CBO TESTIMONY

Statement of
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Mr. Chairman and Members of the Subcommittee, I appreciate this opportunity to discuss the topic of "reinventing" NASA. The Subcommittee has a long commitment to improving the National Aeronautics and Space Administration's (NASA's) performance. This hearing is particularly timely in light of the National Performance Review's suggestions to make NASA's program work better and cost less. Moreover, as those who follow the agency's progress know, NASA's efforts to reinvent its programs and way of doing business predate the new governmentwide initiative.

The Congressional Budget Office (CBO) is completing a study requested by the full Committee that addresses NASA's efforts to improve its performance. That study leads to two conclusions, which my testimony will elaborate on:

- Changing the way that NASA does business may offer improved program management and technical performance and some cost reductions, but the associated budgetary savings are uncertain and are unlikely to be realized in the near term.

- Canceling, scaling back, or stretching out programs and reducing NASA's federal work force are necessary to lower the cost of NASA's program to the levels included in the President's 1994 budget plan. Cost reductions created by more efficient management, procurement, and acquisition practices are unlikely to be large enough to allow NASA's budget to be cut further without additional reductions in its program. Ultimately, a smaller budget will mean a smaller program and fewer accomplishments for the civilian space program.

BACKGROUND

NASA's current five-year plan calls for $16 billion less in funding than what the agency anticipated a year ago (see Table 1). Most of this projected reduction is to be achieved by canceling or stretching out projects or down-grading their technical capability. Congressional action is likely to permit even less budget growth in 1994 than the President requested.

Further reductions could be in the offing. The Omnibus Budget Reconciliation Act of 1993 has set appropriation caps for the next five years that will essentially freeze all discretionary spending at 1993 levels. The caps may lead the Administration to scale back NASA's budget plan even further. In that event, the agency could be forced to make additional hard choices.

This testimony examines the role that changing the way NASA does business could play in reducing NASA's budgetary requirement. It then discusses several alternatives for reducing NASA's budget by changing what the agency does.

TABLE 1. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION'S FIVE-YEAR BUDGET IN THE 1993 AND 1994 PLANS
(In billions of dollars of budget authority)

	1994	1995	1996	1997	1988	Total
1993 Plan	17.0	18.6	19.5	20.3	21.0	96.4
1994 Plan	15.3	15.7	16.1	16.5	16.8	80.4
Difference	1.7	2.9	3.4	3.8	4.2	16.0

SOURCE: Congressional Budget Office using data from the National Aeronautics and Space Administration.

CAN PROPOSALS TO CHANGE THE WAY NASA CONDUCTS ITS PROGRAM MAKE A DIFFERENCE?

NASA's recent performance and its isolation from the competitive forces that drive private-sector efficiencies suggest that there could be ample opportunity to improve the way the agency does business. Experiences with reform at NASA and the Department of Defense (DoD), however, provide only limited optimism that such improvements will be effective enough and reduce costs quickly enough to deliver NASA's current program plan at a substantially lower budgetary cost. If additional significant reductions in NASA's budget are necessary, the content of the space program must be addressed. Nevertheless, many suggestions to change the way NASA does business have merit and deserve examination because they offer the prospect of improved performance over the long run.

CBO has reviewed five types of proposals for improving the way NASA does business. Two groups of proposals to improve management and procurement are included in a set of initiatives announced by NASA earlier this year. Three other proposals are consistent with the National Performance Review's recommendations. They would change the agency's relationship with the private sector by buying more of what NASA needs on commercial terms; streamline NASA's program management and overall organization; and continue to carry out the managerial philosophy of total quality management.

Ongoing Management Reforms

NASA's proposed management reforms are largely sensible. Some proposals seek to revitalize control processes that are already in place, and many have been made before. Better management could improve the space program's technical performance and reduce its future cost. Projects in the current budget, however, have already been planned and are under contract. If they have been well planned, they will not fall victim to the cycle of shifting requirements, technical surprises, and contract changes that has characterized troubled programs in the past. If not, it is too late for NASA's current round of management reforms to help them. For the future, the commitment of NASA's senior management and the nation's political leaders to improving NASA is probably more important than the specific approach to managing projects and programs.

Improved project planning would entail a more expensive early development phase for most projects that would allow for a better preliminary design and assessment of technical, cost, and schedule risks. The idea is a perennial favorite and was included in both the phased project planning system adopted in the 1960s and a 1980 NASA study of project management. The rub lies in following through. Funds for project planning are vulnerable in tight budgetary times. The same point applies to agreements about the

commitment of resources between project managers, managers who oversee groups of programs, and the NASA Administrator: tight budgets can cause commitments to be broken.

The management reform initiative includes a proposal to improve "independent cost estimating" for NASA's major programs. The proposal, which is intended to remedy the agency's persistent problem of underestimating program costs, implies more than simply reviewing estimating methods and adding personnel. At the heart of the matter is the question, independent from whom? Currently, program offices and their contractors prepare cost estimates. NASA proposes to prepare additional cost estimates in its Office of the Comptroller, which is independent of the program offices. It is unclear, however, that such estimates would meet the standard of unbiasedness set forth in the 1990 report of the Augustine Committee, which called for independence from "overselling on the part of program advocates, both in government and industry."

One version of how the $8 billion early estimate of the cost of the space station evolved illustrates the importance of independence. A scholarly analysis by Howard E. McCurdy makes clear that at the time the program was being "sold," the agency's formal cost-estimating process pointed toward a

figure higher than $8 billion.[1] According to McCurdy, however, the highest authority within the agency chose to put forward a more politically appealing lower estimate. Neither improving the quality of the program office's cost estimates nor seeking independent assessments is likely to give the Congress better cost estimates unless NASA's senior management is committed to providing them.

Ongoing Procurement Reform

Among a larger set of offerings, NASA proposes three major changes in procurement: modifying the agency's procedures for incentive contracting, granting larger weight to a contractor's past performance when awarding new contracts, and streamlining midrange procurement (purchases between $25,000 and $500,000). Each proposal is consistent with the thrust of the National Performance Review to change procurement policy throughout government.

Formal evaluations of DoD's use of incentive contracting suggest that incentives helped to hold down growth in development costs for strategic missile systems and satellites. As NASA has long practiced incentive contracting, the changes currently being considered are unlikely to lower costs

1. Howard E. McCurdy, *The Space Station Decision: Incremental Politics and Technological Choice* (Baltimore: Johns Hopkins University Press, 1991), pp. 175 and 231-232.

significantly. But basing fees more on the final than on the interim performance of a system and emphasizing contractors' past performance when awarding new business may improve technical results.

Only 13 percent of NASA's 1992 procurement funding was spent under contracts covered by the midrange procurement initiative. Thus, even an extremely successful reform effort that reduced costs by 5 percent would save only about $85 million annually. The initiative might yield additional savings by decreasing the number of NASA employees needed in the procurement area. However, increased productivity in procurement activities is more likely to allow the agency to make do with a smaller increase in procurement personnel than has recently been recommended by both executive branch and Congressional examiners.

A New Relationship with the Private Sector

The various relationships between NASA and the private sector fall along a continuum. At one extreme is NASA's traditional mode of acquisition, which involves the government directly in the design, development, production, launch, and subsequent operation of a spacecraft that produces a data product or service. At the other extreme is the commercial purchase of those same

data and services, without government oversight of the nuts and bolts of spacecraft design, production, and operation. Between these extremes are contracts that permit the use of standard commercial components in NASA spacecraft, that specify a system's final performance rather than design requirements, or that deliver a spacecraft in orbit to the agency.

The vision that underlies suggestions to buy more on commercial terms emphasizes two points. First, the aerospace industry can produce the technically sophisticated products NASA needs more cheaply without government supervision than with that oversight. The traditional mode of procurement forces contractors to maintain separate systems for production and financial control and to use government-approved components. Having NASA buy more on commercial terms could allow producers to reduce costs by integrating their government operations with commercial lines and systems and to use less expensive standard commercial components. A 1993 study by the Defense Science Board argues, for example, that DoD's acquisition costs could be reduced by as much as 20 percent, largely by applying commercial practices. The study concludes that this level of savings is likely only after five years of determined reform.

The second point made by advocates of buying more on commercial terms is NASA's self-defeating tendency to drive up the cost of the hardware it buys in the traditional way through excessive oversight, overly detailed design specifications, and too many contract changes. In their view, costs increase because both contractors and the government spend many personnel hours in process activities rather than in producing the good or service ultimately needed. Some of this oversight is discretionary; some is mandated by law and applies to all government purchases. According to some observers, the government's way of doing business doubles costs. Indeed, in a number of cases, large cost differences have been documented for functionally similar items produced for the government and for the commercial sector. These observations are not supported by formal studies, however.

Among the candidates for purchases on commercial terms are NASA's communications satellites or the services they provide. Some of the data needed for global climate research--which are now provided by hardware that the government has designed, developed, and operates--are also a frequently suggested candidate. Finally, an innovative program to give scientists vouchers for purchasing launch services for small scientific payloads on the commercial market rather than waiting for a government-provided launch is consistent with commercial purchasing.

Purchasing on commercial terms, however, is not a panacea. For example, when the government is the sole customer for a spacecraft or the data it produces, the potential savings from commercial purchasing may be offset by the higher cost of capital the government would pay for private financing and the cost of private insurance.

Risk also is an issue. Spacecraft that require advanced technology may ultimately perform better and cost the government less when procured in the traditional mode, which recognizes cost uncertainties and applies the expertise of both NASA and contractors in solving technical problems. One of the few general lessons learned from years of government acquisition of systems requiring new technology is that fixed-price contracting--an essential element of commercial purchases--is not appropriate for such systems.

Systems used for piloted spaceflight raise an issue of accountability. The public holds NASA directly accountable for the risk of loss of human life in spaceflight, implying a significant degree of oversight by NASA personnel in the design and development of hardware used in piloted spaceflight programs. NASA's relations with its contractors have moved away from commercial terms and toward direct supervision of contractors each time the U.S. space program has suffered a loss of life. The prevalence of piloted activity in the current program and budget may impose a limit on the agency's

comfort level with commercial purchases and the potential of this type of reform to reduce costs.

A final drawback to a wider adoption of commercial purchasing is its potential effect on NASA's ability to be an intelligent customer. The National Academy of Public Administration's 1991 study addressed this issue and concluded that the breadth of the current program and the personnel hours necessary to support award-fee contracting were compromising the agency's ability to be a "smart buyer" because NASA personnel were increasingly in a hands-off role. Transferring more responsibility to the private sector could further decrease in-house technical ability.

Streamlining

The critics' portrayal of NASA as a struggling organization choking on its own processes underlies calls to streamline NASA's acquisition and management system. Advocates of streamlining see two action items: freeing NASA from excessive regulations for procurement and acquisitions, and diminishing the role of NASA's Centers in program management.

Streamlining proposals focus on the process by which the agency designs, develops, and operates even its most technically challenging systems. They emphasize the authority and responsibility of program managers, who would report directly to a central oversight authority. Costs supposedly would be lower because decisions would be made more quickly and fewer resources would be consumed in oversight and assessment. These proposals overlap with the call for NASA to buy more on commercial terms, but even in traditional procurement, streamlining would place the agency in a more hands-off relationship with its contractors.

Streamlining is a frequently mentioned concept in the National Performance Review. The NPR report recommends that the federal acquisition regulations be converted from "a set of rigid rules to a set of guiding principles." According to the General Accounting Office's "High-Risk Series" review of NASA's contract management, in many respects NASA has already adopted this policy to no positive effect. GAO found that failure to comply fully with procurement requirements has led NASA's Centers to approve contract changes without adequate technical evaluation and to allow unpriced contract changes to persist. These factors have contributed to cost overruns and unsatisfactory performance.

Even if streamlining improves performance, there remains the issue of the social objectives of government procurement beyond buying a good or service at the lowest price. These objectives include regional economic development and preferential contracting to small businesses and minority-owned firms. There is no compelling reason that space programs, rather than any other concern of the government, should be exempt from these objectives.

Total Quality Management

Beyond NASA's specific problems is a pervasive sense of institutional crisis. NASA's Administrator has alluded to this on many occasions and has embarked on an effort to redefine NASA as an institution. The "quicker, cheaper, better" approach to spaceflight projects, the redesign of the space station, the planned reduction in NASA's federal work force, and the agency's proposed management and procurement reforms are all part of this effort. Adopting and carrying out the managerial philosophy of total quality management (TQM) is both a symbol of the agency's commitment to reform and a unifying thread among the changes its senior management seeks. This thread also connects NASA with the broader movement to reinvent government.

TQM is a managerial philosophy with the objective of achieving customer satisfaction through continuous improvement of production processes. Customer satisfaction and the positive performance indicators that go with it are achieved by committed managers and empowered employees seeking to continuously improve their products by applying empirical data and analysis to production processes. First adopted by private manufacturing firms in Japan, the approach spread to private manufacturers in the United States in the late 1970s, achieved wide acceptance in the 1980s, and by late in that decade was being adopted by large parts of the federal government. Although it originated in manufacturing, TQM has spread to the service sector, where it has gradually won adherents.

NASA was one of the first federal agencies to adopt TQM, during the late 1980s. According to a 1992 General Accounting Office survey, eight NASA installations employing roughly 20,000 people have adopted TQM. GAO asked respondents to place themselves in one of five phases of TQM. Four of the NASA installations placed themselves in the second phase, "just getting started"; three in the third phase, "implementation"; and one in the fourth phase, "achieving results." (The first phase is "deciding whether to implement TQM," and the final phase is "institutionalization.")

The GAO survey reported two sets of results: external organizational performance--the implementing agency's assessment of its relationships with its customers--and internal operating conditions. For NASA installations and for a larger survey sample of more than 2,200 other federal installations, self-reported improvement was correlated with progress along GAO's five-phase scale. These improvements include cost reduction, although GAO does not report the size of the reduction or in what categories of effort it occurs.

Even if ultimately successful, adopting TQM is unlikely to lower the cost of NASA's program or have a significant budgetary impact, at least in the next several years. The private sector's experience with TQM indicates that it is most effective when consistently practiced over a long period of time and when improved quality precedes reduced costs. The federal experience with TQM, including NASA's, is relatively new. These findings should create skepticism about claims that immediate cost savings will follow the decision to employ TQM.

BUDGETARY IMPLICATIONS OF REFORM

CBO's review of NASA's ongoing effort to change the way it conducts its business indicates that this effort will probably not result in large budgetary savings. Experience shows that the costs of some projects are likely to exceed

the current estimates. Better management may be necessary just to bring them within those estimates. Furthermore, reforms, if effectively carried out, will have their greatest budgetary effect on new projects rather than on those currently in the program. The current program's focus on piloted spaceflight is likely to limit the applicability and budgetary savings of proposals that generate cost reductions by aggressively transferring the implementation of NASA's program to the private sector. The demand of the public for accountability may not permit NASA to take a more hands-off position.

NASA and the Savings Estimates in the National Performance Review

The Administration's National Performance Review estimates that carrying out its specific recommendations for NASA will reduce NASA's budget for 1995 through 1999 by $1.9 billion, or about 2 percent of the total five-year budget authority in the budget plan contained in the President's 1994 request.

NASA has provided CBO with some supporting documentation for this savings estimate, which indicates that $370 million of the savings will come from reducing the use of contractors for support services. An additional $104 million will come from holding the level of NASA personnel fixed at 22,900 after 1994, a saving permitted by the restructuring of the space station. The

remaining $1.4 billion in savings will be sought from unspecified program reforms, reductions in the cost of operating major NASA programs, and focusing resources on activities with the highest priority. Even vaguely described, these changes sound as much like decreasing what NASA does as changing how NASA conducts its affairs. The Administration's 1994 budget proposals reduced the out-year growth of NASA's budget largely by canceling, scaling back, or stretching out programs. Further reducing the growth in NASA's budget will most likely require additional reductions in programs and personnel.

Additional savings might be sought from NASA as a means of reaching the National Performance Review's target of roughly $65 billion in governmentwide savings from "streamlining the bureaucracy through reengineering" and "reinventing federal procurement." At this time, it is unclear whether NASA will be asked to reduce its work force beyond the levels currently proposed or whether additional procurement savings will be sought.

The Case of the Space Station

The space station program is rapidly becoming a test case for proposals to change the way NASA does business. The NASA Redesign Team's report to the Advisory Committee to Redesign the Space Station and the committee's own report are bullish about the prospect that changing the program's management and organization will reduce the cost of the program and NASA's overall budget. The committee views the team's estimate of annual program savings of $300 million as "minimum gains." The committee asserts that NASA could realize savings of $700 million to $1 billion annually once the improvements that begin in the space station program work their way through the entire system.

Although the changes being considered for the space station program do not line up precisely with specific proposals to change NASA's overall conduct, in some respects they come close. For example, the redesigned space station program will streamline procedures in contracting, the contractor's development of the design, and NASA's management of the project. According to the redesigners, streamlining NASA's management will permit the number of NASA personnel directly assigned to the program to be reduced, from 2,300 to 1,000 (including 700 NASA employees who will be

made available to the program at the Centers). Streamlining will also permit a corresponding but unspecified decrease in the contractor work force.

Do the estimated savings created by changing the way NASA conducts the space station program mean that NASA can buy what it intended to at the beginning of 1993 within a far lower budget? The answer probably is no. This redesign, in the tradition of its predecessors, is likely to scale back the space station program and stretch out its schedule. Moreover, the impressive savings estimated by the redesign team are from a higher base than was previously estimated by NASA for the Space Station Freedom design included in NASA's 1993 plan.

To further reduce the cost of the space station program to the level included in the President's 1994 budget plan--$2.1 billion annually for 1994 through 1998--the schedule for the current Alpha design will have to be stretched out even more than anticipated in the redesign proposed in June. An alternative, the Russian configuration, may reclaim both content and time within the $2.1 billion but only at the cost of increased technical and political risk. Finally, a large part of the "savings" claimed in the redesign effort are to be realized in operating whatever station is built over a 10-year period. Long-time observers of NASA are understandably concerned; these claims

sound similar to ones made for high flight rates and low operating costs for the shuttle system--claims that have proved false.

Additional skepticism as to whether the agency can deliver on the cost and content of the space station design seems warranted. There is extraordinary pressure to reduce costs. In the past, such pressure has led to the underestimation of project costs. Although significant elements of the Alpha design are based on the very mature Freedom design, new engineering issues and cost uncertainties arise with each new paper design. NASA readily admits that past problems have arisen from such uncertainties. These uncertainties could well threaten the cost, content, and schedule of the redesigned space station.

REINVENTING NASA MAY REQUIRE CHANGING WHAT NASA DOES

If NASA's budget must be decreased, and if changing the way that the agency does business cannot account for substantial near-term savings, then more of the agency's program must be canceled, stretched out, or downgraded. NASA has preserved its program structure during the last several rounds of reductions in its budget plans. CBO is analyzing three alternatives to the current program that break the recent pattern of sacrificing program

commitments, schedules, and technical capabilities to keep the basic program structure intact (see Table 2). Each alternative sheds significant parts of the agency's current program and is funded at a flat nominal level at or below NASA's 1993 appropriation of $14.3 billion. The three alternatives to the current program are:

- **A program that emphasizes piloted spaceflight at a sustained budget of $14.3 billion annually.** To fund this emphasis, plans for robotic space science would be cut. This alternative concentrates on the space station program and on new technology to support future piloted exploration of the solar system. It responds to the criticism that NASA's current program does not give a high enough priority to human exploration of the solar system. Spending for space science and technology activities in areas that do not directly support human exploration would be reduced dramatically. The pace of piloted exploration is likely to be slow, however, as most estimates of the cost of a Moon-base or a piloted Mars mission make such activities very difficult to afford within a constrained budget.

TABLE 2. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION'S 1993 OPERATING PLAN AND ALTERNATIVES
(In millions of dollars of budget authority)

		Alternatives		
	1993 Operating Plan	Piloted Space-flight	Space Science	Technology and Science
Research and Development				
Space station	2,123	3,000	0	0
Space transportation capability	649	650	555	0
Space science and applications				
Physics and astronomy	1,104	300	1,200	450
Planetary exploration	474	800	700	300
Life sciences	140	190	200	0
Microgravity	173	200	200	0
Earth science	864	300	1,200	1,200
Other	111	0	200	200
Subtotal	2,866	1,790	3,700	2,150
Space research and technology	273	800	200	500
Commercial programs	164	0	0	100
Aeronautical research and technology	866	500	500	1,500
Safety, reliability, and quality assurance	33	33	33	33
Academic programs	93	93	93	93
Tracking and data advanced systems	23	23	23	23
Total	7,089	6,890	5,104	4,399
Spaceflight, Control, and Data Communications				
Shuttle production and operations capability	1,053	1,053	600	0
Shuttle operations	3,016	3,016	2,600	0
Space and ground tracking systems	836	836	836	500
Launch services	181	181	280	1,000
Total	5,086	5,086	4,316	1,500
Construction of Facilities	525	525	300	285
Research and Program Management	1,615	1,615	1,265	800
Inspector General	15	15	15	15
Total, Operating Plan and Alternatives	14,330	14,330	11,000	7,000

SOURCE: Congressional Budget Office using data from National Aeronautics and Space Administration, "Operating Plan for 1993" (1993).

- **A program that emphasizes robotic space science at a budget of $11 billion a year and includes piloted spaceflight only for scientific purposes--a criterion under which the space station would be canceled.** This alternative emphasizes the creation of new knowledge, including that gained in piloted spaceflight, but it does not support piloted spaceflight for the purposes of demonstrating international leadership or preparing for future piloted exploration of the Moon or Mars. This content mix addresses the criticism of NASA's program that too much emphasis is placed on piloted spaceflight when the agency's major contribution is creating new scientific knowledge. This alternative does not address directly the "cheaper, better, quicker" criticism of shuttle-era space science. It should, however, permit experimentation with small satellites within the space science program.

- **A program budgeted at $7 billion annually that eliminates piloted spaceflight and instead emphasizes robotic space science and developing new technology for both private industry and public missions.** This alternative effectively ends the current era of piloted spaceflight for the United States but addresses the criticism that NASA's activities do not contribute

to the competitiveness of U.S. industry. Resources would be concentrated in areas that are most likely to produce tangible payoffs--technology development directed toward specific industries and space science activities with significant applications value.

The alternatives are illustrations of different program structures; they are not well-defined program plans. An actual program plan would include far more detail about the activities NASA would undertake and a transition strategy and budget for personnel, facilities, and programs. As the ongoing adjustment to lower defense spending shows, an agency incurs significant costs when it reduces its work force and closes facilities, as NASA would most likely do if either of the alternatives that would dramatically reduce the agency's piloted activities were carried out.

CONCLUSION

The effort to reinvent NASA includes many proposals to change the way the agency does business. Some proposals offer the prospect of improved technical performance and cost reduction in the long run. Changes in the way NASA conducts its affairs, however, are unlikely to solve the more immediate imbalance between the budgetary appetite of the agency's program and its five-year funding prospects.