

Chapter 5

BROADENING THE DEBATE

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SPACE INFRASTRUCTURE AS METHODS AND MEANS

Even the most informed ardent supporters of a U.S. civilian "space station" program agree that any such facility would be a means to various ends, rather than an end in itself. The ends proposed may be grouped into four categories: industrial (e.g., manufacturing materials); commercial (e.g., servicing satellites); scientific (e.g., conducting experiments in the life sciences); and national security (e.g., maintaining a permanent U.S. manned presence). These ends, despite their diversity, have in common a presumption that space activities will in future become more routine and more clearly operational, less experimental, and less tentative. This presumption in turn derives from an important change in the way that we are now beginning to view space.

Twenty-five years into the Space Age, we are in a position to view near-Earth space much as we would a vast tract of undeveloped raw land on the Earth's surface:

- We have identified at least **some of the desirable locations (particular orbits)**.
- We have established **an initial legal framework** for their beneficial occupancy (the Outer Space Treaty).
- We have **reliable transportation** for people and machinery to and from these remote areas, from selected locations on the Earth's surface (via the Shuttle).
- We can maintain **reliable communications** with these remote areas (via NASA's satellite communications system).

These capabilities are prompting us to undertake the considered development of near-Earth space—with, therefore, the long-term implications for use and support of any assets and people placed there.

indeed, the terms "space station" or "space transportation node" are most accurately understood as identifying elements of long-term, perhaps permanent, space infrastructure, concentrated initially, for the most part, in low-Earth orbits. These elements would provide in-space

structure, electrical power, thermal control, warehousing, stability (as to location, attitude, and temperature), communications, fuel, associated docking and air lock capabilities, local transportation, LEO-GEO transportation, and, if staffed by men and women, life support and residential and working space. Because it is expected to be sophisticated, and useful for periods of several decades, this space infrastructure could provide a new and qualitatively different regime of space assets, allow the provision of new space services, and support the conduct of space activities in a new and presumably more efficient and effective manner.

Four major decisions have marked the U.S. civilian space program: the establishment of NASA in the National Aeronautics and Space Act of 1958, the initiation of the Apollo program in 1961, the establishment of COMSAT in the Comsat Act of 1962, and the initiation of the Shuttle program in 1972. But, despite the growing importance of the Nation's publicly supported space activities, the pattern of decision making over the past 20 years has seldom proceeded in the light of broad public discussion. Until very recently, the discussion of whether to undertake a "space station" program and, if so, what elements it should contain, had also been confined principally to engineers and scientists within NASA, and within NASA-supported university programs and aerospace contracting firms. Consideration of the views and interests of these communities has, to a very great extent, determined the kind of "space station" program now suggested by NASA.

As NASA's Shuttle development program comes to a close, thousands of its in-house engineers and technical support staff and, in principle, as much as \$2 billion per year in contract funds, under its present "budget envelope," would be freed up to be applied to one or more new programs. Given the agency's natural desire not only to maintain its current size (a size NASA leaders judge to have the support of the general public),

but to grow at 1 percent per year¹—a desire supported by the Reagan Administration—this combination of people and funds that could soon become available suggests, strongly, that any new programs must include the development and acquisition of a great deal of new technology, preferably related to having people in space; large numbers of technologists would be gainfully employed both in NASA and in the space industry under contract to NASA. NASA's plans could well have been further influenced by the fundamental political belief that the agency might not long survive in its present form without a single, large, "people-in-space" program upon which a majority of its energies are focused. If a number of smaller programs were initiated instead, each of them, it is thought, could be terminated without widespread objections arising in the political process. Finally, NASA may have thought it prudent to propose a "space station" program rather than some other large endeavor(s) (e.g., a return of Americans to the Moon, sending people on an expedition to Mars, etc.) both because the former had been carefully studied over the years, representing, in NASA's view, a natural complement to the Shuttle, and because alternative large programs seemed too grandiose, have not recently been discussed with the general public, and, therefore, were less likely to enlist the required support, both within and without the administration.

Once the decision had been made to begin defining a "space station" program to be proposed for congressional approval, NASA began canvassing possible user communities to learn what characteristics they would like it to incorporate in order to meet their needs. This process would

¹ NASA management has a strong commitment to its own institutional future. NASA Headquarters material, NASA HQ MF 83-2275(1), prepared for a presentation to its internal Policy Review Committee in mid-1983, and subsequently presented to a Board of the National Research Council, lists eight "Agency Goals." The first goal is: "Provide for our people a creative environment and the best of facilities, support services, and management support so they can perform with excellence NASA research, development, mission, and operational responsibilities."

The second goal speaks to the space transportation system (the Shuttle), and the third to the establishment of a permanent manned presence in space.

App. B shows that, in previous years, this commitment has also been strong.

ensure that the actual infrastructure, when built, served as many constituencies as possible, and also might moderate potential opposition from groups who might view any large project as a threat to the budgets of their relatively smaller activities.

The groups canvassed included the various NASA Centers, the National Research Council (the Space Science Board and the Space Applications Board), the space industry, various potential foreign providers and users of space technology (the European Space Agency, Canada, and Japan), and, in general, any groups that had worked on previous "space station" studies. The essential form of NASA's questions to these various groups was: *if* there were a permanent and permanently staffed "space station," what activities might it reasonably support, how would these activities influence its design, and of what value would those support activities be? Eight aerospace groups, placed under contract to NASA in the fall of 1982, undertook parallel "mission analysis studies"² in order to determine a set of activities for the first 10 years of the "space station's" operation, the fundamental characteristics suitable for accomplishing these activities, and the presumed value to be associated with obtaining and using them. These contractor groups soon formed similar judgments regarding the amount of money that (NASA hoped) would be made available, a desirable acquisition schedule, and NASA's preferences on such matters as the employment of people in space and the use of new v. already space-qualified technology. Also, using standard industry cost estimating practices, they suggested the likely acquisition costs of the infrastructure elements to the Government,

The process by which users were canvassed was essentially open-ended: no potential use that either required or would materially benefit from a "permanently manned space station" was rejected out of hand. Given NASA's internal circumstances, this open-ended character was certainly unexceptionable: the more—and the more varied—the identified uses, the more capable, sophisticated, and large the supporting infrastruc-

²The results of these studies are summarized in app. A.

ture would have to be. The greater the resulting capability and sophistication, the more engineers would be required to design, develop, and produce it—and the greater its cost. Increased costs, in turn, would imply more Government contracting—and understandably generate greater interest in and support for the program by the space industry.

In general, the greater the number of potential users and potential suppliers, the greater the influence that could be brought to bear on Government decision makers to approve any “space station” program. In any event, essentially all important space industry groups were represented in the eight aerospace groups of companies, and the number of potential uses recommended for inclusion totaled well over 100.

If there were any important potential uses left out of account, either because the supporting technology would be too costly or could not be obtained in time, or because NASA judged their discussion to be inappropriate for the time being, they could still be provided for later, not in the initial operational capability (IOC) “station,” but in the subsequent full capability “space station” program, which could continue to the end of this century.

It is important to appreciate that the form in which NASA put its original questions to the eight aerospace groups largely determined the approach taken to potential acquisition of a civilian “space station.” And this approach, in turn, largely determined the result—a “Christmas-tree” proposal in which there was something for all identifiable po-

tential users, with little attempt either to weigh the seriousness of their intentions to use the facility, or to gauge their willingness to see funds that they would employ otherwise used instead to develop it. A different, and perhaps more appropriate question, would have been: in view of the maturing capabilities and increasing numbers of the spacefaring nations of the world,³ what elements of long-term, in-orbit infrastructure would be appropriate to facilitate the considered development of near-Earth space? This question would not have required initial assumptions that the facilities would be permanent and permanently manned, that the size of the eventual program would have to be geared to maintaining NASA’s size and form, and that all possible users should be accommodated.

But even with the large number of uses that were identified, little doubt remains that the kind of “space station” which NASA prefers cannot now be fully justified on scientific, economic, or military grounds,⁴ or combinations thereof. Rather, a decision to approve it will rest, finally, on a political judgment that will reflect many intangible factors as well.

³Ideally, one should add: “and in view of the goals and objectives of our civilian space program.” However, as argued throughout this report, there is no publicly accepted agenda of such goals and objectives,

⁴It must also be noted that, since the cancellation of the Manned Orbiting Laboratory Program in 1968, the U.S. military has been consistent in its public position that there is no military requirement for a “manned space station.” This position is still publicly maintained and remains in force, even in the context of the President’s call, in March 1983, for development of advanced ballistic missile defense systems that could see large amounts of very sophisticated and costly military technology deployed in space.

NEED FOR GOALS AND OBJECTIVES

This entire panoply of relatively narrowly focused and nearer term ends provide, in OTA’s judgment, insufficient justification for a major, new U.S. civilian space effort. Moreover, there is general agreement neither on a set of long-range goals which the U.S. civilian space program now is expected to achieve nor on a set of specific objectives which, as they are addressed, would serve as milestones of progress toward those goals. And without such a set of goals and objectives the Nation cannot make a clear deter-

mination of the basic characteristics of the infrastructure elements actually needed, of their acquisition schedule and cost, or of the means whereby they should be acquired.

If future U.S. space-related goals and objectives are to be effective in providing direction to future U.S. space efforts, they should be such as to command widespread attention; have great inherent humanitarian and scientific interest; foster the development of new technology; have relevance

to global issues; prompt international cooperation; and involve major participation of our pri-

vate sector so as to advance our economic prospects.

THE POLICY BACKGROUND

The overall end of U.S. space activities was first stated as a preamble to the National Aeronautics and Space (NAS) Act of 1958, as amended (sec. 102 (a)): "The congress hereby declares that it is the policy of the United States that activities in space should be devoted to peaceful purposes for the benefit of all mankind." Six policy principles, forming the core of the NAS Act, give substance to that overall end. These six have provided the framework in accordance with which the civilian space program has evolved to the present day. These principles may be stated as follows:

- that U.S. preeminence in space science, exploration and applications be maintained;
- that economic, political, and social benefits be derived;
- that knowledge be increased;
- that civilian and military activities be separated (though they are to be coordinated and are not to duplicate one another unnecessarily);
- that NASA, the civilian agency, be limited largely to research; and
- that international cooperation be fostered.

Thus, the NAS Act articulated the policy principles for overall guidance of the U.S. civilian space program, but the act alone has not provided (and cannot be expected to provide) the particular goals for civilian space activities. Lacking such guidance, the space program has instead been directed by political and budgetary pressures not always relevant to a logically ordered exploration, development, and use of space. At the same time, none of the policymaking bodies successively established in the executive branch nor any of the committees of Congress have been able to ensure that a long-range plan of particular policies and programs would be pursued. s

⁵For a full discussion of these policy principles and their implications, see *Civilian Space Policy and Applications, OTA-STI-177* (Washington, DC: U.S. Congress, Office of Technology Assessment, June 1982).

Over the years, a number of specific goals and objectives have been proposed. Significantly, however, none of them has arisen as a result of widespread public discussion. With the maturity of U.S. space capabilities (and the capabilities of several other countries and our own private sector as well) on the one hand and the straitened financial circumstances of the Government on the other, this situation is in need of fundamental change. That is, if the United States is to maintain a strong commitment to a continuing civilian space program, then an informed national agreement on the goals and objectives of such a program is most important.

At the beginning of the Nixon Administration, the Apollo program was rapidly coming to a successful close, but no clear definition of a post-Apollo space program had emerged. Early planning efforts had failed to yield a consensus, and space program budgets had decreased dramatically, presenting the new administration with growing unemployment in the aerospace industry as well as a major technological agency that did not have clear signals regarding its future. In order to address these problems, the Presidential Space Task Group (STG) was established under the chairmanship of the Vice President. The STG review was the first comprehensive interagency planning effort that was carried out with respect to the civilian space program.

In its final report,⁶ the STG recommended commitment to a balanced publicly funded program that included science, applications, and technology-development objectives, but no immediate commitment to expeditions to the planets. They suggested no change in the institutional structure nor an operations role for NASA, but did emphasize the desirability of expanding international cooperation. The major technological development that the STG suggested was the reusable

⁶*The Post-Apollo Space Program: Directions for the Future, Space Task Group Report to the President, September 1969.*

space Shuttle system that could support an eventual “space station.” The clear priority was for Shuttle development first, with a “space station” as a potential future development. Support for exploratory expeditions to the planets was retained as a long-range option for the Government’s civilian space program, with a “manned Mars mission before the end of this century as a first target.”

In 1976, almost two decades after the adoption of the NAS Act, NASA issued its own “Outlook for Space” report. This document addressed the cultural goal of better scientific understanding of the physical universe and the social/economic goal of further exploration and exploitation of the solar system. The report suggests four goals reflective of basic human physical needs:

1. improving food production and distribution;
2. developing new energy sources;
3. meeting new challenges to the environment; and
4. predicting and dealing with natural and man-made disasters.

In October 1978, President Carter released a space policy statement that summarized the important aspects of an administration review of space policy and provided guidance regarding the President’s view of national objectives in the publicly supported civilian space program over the next several years. This statement reaffirmed endorsement of a balanced space program and committed the administration to the continued development of the space Shuttle system and its use during the coming decade. However, the statement made no new program commitments and specifically rejected any major new technological development. No goals were set to provide a focus for the program and the general philosophy was best characterized by the statement that “activities will be pursued in space when it appears that national objectives can most efficiently be met through space activities.” Overall, the policy statement left many questions unanswered. It made several statements about what the United States *would not* do in space, but remained very general regarding the nature of what it *would* do. In addition, it became clear that fiscal constraints were likely to continue, and, as a con-

sequence, commitments to specific multiyear Government programs would be made *only* with great care. This announcement was received with some dismay by the congressional leaders involved with the space program and by the aerospace community. This concern spawned a number of hearings and proposed legislative approaches to a more vigorous space policy for the United States, and led to the request for the OTA assessment of *Civilian Space Policy and Applications*.

Then on July 4, 1982, President Reagan announced the issuance of his National Space Policy Statement “. . . to provide a general direction for our future [space] efforts . . .,” asserting that “. . . our goals for space are ambitious, yet achievable.” This statement “. . . establishes the basic goals of United States policy which are to:

1. strengthen the security of the United States;
2. maintain U.S. space leadership;
3. obtain economic and scientific benefits through the exploitation of space;
4. expand U.S. private sector investment and involvement in civil space and space-related activities;
5. promote international cooperative activities in the national interest; and
6. cooperate with other nations in maintaining the freedom of space for activities which enhance the security and welfare of man kind.”

On June 27, 1983, the Science Advisor to the President “. . . challenged] the aerospace community to do some bold thinking about the future [concerning space],” and went on to observe that “. . . the real issue is how we can fashion a space program that addresses today’s national aspirations and needs . . . and . . . re-ignite[s] the spirit of adventure that captured America in the past” He questioned “. . . why don’t we let the American people share the grand vision of the future of space?”

But the articulated goals, particularly in the absence of specific objectives designed to address them, fall well short of what the United States, today, might expect of its publicly supported civilian space activities.

They do not speak at all of such fundamental matters as having human beings in space; of hav-

ing the general public directly involved in space-related matters; or of ameliorating the great inhibition that the present cost of space assets and activities has on the development and use of space. And there is little in these words to suggest the imaginative, the exciting, the challenging or the adventurous or, to use the Science Advisor's word: the "bold."

Finally, behind all of this there are the growing accomplishments, competence, and inde-

pendence of the Western European countries and Canada, Japan, Brazil, the People's Republic of China, India, and others, as well as the large and constantly expanding U.S.S.R. space program that, in its nonmilitary aspects, commands the attention and respect of our civilian space leaders.⁷

⁷See *Salyut—Soviet Steps Toward Permanent Human Presence in Space—A Technical Memorandum, OTA-TM-STI-14* (Washington, DC: U.S. Congress, Office of Technology Assessment, December 1983).

TODAY'S TOO NARROW DEBATE

As the important matter of defining and articulating such national goals and objectives is addressed, it should not be taken as implied here that such definition and articulation are not now going on. What should be understood is that, for all practical purposes (including that of obtaining any civilian "space station"), this activity is being conducted by space-related scientists, engineers, and program managers—almost all within the Government, within university offices supported by the Government, or within the Government-supported aerospace industry. At best, then, the goals and objectives that would be expected to result from this kind of consideration might, understandably, represent viewpoints that are narrow relative to the wide spectrum of our national interests and opportunities in the civilian space area today. It is likely that an expression of goals, and especially specific objectives, arrived at in this fashion will reflect, perhaps unduly, the interests of their originators. And finally, the U.S. political system oftentimes places as

much weight on the process by which a national decision is reached as on the substance of this decision; therefore, the better course for the Government in the longer run is to encourage as many of our citizens who are interested in space to participate in the pre-decision debate.

It was quite appropriate that, for most of the past quarter of a century, our national space goals and objectives primarily reflected those of the science and technology communities alone. These communities have done their work well. Consequently, our space activities now can, and should, be broadened to reflect both the maturity of our space knowledge and skills, and the general public's broader interests and concerns.

The matter of describing a new and clarified set of long-term civilian space goals, and laying out specific civilian space activity objectives, is made more urgent by the recent increase of military interest in space—an increase that may well soon accelerate.

RECENT PROPOSALS

Recently, there have been a number of calls to formulate a set of broadly based, contemporary national goals and objectives in the civilian space area.

For instance, Simon Ramo observes in his new book *What's Wrong With Our Technological Society and How to Fix It* (pp. 175-176):

After twenty-five years it is still true of the entire commercial use of space in the United States

that the government and the private sector have not yet worked out their best permanent roles. Less forgivable is something else. With space so clearly an arena of powerful economic and [national] security interest for the nation, we have been approaching plans and policies about space for well over a decade on an intermittent, t-top-and-jump short-range political basis. NASA has many hopes and plans, of course, but the nation does not have a plan for the next two decades. A real plan would describe both goals and

anticipated budgets. It would have recognition, acceptance, and stature with all the power centers influencing advances and applications in space, namely, the government's Executive Branch, Congress, industry, and the scientific and technological fraternity. A real plan would be one to which all these forces were committed long-term, in the same way that at the start of the 1960s we were committed to landing a man on the moon before the end of the decade. . . . [And while] the possibilities of space warfare [and] economic constraints [must be considered] none of these factors should prevent the United States from having sound long-range space goals as a guide to the government's budgeting process. . . . Less-than-adequate attention has been given to setting priorities and long-range goals and allocating missions to each sector.

in a recent report prepared by the Subcommittee on Space Science and Applications and transmitted to the Committee on Science and Technology of the U.S. House of Representatives, Representative Ronnie Flippo, then Chairman of the Subcommittee, stated that: ". . . there is a lack of long-range goals for our space program."⁸ The report noted that 7 years earlier it had also addressed "Future Space Programs" and then emphasized that NASA should ". . . focus on an over-arching concept [that] should represent one or more mind-expanding endeavors which challenge the imagination and capability of the country [the] key element of [which] should be sub-

⁸*Future Space Programs: 1981, Subcommittee on Space Science and Applications, Committee on Science and Technology, U.S. House of Representatives, May 1982, p. 1.*

stantial return on past and current investments in space through clear . . . benefits to the society on earth in the form of greatly expanded services and direct contributions to solution of earth-bound problems."⁹

The "NASA Advisory Council Study of the Mission of NASA" (released on Oct. 12, 1983) suggests activities that, in some cases, could be considered goals or objectives: explore the solar system, pursue scientific research in space, exploit space for public and commercial purposes, and expand human presence in space. And NASA awarded a near \$1 million contract to a private organization (Ecosystems) to provide it with suggestions on ". . . long-term research goals and the technology it should work on to meet those goals."

The President's Private-Sector Survey on Cost Control, in commenting on the ". . . Federal expenditure on R&D [of] about \$48 billion a year . . . faults the major science agencies for failing to have clearly defined goals and plans for meeting them."¹⁰ And an editorial in the *Christian Science Monitor* pointedly observes that ". . . it is most important that the U.S. develop a consensus on manned-space-flight goals. None now exists . . . Until consensus exists no specific space station concept can be usefully approved."¹¹

⁹*ibid.*, p. 3.

¹⁰*Science*, No. 222, No. v. 25, 1983, p. 903.

¹¹*The Christian Science Monitor*, Dec. 12, 1983, p. 23.

PRESIDENT REAGAN'S CALL FOR A "SPACE STATION"

In 1984, the future of the Nation's activities in space was placed squarely on the congressional agenda. In his State of the Union Address, President Reagan spoke at considerable length about the space area and what he judges should be the Nation's aspirations in regard to it. And he devoted his radio address during the same week to space. He directed NASA to commence the development of permanent, low-Earth-orbit infrastructure that would support human beings in space, and to obtain it within the next decade. And he asked Congress to authorize and appro-

priate Federal funds to begin studies of this proposed infrastructure.

Of particular relevance here is the president's assertion that: "[one of] our great **goal[s]** is to build on America's pioneer spirit and develop our next frontier . . . : space."; "America has always been greatest when we dared to be great. . . . We can follow our dreams to distant stars." And in developing the infrastructure (i. e., a civilian "space station") he called for international participation so

as to: “. . . expand freedom for all who share our **goals.** ”

In his radio talk, he spoke to the: “. . . challenge [of] reaching for exciting goals in space . . . ,” while explaining that, as well, “Our space goals will chart a path of progress toward creating a better life for all people” [and he emphasized that]: “a . . . space station [should be seen as] a stepping stone for [addressing] further goals.” Emphasis added.

STEPS TOWARD BROADER PARTICIPATION

Interestingly enough, the circumstances discussed above have resulted in only one important change to the basic 1958 Act—the explicit emphasis on space commercialization that was added this summer. Indeed, it was only in the fall of 1983 that Congress began to hold hearings that might lay a basis for such changes. Scores of billions of public dollars have been appropriated to pay for our public civilian space program since we reached the Moon, and almost surely scores of billions more will be appropriated during the next few decades, but, to date, without the kind of thoughtful and fundamental reappraisal of our contemporary national interests and activities in space that many are coming to believe the issues now demand. Our publicly supported civilian space area has seemed to suffer from a form of benign neglect.

However, the debate is quickening. Congress has taken an extraordinary step regarding the articulation of national goals and objectives in the civilian space area. In passing the National Aeronautics and Space Act of 1985, Congress, among other things, found and declared that “. . . the identification of long-range goals and policy options for the United States civilian space program through a high-level, representational public forum will assist the President and the Congress in formulating future policies for the . . . program”; and they called for the establishment

In effect, the President’s speeches have now prompted, and indeed his specific request for Federal law and funds for a major new initiative in the publicly funded civilian space program essentially requires, the conduct of a national debate over the next year or two regarding our national interests, goals and objectives in the civilian space area.

of a “National Commission on Space” that will assist the United States “. . . to define the long-range needs of the Nation that may be fulfilled through the peaceful uses of outer space”¹²

With the President’s signature to Public Law 98-361, there has been put into motion the first formal and fundamental reexamination of the Nation’s civilian space aspirations, objectives and institutions since the passage of the NAS Act in 1958.

From the outset of this assessment, the need for identifying a far-sighted set of generally acceptable civilian space goals and objectives that reflect today’s circumstances has been apparent. Most notably, the assessment’s Advisory Panel has strongly urged that an initial set of such goals and objectives be identified and proposed for broad study and discussion so as to lay a more rational basis for the consideration of any large and costly space civilian “space station.”

In response to that call, and with the intention of providing a sound and useful starting point for a national debate on the scope and direction of the Nation’s space activities, the next chapter of this report provides an ensemble of interrelated goals and objectives for consideration by Congress and the American public.

¹²Public Law 98-361, Title II.