an international communications satellite system whose initial "Early Bird" satellite is based on NASA's Syncom.

Recently Syncom III, shown in Figure 13, transmitted real-time television of the Olympic Games from Japan to the United States. The precision achieved in the Syncom launch and positioning operations is indicated by the fact that Syncom Ill's period is almost synchronous and the inclination of the orbit is less than one-tenth of a degree from equatorial. This means that it moves north and south with respect to the Earth's equator less than 6 miles a day.

In addition to its primary communications function, Syncom has proved useful for scientific measurements used in better defining the shape of the Earth at the equator.

Fig. 13

SYNCOM Spacecraft
Active Synchronous Communication Satellite



Launch Weight	146 lbs. (including Apogee motor)
Control Systems	Gas jets
Propellant	Solid
Stabilization	Spin

Status
- SYNCOM I launched Feb. 14, 1963
  Achieved near synchronous orbit
- SYNCOM II launched July 26, 1963
  On station Aug. 16, 1963, at 55°W
  Communications "on" time
  over 4500 hours.
- SYNCOM III launched Aug. 19, 1964,
  into synchronous equatorial orbit
  over the Pacific Ocean.

Unmanned Exploration

The basic objective of this NASA program is to acquire fundamental knowledge of the space environment and of those phenomena which can be studied best from spacecraft, for both scientific and practical purposes....

[11] The unmanned space exploration program was initiated in 1958 when instruments carried by the first of the Explorer series of satellites revealed the existence of the Van Allen Belts encircling the Earth. Since that date, 26 Explorer and Monitor satellites... have been launched. These relatively small satellites, which have been placed in orbit by Jupiter C, Scout and Delta launch vehicles, are usually designed to make measurements of specific phenomena in space such as the distribution and energies of the particles trapped in the Earth's magnetic field (as with Explorers XIV and XV), ionospheric measurements

to determine electron densities and their variation bath diurnally and with changes in solar activity (as were made by Explorer VIII and the United Kingdom's Ariel 1), or other phenomena such as micrometeoroid flux and atmospheric structure.

As an example of some of the findings of one of the newer Explorers (Explorer XVI, launched November 27, 1963).... A transition region was found between the steady solar wind of interplanetary space and the magnetosphere, where the solar wind was turbulent and the magnetic field unsteady. Of extreme interest, also, was the discovery, on the fifth orbit, that the Moon as it moves through the solar wind apparently generates a wake that extends for a distance of at least 120,000 miles on the side away from the Sun.

This program of launching relatively inexpensive Explorer class satellites to make measurements of specific phenomena will be continued. A new series of Explorer satellites will carry payloads developed by universities and will also be used to continue international cooperation projects such as the U.K. Ariel II, the Canadian Alouette, and the Italian San Marco.

[12] The sounding rocket program is an important element of near-Earth exploration. It opens to investigation that vast region of the Earth's atmosphere that is too high for balloons to reach and too low for satellites. It also provides in-flight development testing of instruments and other equipment intended for later use in satellites. Further, new experimenters from universities, industry and foreign organizations are provided a logical and inexpensive way of gaining experience in space science techniques.

Shown in Figure 17 is the second generation of scientific satellites, the orbiting observatories. These larger satellites ore designed to make mare precise, more complex and better coordinated measurements of stellar, solar and geophysical phenomena.

The first Orbiting Solar Observatory, (OSO), was launched in March 1962, and successfully reported data on solar phenomena for well over a year. The second OSO, launched in February 1965, will continue making solar measurements during the present quiet period of the solar cycle.

The first of the Orbiting Geophysical Observatories (OGO) was launched in September 1964 into a highly elliptical orbit. Although 2 of the long booms shown did not deploy properly and the satellite was not stabilized as intended, 18 of the 20 experiments are operating and many of the objectives will be accomplished. The OGOs are designed to carry 20 to 50 experiments and will allow correlated measurements of Earth-related phenomena at a single point in space.

The first Orbiting Astronomical Observatory (OAO) will be launched in late 1965 or early 1966 and will allow the first extended observations of stars and planets from above the Earth's atmosphere. An eventual goal in this series of satellites to produce the capability of pointing a 36-inch telescope at a star to within plus or minus one-tenth of a second of arc, and one of its early experiments will be the mapping of the heavens in ultraviolet cave lengths.

Capabilities for interplanetary and planetary exploration were successfully demonstrated by Pioneer V, launched in 1960, and by the Venus probe, Mariner II, shown in Figure 18, which was launched in August 1962. Pioneer V set a record for that time by communicating to Earth from a distance of 22,000,000 miles, and returned new data on the interplanetary environment. Mariner II, 109 days after it was launched, passed close to the surface of Venus and [13] transmitted to Earth man's first close-up information about another planet. Although the data transmission capacity was limited, Mariner II gave us information on the surface temperature, magnetic fields, dust environment and radiation belts of Venus.

Mariner II also demonstrated the value of the mid-course maneuver capability on which we have standardized for guiding a spacecraft to a desired destination–in this case to within approximately 20,000 miles of Venus when it was 35,000,000 miles from the Earth.

The Mars probe, Mariner IV, was launched during the November 1964 opportunity. During its 8-month trip to the planet, this 575-pound spacecraft is making interplanetary measurements of the magnetic fields and solar winds. On arriving at the vicinity of the planet, the spacecraft, if operating properly, will make measurements of the Martian magnetic fields and radiation belts, collect some data on the Martian atmosphere, and will transmit to Forth about 20 television pictures of the planet's surface.

The Moon probe, Ranger VII, illustrated in Figure 19, gave man his first close-up look at the surface of Earth's nearest neighbor in space by transmitting approximately 4,300 television pictures to Earth in the last 15 minutes before it impacted on the lunar surface. Ranger also demonstrated our increased competence in mid-course maneuver capability, in this case to carry television cameras to within 10 miles of a preselected spot on the Moon's surface. It also demonstrated a communications capability for transmitting wide-band information over the quarter-million-mile Earth-Moon distance.

As illustrated in Figure 20, NASA is also developing the Lunar Orbiter and the Surveyor spacecraft for unmanned exploration of the Moon. Initial Lunar Orbiters, scheduled for launch in 1966, are designed to obtain topographic information by photographing an area of about 15,000 square miles with a resolution of 25 feet and of about 3,000 square miles with a resolution of 3 feet. Furthermore, the mass distribution and shape of the Moon can be determined from perturbations in the spacecraft's orbit. Later Lunar Orbiters will carry scientific instruments, as Well, that Will increase our knowledge of the lunar environment and of the surface and subsurface characteristics. The Surveyor spacecraft is designed to land on the Moon and make measurements of the bearing strength and composition of the lunar surface, to take close-up panoramic TV pictures of the lunar surface, to measure seismic activity, and to determine the flux of primary [14] and secondary particles impinging on the surface. The Surveyor and Lunar Orbiter will serve as a team to survey and select suitable sites for manned landings. The biosatellite program consists of orbital flights up to 30 days of recoverable capsules, which contain various biological experiments, illustrated conceptually in Figure 21. The experiments carried will range from studies of the effects of weightlessness and radiation on elemental cell functions to investigations of heart and nerve functions in primates immobilized for prolonged periods in a weightless condition. This program will use thrust-augmented Delta launch vehicles and take advantage of the recovery techniques developed by the Air Force in the Discoverer program.

Manned Operations

As illustrated in Figure 22, the current manned operations program provides an orderly progression of operational capabilities from the 2,900 pound Mercury spacecraft to the 7,000-pound Gemini, to the 95,000-pound Apollo-LEM system.

Figure 23 illustrates the progression of manned launch vehicles from the 368,000 pound thrust Atlas which launched the Mercury spacecraft to the 7 1/2 million-pound thrust Saturn V which will launch the Apollo.

The Mercury spacecraft, launched by the Atlas, provided this country's first capability for manned Earth-orbital flight and was used in the 3-orbit mission by John Glenn in 1962. The Mercury-Atlas system capability was later extended to accomplish Gordon Cooper's 22-orbit, 34-hour flight in 1963.

The Gemini two-man spacecraft, with its Titan II launch vehicle, will make possible missions of up to 14 days in Earth orbit, beginning in 1965. New equipment will permit orbit change, rendezvous and docking, and will enable the astronauts to venture out- [15] side the spacecraft into free space. Dual launches of the Gemini by Titan and the Agena by Atlas will place an unmanned Agena target into orbit and enable the Gemini astronauts to perfect the rendezvous and docking systems. These missions will verify the operations and techniques to be used later in the more ambitious Apollo missions.

In Project Gemini, NASA is providing a flexible, experimental space tool with which to flight test equipment, conduct scientific experiments, and develop techniques and provide training for Project Apollo. The Department of Defense Manned Orbital Laboratory will also make use of Gemini for the launch and return to Earth of the astronauts who will work in the laboratory.

As illustrated in Figure 24, the Gemini spacecraft consists of two major elements, the reentry module and the adapter, with a combined weight of 7,000 pounds. The reentry module provides life support and control equipment for the two crewmen, contains most of the experiments and also contains the rendezvous and recovery systems. The adapter element provides the link between the Titan II launch vehicle and the reentry module, and is composed of two sections, an equipment section to provide augmented life support, stabilization equipment and expendables for flight durations of up to 14 days, and a retrograde section to slow down the spacecraft from its orbital velocity.

Several of the Gemini missions are designated primarily as rendezvous missions to explore the feasibility of various modes of accomplishing rendezvous utilizing different levels of automation in the sensing and control equipment.

In a typical mission, an Agena engine will first be launched into a 160-nautical-mile circular orbit. The manned Gemini spacecraft will then be placed into a lower circular orbit at 130 nautical miles. The different periods of the two spacecraft in these concentric orbits will cause a continuing change in the relative position of the Gemini with respect to the Agena. When the relative positions are proper, the Gemini spacecraft will be accelerated in a transfer ellipse to the higher orbit where the rendezvous and docking will be accomplished. These missions will be short-lived because of the weight requirement for fuel which reduces the expendables that can be carried for life support, power supply, and stabilization.

[16] On the Gemini long-duration missions, primary emphasis will be placed an biomedical and behavioral aspects of man in a weightless condition; however, scientific and technical experiments are being planned for all missions. Specific experiments range all the way from visual definition experiments requiring no equipment and astronomical observations made with a 2-pound ultra-violet camera to radiometric or astronaut maneuvering experiments using equipment weighing as much as 200 pounds. The experiment program is tailored to the available weight, volume, and power in the spacecraft on each mission, as well as to the participation and accessibility which can be provided for the astronauts. Although the volume available for experiments within the pressurized cabin is limited, extra-vehicular operations are planned for the astronauts to permit free-space experiments, maneuvering, and other external operations such as the testing of manual dexterity and the use of specialized tools for spacecraft repair functions.

The Gemini spacecraft is already undergoing flight test. The successful launch of the first and second unmanned Gemini's in April 1964 and January 1965 will be followed soon by the first manned orbital flight. The easy access to the crew compartment is emphasized in Figure 25, which shows the Gemini spacecraft mockup.

The larger goals of the presently planned manned space flight program will be attained by the three-man Apollo-LEM system to be launched by the Saturn IB beginning in 1966 and by the Saturn V beginning in 1967. The Apollo Command and Service Modules, with fuel partially removed, will be launched first by the Saturn IB for Earth-orbital missions of up to 10 days duration. A number of such flights will be made in which rendezvous, docking, maneuvering, and other operations will be conducted.

Later, the total 47.5-ton Apollo-LEM spacecraft will be qualified in Earth orbit and eventually propelled to the Moon by the Saturn V, thus extending the area of space in which man can operate from near-Earth orbit to as far out as the Moon, and including the lunar surface.

The size of the Apollo-LEM spacecraft, shown previously in Figure 22, as compared with either the Mercury or Gemini spacecraft, is in part due to the longer duration of the Apollo missions, the larger heat-shield, and the increased crew; however, the major increase is due to the requirements for a large propulsion capability for maneuvering in space. The Service Module provides a propulsion capability for mid-course correction, lunar-orbit braking, and lunar-orbit escape, while the Lunar Excursion Module provides the capability for lunar landing and lunar takeoff.

The very large capability of the Apollo space exploration system (illustrated in Figure 26) will open a new era to manned space flight. Earth-orbital missions reaching out to synchronous orbit distances and of 14 days duration can be conducted, and lunar and other missions out to lunar distances will be possible, including one-day stays on the lunar surface for two men, or [17] 4 days stay in lunar orbit for three men.

On Earth-orbital, lunar-orbital, and lunar surface missions, provision is being made for the conduct of an extensive experimental program. Because of the increased size and the presence of man, these experiments will, in general, be more complex and extensive than those performed in unmanned vehicles. In the Command Module, volume has been provided for about 3 cubic feet of experimental equipment and with a return-to-Earth capability of about 80 pounds of instruments or lunar samples. In the Service Module, a complete empty bay provides an available volume of 250 cubic feet for the mounting of instruments; the weight available would depend upon the particular mission and the amount of fuel or other expendables required.

In the Lunar Excursion Module, 2 cubic feet of experimental equipment, weighing up to 80 pounds, can be installed within the existing ascent stage, and 15 cubic feet of instruments, weighing up to 250 pounds, an the descent stage in an area accessible to the astronauts while standing on the lunar surface. On all missions, however, the permissible weight of experiments must be evaluated against the comparable weight of expendables for fuel and life support, in order to extend the maneuver capability or duration of the mission.

A better impression of the room provided for experiments, as well as the progress that is being made in finalizing the design concept of the Apollo-LEM system, can be gained from the mockups of the major spacecraft elements shown in Figure 27. The area in the exposed bay in the Service Module could be utilized for installation of instruments that do not need direct monitoring by the astronauts. This space might also be used for carrying complete unmanned spacecraft in a piggy-back fashion for later deployment on unmanned space missions or for lunar surface probes.

Launch Vehicles

Figure 28 shows the boosters now included in the National Launch Vehicle Program which range from the Scout vehicle, capable of placing about 325 pounds in a 100-mile Earth orbit, to the Saturn V which will place about 250,000 pounds in the same orbit. The Thor/Delta vehicle, which will place about 930 pounds in a 100-nautical-mile Earth orbit or propel a 105 pound payload to escape velocity, has been the most successful of U. S. launch [18] vehicles, placing 26 payloads in Earth orbit out of 29 attempts. The capacity of the Thor/Delta has been improved recently by the addition of three 33-inch diameter strap-on solid rocket motors, giving about 25 per cent increase in Earth orbital payload capability. The thrust-augmented Thor/Agena will be capable of placing about 1,800 pounds in Earth orbit, when launched from the Western Test Range.

The two Atlas-based vehicles are the Atlas Agena and the Atlas/Centaur. The Atlas Agena can place up to 6,300 pounds in Earth orbit. It has been used successfully to launch the 750- to 800-pound Ranger probes to the Moon; and, on November 28, launched the 575-pound Mariner IV to Mars. The Atlas/Centaur, nearing completion of development, will accelerate 2,300 pounds to escape velocity or 9,700 pounds to Earth orbital velocity. It will be used as the launch vehicle for the Surveyor spacecraft designed to achieve a soft landing on the Moon.

The Centaur was the first rocket stage to use hydrogen and oxygen as fuel, a combination which gives an increase in specific impulse from about 300 seconds, available with standard fuels, to more than 400 seconds. This is an improvement of particular importance to missions requiring velocities equal to, or higher than, that far Earth escape.

The Titan series of launch vehicles is under development by the Department of Defense. The Titan II is used by NASA to launch the 7,000-pound, 10-foot diameter Gemini spacecraft. The Titan IIIA (not illustrated) consists of the Titan II to which an additional stage, called the trans-stage, has been added. The addition of two 120-inch solids to the IIIA produces the IIIC (illustrated in Figure 28), which will place about 25,000 pounds in low Earth orbit or propel about 5,000 pounds to escape velocities.

In the Saturn family of vehicles, the Saturn IB is capable of placing 35,000 pounds in Earth orbit; and the Saturn V, 250,000 pounds. The Saturn V will also accelerate 95,000 pounds to Earth escape velocity.

The Saturn program indicates the use of standardized rocket engines. The first stage of the Saturn IB is made up of eight LOX-RP-1 fueled H-1 engines – an up-rated version of the S-3 engines that were developed for the Atlas booster. The upper stage of the Saturn IB uses one hydrogen-oxygen S-2 engine which will also be used in a cluster of five to power the second stage of the Saturn V.

In the Saturn V, five 1,500,000-pound thrust F-1 engines power the first stage. The second stage will use five J-2 engines. The third stage uses one J-2 engine and is almost identical to the second stage of the Saturn IB.

These vehicles thus provide a wide range of launch capabilities based on a minimum number of [19] engine types. However, it is important to note that there are wide gaps in escape payload capability between the 950 pounds of the Atlas/Agena, the 2,300 pounds of the Atlas/Centaur, the 5,100 pounds of the Titan IIIC, the 13,000 pounds of the Saturn IB/Centaur, and the 95,000 pounds of the Saturn V.

Technology

The technological base which supports the development of the mission capabilities described has been made possible by the experience gained by our military services in the ballistic missile program and the broad research and technology development programs carried on by industry and by NASA. When the space age began in 1957, the reserve of technology which could be tapped to meet the immediate needs of the United States proved insufficient. The reliability and thrust of the launch vehicles, for example, were far short of that required to meet the challenge of the Soviet space program. However, due to the foresight exercised at that time in undertaking, without specific end uses in sight, the development of the 1-1/2 million-pound thrust F-1 engine, and other important projects, this country was able to make sound technical decisions when it became necessary to expand its space program in 1961. This expanded program is designed to assure United States leadership in space and to be ready to respond when national needs or objectives require new aeronautical or space systems. With respect to such a large, complex, and unknown environment as space, and the still not precisely defined characteristics of the Earth's atmosphere, this Nation would be oblivious to the lessons of history if it required that all its exploratory research and development efforts be matched to completely defined missions. It is clear from the 1958 Aeronautics and Space Act that NASA was established to make sure we would develop the capability which was clearly lacking at that time, and to develop the kind of policies and priorities that would do the job needed. Where there is reasonable promise of success in the development of such things as new materials, propulsion systems, or techniques, it is NASA policy to pursue these directions even though a specific use is not clearly defined. We have found that we can organize these efforts so as to point at broad classes of possible uses, giving the necessary technical base for options as to missions and the best ways to accomplish them. In his testimony before the Committee on Science and Astronautics on February 4, 1964, Dr. Hugh Dryden recalled how the United States, despite initial positions of advantage, failed to carry forward work of which it was capable in aeronautics, in jet propulsion, in ballistic missiles, and in the launch vehicles and spacecraft necessary for space exploration. The result in each case was that other nations moved ahead, placing the United States at a disadvantage and requiring an enormous effort to catch up. Our present relative position in space leaves no room for complacency. As Dr. Dryden said, "We must not delude ourselves or the nation with any thought that leadership in this fast moving age can be maintained with anything less than determined, whole-hearted, sustained effort."

It is on this basis that NASA is continuing to carry out a broad, long-range program in research and technology development. This program is aimed at the establishment of future mission capability, and it can be expected that new advances in technology will be made and will provide a better basis of judgment than we have had before as to the value of missions and projects and as to when they can be undertaken at reasonable costs and risks.

In the next two sections of this report, dealing with intermediate and long-range missions, we shall attempt to identify, when possible, the technological advances that are required for their accomplishment. These research and technology development programs will be discussed in [20] detail following the section on long-range missions.

Same examples of the capabilities which have been, or are being, developed to date are:

a. Solar cell power supplies capable of producing 650 watts.

b. Guidance and control capabilities for placing a spacecraft within a few thousand miles of a distant planet, or within a few miles of a given point on the Moon.

c. Communications technologies which provide almost continuous communications with manned spacecraft in Earth orbit, the transmission of about five television pictures per second from the Moon, or radio reception from a spacecraft over a 100 million miles in space.

d. Spacecraft stabilization technology which will enable precision instruments to be pointed, in some instances, to within $^1/_{10}$ second of arc.

e. Life support systems which will enable three men to remain in space for as long as 14 days and to venture as far as 250,000 miles from the Earth.

f. The reliability of both spacecraft and launch vehicles. Spacecraft reliability has been improved to the paint where many unmanned spacecraft now have lifetimes of well over one year, and manned spacecraft will be capable of dependable operation for 14 days or longer. Reliability of launch vehicles has been improved to such an extent that the per cent of successful vehicle launches has risen from about 60 per cent in 1960-61 to over 90 per cent at the present time.

g. A world-wide tracking, data acquisition, and communications system to support manned flight, scientific and application satellites, injection, monitoring, and deep space probes, as illustrated in Figure 29.

Along with the missions which are being undertaken and the capabilities which are being developed, the first years of the Nation's effort in space have produced a broad scientific and industrial base, and the facilities and management systems needed far carrying out an effective program of space exploration.

A major part of our present space capability is found in the expansion of NASA since 1961. About 2-$^1/_3$ billion dollars have been invested in strengthening the industrial facilities and government laboratories associated with aeronautical and space research and in adding new installations. These include the Goddard Space Flight Center in Maryland, the Michoud Plant at New Orleans, the Mississippi Test Facility in southern Mississippi, the Manned Spacecraft Center at Houston, Texas, and the New Merritt Island Launch Facility at Cape Kennedy, of which the Saturn/Apollo Vehicle [21] Assembly Building is shown in a cutaway view in Figure 30. The exacting demands of space systems in the electronics Field have also required a new Electronics Research Center which will conduct and supervise research in this vital field from its location in Cambridge, Massachusetts.

NASA has contracted out more than 90 per cent of its research and development work. Over 1,600 manufacturing firms have held prime contracts of over $25,000 and about 20,000 firms have worked under prime or sub-contracts. Surveys made by 12 more prime contractors disclosed 3,000 subcontracts of over $10,000 to sub-contractors located in all 50 states. During slightly over 6 years of operation, NASA contracts have totaled more than $13 billion, adding great strength to the country's industrial base.

The conduct of space research and development, involving the design and manufacture of the most complex systems ever attempted, is demanding major improvements in methods of conducting large-scale organized effort. Included are new methods of production control, systems integration and checkout, and reliability and quality control.

The substantial expense involved in launching space vehicles, and the intricacy of the devices involved, have imposed unusual requirements of precision manufacture and quality assurance. As a consequence, increasing reliance is being placed upon incentive contracts, and new ways of encouraging improved government personnel and contractor performance are being developed.

The space program is indeed a large and varied research and development effort. The harsh environment of space requires major advances in all areas of technology, in materials, in electronics, in propulsion, in guidance and control, in power sources, in lubricants and coolants, in communications, in the integration of systems and the establishment of high levels of reliability, and in the maintenance of human life in space. It is already clear that our balanced and broadly-based space effort is producing important scientific and technological advances that are not limited to space use.

Experiments or pilot model efforts, through which these advances constituting major National resources for both security and economic growth can be made available quickly and efficiently for non-space use, are being carried out. NASA has established a program in technology utilization, with headquarters in Washington and with offices in each of the NASA centers. Innovations are being identified and described in appropriate publications; these are disseminated widely. Regional dissemination centers have been established on a trial basis at a number of universities. At each of these, NASA material is put on computer tapes and access provided to industrial concerns who support these centers through user fees and contributions. This system makes this material available within about 6 weeks of it's reporting date to Headquarters from both NASA centers and contractors, and makes it available on a selective basis conforming to the interests of the users. The system also provides a method by which the user can secure [22] complete, in-depth information on any advance in an area of particular interest. The objective of this program is to spread the advanced technical industrial capabilities developing in the space program within and beyond the government contractor population to the maximum extent practicable, and particularly to bring about the identification and practical utilization by American industry of new processes and products developing in the space program.

Scholars in the Nation's universities conduct much of the basic research, and prepare many of the experiments required for advances in space science. The breadth of the program has produced, at many universities, new requirements for interdisciplinary cooperation and participation among the scientific specialties, and between science and engineering.

NASA-supported research effort in universities involves both project-related research, as illustrated in Figure 31, and a Sustaining University Program comprised of training, research and facilities grants. Under the training program, 142 universities have received grants to support a total of 3,132 candidates for predoctoral training fellowships in space-related fields. Research grants under the Sustaining University Program have been made to 53 educational institutions, most of them involving interdisciplinary effort, and many of them "seed grants" aimed at strengthening research activity at universities capable of expanding their research programs. A total of 27 facilities grants is shown in Figure 32) have been made to universities to provide additional laboratory space required in the performance of space-related research.

A significant element in the overall NASA university effort, particularly in the case of those universities receiving facility grants, is the encouragement of a closer working relationship between the university research activities and those businesses and industries with which the university already has close relations. This aims to facilitate the transfer of space research results to practical, industrial application. Memoranda of understanding accompanying the facility grants provide that the university will, in an organized and interdisciplinary manner, seek ways in which such transfers can be achieved, and strive for closer relationships with the business community.

[23] Participation in the U. S. space program has not been limited to this country. Individuals or agencies in 69 nations throughout the world have joined the United States in space projects, including the establishment of tracking and data acquisition stations, as illustrated in Figure 33. In all of these projects, cooperation has been literal and substan-

tive, requiring significant contributions from both sides, without financial exchange, and meeting the test of scientific value.

NASA has launched four satellites in cooperation with Great Britain, Canada, and Italy and has existing agreements to launch others with all of these countries as well as with France and the European Space Research Organization. The present practice in these projects is that the cooperating country conceives and engineers the complete satellite, using its own resources.

Individual experiments proposed by foreign scientists, sponsored by their governments and selected on their merits, are also accommodated in NASA satellites. One British experiment flew on Explorer 1, and 12 other British, Dutch, and French experiments are scheduled for inclusion on NASA satellites which will be launched over the next few years.

NASA has participated in cooperative sounding rocket projects with 14 countries, involving more than 100 cooperative launchings, and currently has agreements for launching nearly 50 more in such projects. The multitude of foreign sites established for this program and the extent of capability stimulated by it vastly increase the possibilities for synoptic research, while reducing its cost.

A wide variety of ground-based cooperative projects involving foreign scientists has been organized to produce observations or measurements enhancing, and sometimes even necessary to, NASA's orbiting experiments. Thus, 42 countries have collected local meteorological information for correlation with TIROS observations, and 11 countries have already built, or will soon complete, ground terminals necessary for test transmissions in connection with our communications satellite programs.

Under international scientific and technical personnel exchanges, 103 gifted foreign Research Associates have contributed their talents to work in NASA centers, 84 International Graduate Fellows have trained in U. S. universities, and 180 foreign technicians have trained at NASA centers in support of cooperative projects and ground facility operations.

This completes the review of the capabilities which have been developed during the first 6 years of space exploration, or which will be developed within this decade. . . .

[61]

VI. Summary

Our study of future programs has covered three major categories as illustrated earlier in Figures 4, 34, and 54, repeated here for ease of reference. These have covered:

a. A review of the capabilities being developed by current programs;

b. Intermediate missions which would support National objectives in space and afford steady progress toward longer-range goals, and at the some time make most effective use of capabilities developed thus far; and

c. Long-range missions which may comprise the Nation's space exploration goals in the decades ahead.

In the areas of aeronautics, satellite applications, unmanned and manned space exploration, launch vehicles, and research and technology development, it is possible to trace horizontally the development path from 1958 to a decade or further into the future. It is obvious that there is increased uncertainty as the plans are projected into the future.

The details of these new missions, such as specific spacecraft designs and exact mission plans will, of course, be the subject of continued study by Headquarters and Field Centers of NASA, by interested government agencies, by universities, and by industry. Continued [62] space exploration will be an evolutionary process in which the next step is based largely on what was learned from the experience of preceding research and flight missions. The pace at which these new programs will be carried out will necessarily depend upon many other factors, such as the allocation of budgetary and manpower resources and the changing National needs of the future.

This study has not revealed any single area of space development which appears to require an overriding emphasis or a crash effort. Rather, it appears that a continued balanced program, steadily pursuing continued advancement in aeronautics, space sciences, manned space flight, and lunar and planetary exploration, adequately supported by a broad basic research and technology development program, still represents the wisest course. Further, it is believed that such a balanced program will not impose unreasonably large demands upon the Nation's resources and that such a program will lead to a preeminent role in aeronautics and space.

Fig. 34

Intermediate Missions—Extensions of Present Capabilities

Aeronautics
- Supersonic transport
- Hypersonic engine development
- V/STOL

Satellite Applications
- Applications technology satellites
- Direct broadcast FM
- Communications/navigation satellites
- Meteorological observation technology

Unmanned Exploration
- Observatories, Pioneers and Explorers continued
- Planetary fly by, orbiters, and landers

Manned Operations
- Earth orbit application (1 to 2 months)
- Equatorial orbits
- Polar orbits
- Synchronous orbits
- Rendezvous, inspection, repair, and rescue
- Lunar mapping
- Extended stay in Lunar space (3 to 14 days)

Launch Vehicles
- Saturn 1B Centaur
- 7000 lb. high energy stage

Technology
- Isotope power supplies (1 to 2 kW)
- Guidance and control (within miles of point on Mars)
- Communications (3000 bits/second from Mars)
- Stabilization
- Propellant storage
- Life support (3 men, 1 to 2 months)
- Sterilization
- Reliability

Fig. 50

Extended Apollo Mission Capabilities

Mission	Configuration	Orbit N M Incl	Duration Days	Payload Lbs	ΔV fps	Equivalent Plane Change deg
Earth Orbit	Sat IB/XCSM/LEM AS	200/30°	30	5,000 0	0 2,000	— 4
Earth Orbit	Sat V/XCSM/LEM ASP Initial	200/30°	30	210,000 0	0 26,000	— 60
			90	200,000	0	—
Earth Orbit	Sat V/XCSM/LEM AS	200/Polar	30	17,500 0	0 4,000	— 9
Earth Orbit	Sat V/XCSM/LEM AS	200/Polar	60	12,500 2,000	0 2,000	— 4
Earth Orbit	Sat V/XCSM/LEM AS	Synchr/0°	30	9,500 0	0 1,500	— 9
Earth Orbit	Sat V/XCSM/LEM AS	Synchr/28°	60	10,000	—	—
Lunar Mapping	Sat V/XCSM/LEM ASP	80√/Polar	28	9,500	—	—
Lunar Surface Exploration	Sat V/XCSM/LEM Dual Launch	Lunar Surface	14	2,500	—	—

Notes XCSM—Apollo command and service module with additional subsystems and expendables
LEM AS—LEM ascent stage without subsystems, dependent on XCMS
LEM ASP—LEM AS plus LEM descent stage propulsion

Fig. 51

Manned Earth Orbit Experiments

I Space Sciences
- Biosciences
- Physical Sciences
- Astronomy/Astrophysics

II Earth Oriented Applications
- Atmospheric Science and Technology
- Earth Resources Survey and Inventory
- Communications

III Support for Space Operations
- Advanced Technology and Subsystems
- Operations Techniques/Subsystems
- Biomedical/Behavioral

Fig. 54

Long-Term Development

Aeronautics
- Hypersonic transports
- Recoverable orbital transport
- Commercial V/STOL aircraft

Satellite Applications
- Direct TV broadcast
- Navigation & traffic control
- Continuous global weather observation

Unmanned Exploration
- Probes & landers to distant planets
- Solar probes
- Galactic probes

Manned Space Exploration
- Conventional take off and landing of space vehicles
- Flexible Earth orbital operations
- Large permanent space laboratory
- Roving Lunar vehicles and Lunar bases
- Planetary exploration

Launch Vehicles and Propulsion
- 1 million pounds in Earth orbit
- Recoverable boosters
- Nuclear engines
- Electric propulsion

Technology
- Nuclear & isotope power supplies (megawatt)
- Guidance & control (controlled landings at desired locations on other planets)
- Communications (wide band communications with planetary vehicles)
- Stabilization
- Permanent life support systems
- Reliability

Fig. 68

Lunar Landed Payloads

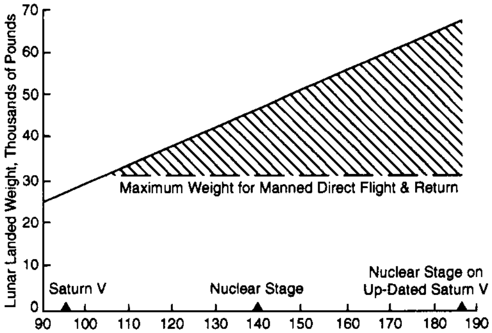
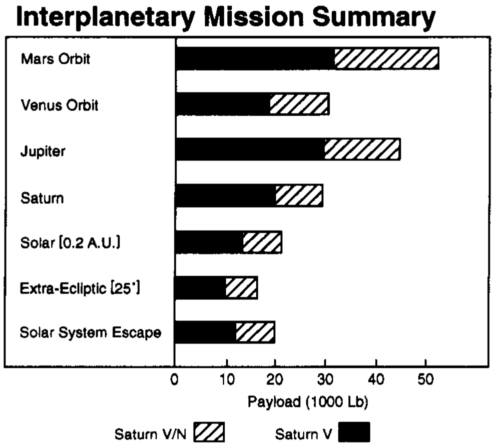


Fig. 69



Document III-18

Document title: James E. Webb, Administrator, NASA, to the President, August 26, 1966, with attached: James E. Webb, Administrator, NASA, to Honorable Everett Dirksen, U.S. Senate, August 9, 1966.

Source: NASA Historical Reference Collection, History Office, NASA Headquarters, Washington, D.C.

By 1966, the NASA budget had peaked, and the agency's future, once Apollo had been completed, was unclear. NASA Administrator Webb was becoming increasingly frustrated by the unwillingness of the White House and the Democratic-led Congress to support the budget for the space program that he thought was needed to continue a productive effort. The Bureau of the Budget had reduced NASA's fiscal year 1967 budget request by $712 million, and in August Senator William Proxmire (D-WI) proposed that the Congress reduce the budget by another $1 billion. To counter the Proxmire proposal, Webb had to seek the support of the Republican leader in the Senate, Everett Dirksen (R-IL).

Webb attached the letter he had sent to Dirksen, which sought his help in defeating the Proxmire amendment, in this August 26 letter to President Johnson in which he expressed his growing unhappiness with NASA's outlook. In particular he protested the guidelines for the fiscal year 1968 budget that had been given to the agency by the Bureau of the Budget, which to Webb's thinking were inconsistent with a plan for the president to give a speech setting out "a ringing challenge for the next half century in space."

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[1] Dear Mr. President:

Almost six years ago when you urged me to accept the responsibilities which devolve upon the Administrator of the National Aeronautics and Space Administration, I asked if my task would be to carry out a preconceived program or to figure out what needed to be done and do it. You said, "the latter," and, of course, this was on the basis that President Kennedy would have to approve whatever you and I worked out. You will remember that in the sessions you had in 1961 with your advisers and Congressional leaders, I was quite reluctant to undertake the responsibility of building a transportation system to the moon and that you had to almost drive me to make the recommendation which you sent on to President Kennedy.

As to my discharge of this responsibility after the decision was made, and of the other responsibilities inherent in the aeronautical and space science activities of NASA, you are in position to judge. I believe the record justifies your continued support. There are few, if any, enterprises of such size and inherent difficulty that have yielded more total value in proportion to resources invested.

In presenting your 1967 budget to the Senate Subcommittee on Appropriations, I used this language and furnished you a marked copy:

"This budget has been carefully drawn by the President to reflect total national requirements. For NASA this is a particularly stringent budget. We are midway through a ten-year effort to achieve preeminence in all fields of aeronautics and space. This budget is less than we need to carry out this effort with greatest efficiency and minimum risk. Every expenditure that can be deferred until 1968 without causing gaps in our activity has been deferred. This budget provides for continuation of our ongoing efforts and a [2] few long lead-time items for the post-Apollo period. It provides no alternate or backup vehicles."

"The program we began presenting to you in 1961, and have elaborated in each succeeding year, was intended to meet fierce competition and end up ahead. It was also intended to give us a number of options in space from which we could choose those offering the greatest advantages at the least cost. The competition is still fierce, and we are not yet able to feel assurance that we will end up ahead in the option areas where the Russians are developing their strongest potential. A $5 billion budget level in the years ahead will not be adequate to develop and utilize the options we are now in the final stages of developing. Many of these show clear indications of usefulness far beyond their cost.

"In my view the main question which this committee must consider as it takes up the 1967 budget is whether we can or will continue to meet the challenges and pursue the opportunities opening up in space."

"Along with austerity, the NASA authorization request reflects the President's determination to provide sufficient resources to hold open for another year and not to foreclose the major decisions on future programs where failure to apply resources this year would make it impossible to act effectively next year. Most of these relate to whether to make use in 1970 and beyond of the space operational systems, space know-how, and facilities we have worked so hard to build up, or to begin their liquidation."

The combined effect of the action taken by the Senate and House Conferees on our appropriation, which puts us below the above-mentioned $5 billion figure for FY 1967, and the guidelines furnished us by the Bureau of the Budget for the 1968 submission leave no choice but to accelerate the rate at which we are carrying on the liquidation of some of the capabilities which we have built up. Important options which we have been holding open will be foreclosed. Further, the actions we must take will bring into play [3] forces of doubt and uncertainty in the minds of many whose competence, skill and courage have kept us above that thin line that divides success from failure.

There has not been a single important new space project started since you became President. Under the 1968 guidelines very little looking to the future can be done next year.

Struggle as I have to try to put myself in your place and see this from your point of view, I cannot avoid a strong feeling that this is not in the best interests of the country.

I know the heavy total responsibility which you bear, Mr. President, and believe firmly in the actions you are taking to make clear to the Communists that you have on call a large measure of power based on the kind of technology NASA is developing and that you are prepared to employ it to make sure they sustain a loss instead of a profit when they undertake excursions such as that in Vietnam. I have no desire to add to your burdens and have had serious doubts that I should involve you in a protest of your 1968 guidelines. However, when Mr. Moyers telephoned that you wanted to make a speech on space that would chart a course that would constitute a ringing challenge for the next half century, and include where we have come, where we have to go, and the benefits from the program, I decided I should let you know my feelings. They are set forth in the enclosed letter which I sent Senator Dirksen the day we had to collect up the votes to beat Senator Proxmire. I hope you can find time to read it. It is never an easy thing to decide the time has come to ask for help from the minority leader. The senior member of our committee, Senator Russell, voted to support Proxmire, as did Senator Robert Kennedy. Without the effective work of Senators Anderson, Magnuson, and Smith, with considerable help from Allott, we would now be facing a catastrophic emasculation of what we have labored so hard to build up.

If it is your purpose to enunciate a ringing challenge for the next half century in space, Bob Seamans and I will be right with you, but we cannot deliver the kind of successes we have had with the thin budgetary margins of the past three years.

With warm and affectionate personal regards, highest respect, and deep appreciation of your many acts of friendship and support, believe me

Sincerely yours,
James E. Webb
Administrator

[1] August 9, 1966

Honorable Everett Dirksen
United States Senate
Washington, D.C. 20510

Dear Senator Dirksen:

In accordance with your request for information on the effect of the Proxmire proposals to cut up to $1 billion from the space budget for Fiscal 1967, the best I can do in the short time between now and your deadline of noon is to state the following:

1. Through NASA, the nation is in the process of investing approximately $40 billion in the scientific measurement, development of engines, machines and the know-how to operate them, and in the use of this scientific knowledge, technical capability, know-how and machines to make use of both the air and the space region around the earth for practical, economic, and international purposes. Another factor is to make sure we do not wake up some day and find others in possession of the power to deny us the use of space. Beginning in 1958, the various non-military agencies of government were brought together to retrieve the position of leadership in space which we had lost to the Russians. A program looking toward the expenditure of from $22 to $25 billion over a period up to 1975 was initiated by President Eisenhower. With the dramatic capability demonstrated by the Gagarin flight in 1961, this was augmented and speeded up under the leadership of President Kennedy and Vice President Johnson with strong bi-partisan support. Over the past five years, the Congress has appropriated about $22 billion to carry out this effort and a dramatic build-up has taken place as demonstrated recently by the successful Gemini flights and the Surveyor landing on the moon. Right behind these tremendous efforts and these clear demonstrations of the correctness of our engineering approach, our knowledge of the environmental conditions to be met, and the validity of our system of management which allocates over 90 percent of the doing of this job to American industry, we now find ourselves facing an even greater requirement. The end result of an investment involving between $15 and $16 billion in advanced equipment that can far exceed anything we have seen demonstrated yet is now flowing toward our installations for test and on to Cape Kennedy for launch.

[2] 2. While the above five-year record has been achieved within the estimates of cost provided to the Congress at the beginning, we find that reductions made by the Congress in Presidential requests have been largely responsible for slowing up the program by two years and adding more than twice the amount of these reductions to the cost for doing the same amount of work. The reductions made by Congress over five years have amounted to $1,100,000,000 and the increase in cost will amount to $2.7 billion. The enclosed summary of this situation supplied to the Senate Committee on Aeronautical and Space Sciences at the request of Senator Margaret Chase Smith further explains what has happened.

3. For Fiscal Year 1967, the President reduced our request for funds by $712 million, with the result that under the most favorable circumstances the work force in the factories and laboratories of some 20,000 industrial companies, financed by NASA, will be reduced by from 60 to 80 thousand workers. This drastic reduction will have to be made at a time when the Civil Service personnel in NASA centers must take the responsibility for the final test and launch of the end results of the large investments referred to above. The Proxmire proposals would require a further cut of about 100,000 workers and the momentum and effectiveness of the program would, in my opinion, be utterly destroyed. These proposals can only be based on a complete lack of understanding of what it takes to build up a work force of over 450,000 people, proceed rapidly but without the waste of a crash program to develop advanced equipment that can operate with men out to the moon and with automated equipment out to Mars and Venus and then utilize this capability to increase the power of our nation to have on effective voice at the time the largest decisions as to the future of the development of the human race on this planet will be made. Those of us who have had to take the responsibility for what I am describing have little doubt that the balance of technological power among nations is rapidly becoming one of the most important determinants of national economic, social, and political viability as well as leadership in international affairs.

4. Over the past five years, NASA has invested about $22 billion in facilities to permit us, for from 25 to 50 years, to keep a constant challenge before the Russians or any other nation in the utilization of advanced aeronautical and space systems. American [3] industry has invested another $630 to $650 million in capital items, such as test stands, vacuum chambers, etc. The 1967 NASA budget includes $95 million to round out and complete this very large investment and make all of it worth more to the country.

5. We have already sent men into space 22 times before the eyes of the world and brought them back. One failure would have hurt our nation. Within the next three months, we should complete the 12 flights of the Gemini program and move on to the Apollo flights. This will involve the use of the very large Saturn boosters which concentrate in one machine the rough equivalent power of a small atomic bomb. Because of the danger, we must fuel and launch these machines automatically with no human being within miles of the launch pad except the three astronauts on the nose of the rocket. This has never been done before. The burden of doing the final perfection, correcting faults, proving reliability and launching these very large systems with the entire rocket and payload in place on every launch, even the first one, takes high competence, the availability at the launch site of every item required for success, and a good deal of self-confidence and guts. We have built the organization to see this job through, but we cannot hold it together on an up-and-down basis.

6. As to the period beyond 1970, the production lines for our nation's only really big boosters are going to grind to a halt unless we can buy the long lead-time items required to support them. Even if production is continued, these boosters are going to have nothing like the value they could have for our future if we cannot use the scientific and technical knowledge we are now buying at such great cost to do the necessary planning and testing of the payloads, earth sensing equipment, and requirements for operating over long peri-

ods in space which these boosters now open up to us. Senator Proxmire's proposals will, in my view, shortly put us back to the kind of frustration and inability to meet the USSR space challenge that we felt in 1958 with Sputnik and in 1961 with the Gagarin flight.

7. The capability to use our very large rocket engines, advanced electronics, and ability to marry these capabilities with those of the human being, as shown in our Gemini flights, has significance far beyond landing on the moon. What we have done [4] in space shows a can-do nation building strength in science, technology, engineering and management, teaming up its scientific, industrial and governmental institutions to meet the requirements for operating in the new and unlimited environment of space and developing the kind of national capability that will ensure that we are present when the big decisions affecting our future and that of hundreds of millions of people are made.

8. There is no doubt in my mind that cuts made in this program now will have to be restored and multiplied within the next year or two as the Russians begin to use the capability they are in process of developing for flying very large payloads. Beginning in the 1950's we saw them step over what we could do with our Atlas and Titan boosters with the Vostok and Voskhod systems. They clearly have the capability with the booster that has flown the Proton series to step over the capability of the Saturn IB and get up to some 50,000 pounds in orbit. I believe they are now rapidly building the capability to leap-frog over the kind of payloads the Saturn V can boost into space.

9. In the years since 1958 NASA has shown the ability to get a great deal for every dollar of the investments made in aeronautics and space. We urgently need your support in order that some of the most important matters affecting the future of this nation are not put in jeopardy by on ill-considered action. The committees of Congress charged with the responsibility have officially approved the President's budget, and I would hope their judgment could be confirmed. Many of the statements being made in support of large cuts in the NASA budget simply will not stand up on close examination.

I appreciate your desire to understand this situation, and hope I have differentiated the NASA program from some of those you have characterized as "non-essential spending."

Sincerely yours,
James E. Webb
Administrator

Document III-19

Document title: James E. Webb, Administrator, Memorandum to Associate Administrator for Manned Space Flight, "Termination of the Contract for Procurement of Long Lead Time Items for Vehicles 516 and 517," August 1, 1968.

Source: NASA Historical Reference Collection, History Office, NASA Headquarters, Washington, D.C.

To ensure that there were enough heavy-lift boosters to complete the Apollo program, NASA had contracted for the elements of fifteen Saturn V vehicles. George Mueller, Associate Administrator for Manned Spaceflight, hoped to keep open the various production lines involved in the Saturn V program, anticipating that there would be other uses for the giant vehicle—extended lunar exploration and launching a space station, for example—that would require a heavy-lift capability during the 1970s. The first step in ensuring that this could be done was to contract for those components of the vehicle's S-1C first stage that required the longest time to manufacture. In mid-1968, Mueller requested authorization from James Webb to enter into such contracts.

Webb's answer was negative—no uses for Saturn Vs beyond the original fifteen had been approved, and the budget outlook for such approval was gloomy. This memorandum was thus the first step in a process that led to a 1970 decision to terminate the Saturn V program.

Memorandum to Associate Administrator for Manned Space Flight

SUBJECT: Termination of the Contract for Procurement of Long lead Time Items for Vehicles 516 and 517

REFERENCE: N memorandum to the Administrator, dated June 2, 1968, same subject
D memorandum to the Administrator, dated July 31, 1968
AD memorandum to M dated July 13, 1967

After reviewing the referenced documentation and in consideration of the FY 1969 budget situation, your request to expend additional funds for the procurement of long lead time items for the S-IC stages of the 516 and 517 vehicles is disapproved. This decision, in effect, limits at this time the production effort on Saturn through vehicle 515. No further work should be authorized for the development and fabrication of vehicles 516 and 517.

James E. Webb
Administrator

Document III-20

Document title: Bureau of the Budget, "National Aeronautics and Space Administration: Highlight Summary," October 30, 1968.

Source: NASA Historical Reference Collection, History Office, NASA Headquarters, Washington, D.C.

The career staff of the Bureau of the Budget (renamed the Office of Management and Budget in 1970) remains in position as administrations change, and it is an important contributor to continuity in government policies and programs. This summary, prepared during the last months of the Johnson administration but intended for whomever would enter the White House the following January, identifies the significant space policy issues that would have to be addressed by the new president. While Lyndon Johnson had remained committed to completing the Apollo program, the twin crises of the conflict in Southeast Asia and urban unrest in the United States had not allowed him to allocate resources to any major post-Apollo space objectives. As the first lunar landing approached, the space program was clearly at a crossroads.

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[1] # National Aeronautics and Space Administration Highlight Summary

I. Program and Policy Issues

This paper discusses the major aspects of National Aeronautics and Space operations which warrant attention at an early point in 1969.

A. ***Space Program Among Other National Priorities***

The resource requirements of the Viet Nam war and of pressing domestic needs, coupled with an apparent acceptance of the Soviet presence in space, have tended to push the civil space program down the scale of national priorities. As funding requirements for on-going programs have declined, it has been very difficult to obtain funds for new starts. Major space activities require large sums of money, and the development of equipment requires 3 to 8 years from go-ahead to flight. Therefore planning for space programs, and even annual budget decision, is very uncertain unless some general levels of funding commitment in future years can be assumed. In a period in which space enjoyed high priority, total programs were planned and budgeted around the expectation that $5-6 billion would be available in future years. Now future planning estimates range between $3 and $4B, and at the lower end of this scale our ability to undertake significant manned flight becomes marginal.

It appears that a two-fold major policy study should be undertaken to identify (1) the national needs served by space flight, and (2) the priority to be accorded the space program over the next several years in relation to other national priorities.

B. ***Post Apollo Manned Space Flight***

Major decisions must be made in the 1970 and 1971 budgets. Funding variations of ± $2 billion from the present $2 billion per year base are involved. The Manned Lunar Landing is very likely to occur in late CY 1969, thereby ending what is generally considered the major cause of urgency in the progress of manned space flight.

As many as eight Saturn V launch vehicles with Apollo spacecraft will remain unused, as will 7 to 9 Saturn IB's. Budget decisions were made in 1969 to close down all these production lines on completion of Apollo program production. A short term Apollo Applications program has been defined to use the Saturn IB's in low earth orbit, but that program will pass its funding peak in FY 1970 and end in CY 1972. [2]

In the circumstances, pressure is mounting to budget significant sums for follow-on manned space flight activities, which forces the question of whether there should be a program of manned space flight after Apollo.

Termination, or even lengthy postponement, poses problems of abandoning expensive inventories, of local economic disorientation, and allegations of leaving all of outer space, including the Moon, to the U.S.S.R.

Continuation poses problems of funding, program rationale, program definition, and assignment of principal roles between NASA and Defense (see IV-A, below).

By landing a man on the Moon in 1969 we will have proven that we possess an engineering and technological capability to master the basic problems of very large scale manned space flight operations for periods of several days. The Gemini program proved our ability to keep men in orbit for periods of two weeks, and the Department of Defense MOL program is based on the assumption that man can function effectively in orbit for 30 days.

It is difficult to conceive of any use short of a manned planetary expedition that would require men to operate in orbit for more than 30 days. Most scientific endeavors that require the collection of data by means of space flight can be accomplished by unmanned systems at considerably less expense than the manned space flight systems.

The U.S.S.R. is continuing to develop a large rocket that can place payloads in orbit equivalent in size to those lifted by our Saturn V (285,000 pounds.) Only the Saturn V is in this weight lifting class, and no other combination of rocket stages currently existing in the U.S. can compete.

Our manned flight program was established, and expanded to include a manned lunar landing, by policy decisions in response to "technological challenge" from the U.S.S.R. An alternative to the policy of competition would be a policy of cooperation with U.S.S.R. in large manned flight endeavors.

Reasons for proceeding other than competition include enhancing the national prestige, advancing the general technology, or simply faith that manned space flight will ultimately return benefits to mankind in ways now unknown and unforeseen. None of these secondary arguments can be quantified and most are difficult to support.

The case for continuation of a manned space flight effort after Apollo is one of continuing to advance our capability to operate in space on a larger scale, for longer durations, for ultimate purposes that are unclear.

[3] C. ***Unmanned Planetary Programs***

Pressures are strong from the scientific community to increase our pace of unmanned exploration of the planets. The National Academy of Sciences in its report, "Planetary Exploration; 1968-1975" urged NASA to begin an ambitious program of unmanned interplanetary flights, and recommended that a substantially increased fraction of the total NASA budget be devoted to unmanned planetary exploration. "This is an area in which the U.S.S.R. is competing strongly and one of those in which accomplishments have scientific as well as technological significance. Planetary investigations are basic research, however, and as such have no return in an economic sense. Even as a field of basic research planetary studies may have less long term social benefit than biosciences. Planetary programs require long lead time and firm commitment due to the limited planetary flight opportunities. Funding increases of $100M or more per year above the present $85M base are involved in these programs.

D. ***Aeronautical R&D***

The growth of air transportation, the decline of emphasis on military aircraft, and the creation of the Department of Transportation have made commercial applications of key importance in determining the course of aeronautics research. NASA's aeronautics program should be considered within the context of overall government goals and objectives. See separate memorandum on this subject.

E. ***Economic Applications***

Clientele groups, both within the Government and outside, are pressing NASA to increase its level of activity in development of satellites for communications, meteorology, navigation, and surveys of earth resources. Funding in this area runs about $100M per year and could easily double in the next two years. Though this is one of the few programs in NASA that shows promise of generating clear near-term benefits, in several areas, notably meteorology and earth resources, the basic cost/benefit ratio questions remain to be critically analyzed. Major management questions, possible reassignments of activities between agencies, and large increases in modest ongoing budgets are raised by the technical possibility of using satellites to serve the needs of several agencies. Interior, Agriculture, ESSA, DOT and Navy are among the clientele agencies in this area, as is the ComSat Corporation and other communications users.

[4] F. ***Nuclear Rocket***

This joint AEC/NASA project, started in 1956, has established feasibility of a nuclear reactor-powered rocket engine. Over $1B has been spent to date and an additional $1.5-$2B would be required to develop a useable nuclear rocket stage. However, the advantages of nuclear propulsion do not begin to approximate the costs for missions short of a manned Mars landing. No national commitment has been made to undertake this mission which would cost $40-$100B. (see "B" above) Nevertheless, pressures are strong in NASA, industry and Congress to undertake the development of the nuclear rocket. See separate memorandum on this subject.

II. Budgetary Trends and Issues

NASA's funding level has declined from a high of $5.3B in appropriations in 1965 to the current 1969 appropriation of $4.0B. The 1969 operating level is $3.85B. The manned space flight activities account for over $2.0B in the current year.

The budget issues are those associated with each of the above items, plus the need to reassess the need to support the elaborate ground complex of Government, industry, and universities if the rate of space development activity should continue to decline. The cost of this ground complex is more than $1.5B per year (see IV-B, below).

III. Organization and Management Issues

A. ***Use of support service contracts at NASA field centers***

NASA currently employs about 25,000 contractor personnel located in their laboratories in direct support of their 32,000 civil service employees. This is a problem from political, cost, and management standpoints. NASA is faced with a CSC ruling that several of those contracts are illegal. Others may not be administered within the Civil Service laws. At the same time, the agency is operating under the federal personnel ceiling constraints which make conversion to Civil Service difficult, and a future program level uncertainty which threatens the justification for keeping such large numbers of personnel.

B. ***Scope of capability base for future space activities***

NASA currently spends between $1.5 and $2.0B per year to maintain a Government/University/Industry basic capability to engage in space flight activity. This capability consists of the technical and management talent in the NASA laboratories, the world-wide satellite tracking and control networks, scientists and their research teams in universities, research and engineering teams in industry, and specialized ground test and launch facilities scattered around the U.S.

This basic capability complex was established on the assumption that the NASA budget would be about $5.5 B to $6 B per year. As the budget has declined to $3.85B, the flight program development activity has borne the brunt of the reductions and the support complex has been only slightly reduced. The question is whether to assume the possibility of increased funding levels and preserve the base, or to phase down on a long term basis on the assumption that lower funding levels will remain for the foreseeable future. [3]

C. ***NASA advanced research and technology centers***

NASA has not yet developed a means to focus their in-house research on long range mission goals. The research program, costing in total around $400M in contract funds for space technology and aircraft technology, and in-house laboratory effort, is therefore diffused and general. It is difficult to judge how varying levels of funding in these areas relate to advancing the nation's ability to meet long-term space goals.

The laboratories do contain high calibre engineering and technical talent which could be used to serve other national needs besides aeronautical and space flight. Research and technology advancement in surface mass transportation, ocean engineering and other complex technological areas could well be done by NASA laboratories. [5]

IV. Inter-agency Relations

A. ***NASA relationship to DOD space programs***

The NASA operates a space program for non-military purposes which consists of flight programs for collection of science data and for test and demonstration of new space-related technology, and of ground-based applied research and technology. The DOD operates a space program consisting of satellite flights contributing to defense operations and of ground based applied research and technology applicable to Defense oriented space flight. There are joint agency studies under way to review the two agency programs.

Certain economies may be achieved by reassigning and consolidating activities in such areas as standardization of equipment, ground based tracking networks, and technology programs.

A major policy problem concerns the future of earth orbital manned space flight in which DOD now has the Manned Orbiting Laboratory and NASA has the Apollo Applications program. In future, should we plan on two manned programs, a single program jointly run, or should a single agency be assigned responsibility for all manned space flight activities? [6]

B. As mentioned earlier in the areas of aeronautics and economic applications, there is a need to relate NASA's effort to these programs to the requirements established by the Departments of Transportation, Interior, Agriculture, Commerce, and others. The Government-wide goals, objectives and programs in the area of transportation and applications need to be established, and agency missions and roles delineated.

C. ***Total space program funding***

Attached is a table showing the funding for space programs of all agencies 1958-1969.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Summary Budget Trends
(In Millions)

			Employment June 30	
	Budget Authority	Outlays	Permanent	Total, excl. Summer Youth
1963 actual	3,673	2,552	27,904	29,934
1968 actual	4,587	4,721	32,469	33,968
1969 current BOB estimate (tentative)..	3,879	4,250	31,186	32,706

Document III-21

Document title: Charles Townes, et al., "Report of the Task Force on Space," January 8, 1969.

Source: NASA Historical Reference Collection, History Office, NASA Headquarters, Washington, D.C.

Richard M. Nixon was elected president in November 1968. Like the incoming Kennedy administration in 1960, Nixon appointed a number of blue-ribbon transition teams to advise the new government. Nixon's thirteen-person transition Task Force on Space was chaired by Nobelist Charles Townes of the University of California at Berkeley. Unlike the "Wiesner Report" prepared for the Kennedy transition, this report was not released to the public or the press.