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Report to the Administrator, National
Aeronautics and Space Administration

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SPACE PROJECTS

Improvements Needed in Selecting Future Projects for Private Financing





United States
General Accounting Office
Washington, D.C. 20548

National Security and
International Affairs Division

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September 21, 1990

The Honorable Richard H. Truly
Administrator, National Aeronautics
and Space Administration

Dear Admiral Truly,

This report describes the efforts of the National Aeronautics and Space Administration (NASA) to find acceptable private financing sources for seven space projects.

This report contains recommendations to you. The head of a federal agency is required by 31 U.S.C. 720 to submit a written statement on actions taken on these recommendations to the House Committee on Government Operations and the Senate Committee on Governmental Affairs not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with an agency's first request for appropriations made more than 60 days after the date of the report.

We are sending copies of this report to the Director, Office of Management and Budget, and to other interested parties. Please call me at (202) 275-5140 if you or your staff have any questions about this report. Other major contributors to this report are listed in appendix III.

Sincerely yours,

A handwritten signature in black ink that reads 'Mark E. Gebicke'.

Mark E. Gebicke
Director, NASA Issues

Executive Summary

Purpose

To encourage the private sector's participation in civilian space activities, the President's fiscal year 1990 budget proposed private financing for seven key projects in the space shuttle and space station programs. The National Aeronautics and Space Administration (NASA) estimated that these projects would cost well over \$700 million between fiscal years 1990 and 1994 if the government funded them. Because this was the first effort of this type, GAO reviewed NASA's actions to determine the feasibility and appropriateness of obtaining private financing for these projects.

Background

NASA's budget, which was at the \$9 billion level in fiscal year 1988, has increased each year since and is expected to continue to do so in the 1990s. The agency projects that its fiscal year 1993 request will be over \$19 billion. Private financing of space projects was intended to help reduce the rate of increase in NASA's budget in the near term. Overall, these initiatives were intended to actively involve the private sector in developing space projects into profitable ventures and in sharing the government's development costs and risks in return for a share of potential revenues.

The seven projects in the Administration's private financing initiatives were an advanced solid rocket motor production facility, a weightlessness laboratory, a space station payload processing facility, an observational instruments processing laboratory, a robotic arm for the space station, a space station docking system, and part of the extended duration orbiter. In anticipation of obtaining private financing for them, NASA's budget request and estimates for fiscal years 1990 to 1994 were reduced by about \$747 million. The reduction in the fiscal year 1990 budget alone was about \$208 million.

Results in Brief

Efforts to develop commercial interest in seven NASA projects were generally unsuccessful because most of them were not good candidates for commercialization. The projects were selected for commercialization and funds were removed from NASA's budget request before the likelihood of their success was adequately screened.

In choosing projects for possible commercialization, one important screening criterion is a comparison of the government's cost to develop projects by using private or government financing. Such a detailed analysis was done to compare the costs of private and government financing

of the advanced solid rocket motor production facility. NASA recommended approval of the private financing option based on this analysis. However, while most of the analysis was well done, it did not adequately address the government's exposure to possible increases in short-term commercial interest rates. In addition, the analysis included cases where the private borrowing rate was assumed to be cheaper than the government's borrowing rate—an unlikely possibility.

Principal Findings

Most Projects Were Not Good Candidates

The Office of Management and Budget and NASA selected the seven projects and removed them from NASA's budget request before their commercial feasibility and the cost-effectiveness of private financing were adequately studied. Subsequent evaluations showed that private concerns were not willing to invest in most of the projects because they perceived few or no commercial markets for them. In addition, about half of the projects were believed to be too far along in development to modify them for commercial use without added expense and delay. Also, the risk of development within estimated costs was judged to be too high for a few projects.

NASA received financing proposals for the four facility construction projects, but it rejected three of them because they would have been significantly more costly than government financing. NASA recommended approval of the remaining proposal for funding of the advanced solid rocket motor production facility. The proposal was more expensive than using government financing, but NASA concluded that the cost difference of about 4 percent, or \$16 million, was insignificant.

Some Projects Have Been Delayed

Ultimately, only the project involving part of the extended duration orbiter was commercialized. All of the unsuccessful commercialization projects have been reinstated in NASA's budget. Four of them—the weightlessness laboratory, the space station payload processing facility, the observational instruments processing laboratory, and the space station docking system—are not expected to receive any significant funding for this fiscal year. These projects have been delayed.

Problems With the Analyses of the Advanced Solid Rocket Motor Plant Proposal

In its analyses of the proposal for private financing of the advanced solid rocket motor production facility, NASA considered a wide range of possible private interest and government discount rates, but did not adequately address the interest rate risk associated with financing a long-term project using short-term money. NASA's analyses also included cases where the private borrowing rate was unrealistically assumed to be lower than the government's rate.

The private financing proposal called for funding the construction of the facility using 30- to 180-day loans that would be refinanced when due at current rates for a 7.5-year period. NASA recommended approval of this proposal and would have proceeded with it if Congress had not returned the project to NASA's budget and funded it in fiscal year 1990.

Recommendations

GAO recommends that the Administrator, NASA,

- establish and consistently apply appropriate screening criteria for use in identifying projects for commercialization;
- in consultation with the Office of Management and Budget, keep such projects in the budget until they are adequately evaluated as private financing candidates and such financing is found or is judged to be highly likely; and
- ensure that financing options for future projects are properly analyzed.

Agency Comments and GAO's Evaluation

NASA and the Office of Management and Budget generally believe that the GAO analysis and report provide a useful review of these space commercialization efforts. They believe this review will be helpful in the future, given the newness of such activities and the broad variety of available financing options. The Office of Management and Budget did not directly comment on the recommendations, while NASA objected to being the sole addressee of the draft recommendation to keep projects in the budget until they are adequately evaluated as private financing candidates. NASA suggested that GAO either withdraw the recommendation or address it to the Office of Management and Budget.

GAO recognizes that the Office of Management and Budget is a key player in finalizing NASA's budget. The recommendation in the draft report was addressed only to NASA because of its primary responsibility to justify its budget. However, because of the Office of Management and Budget's position that withholding the projects from the budget request was part of a deliberate strategy to demonstrate the Administration's

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commitment to pursue commercial financing, GAO modified the recommendation to NASA to include consultation with the Office of Management and Budget.

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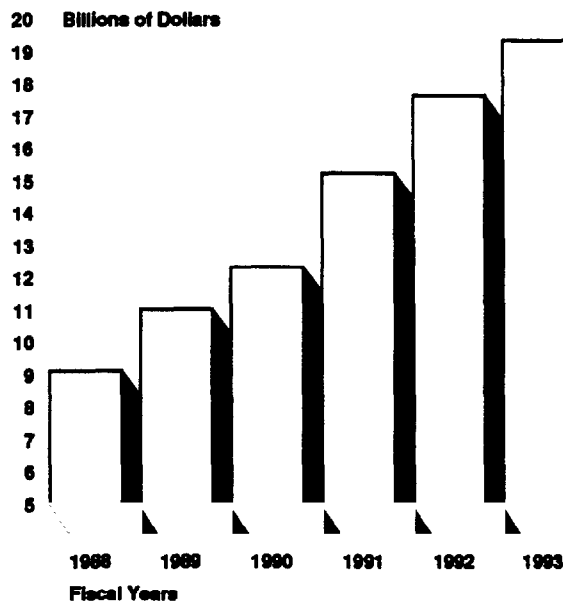
CBO	Congressional Budget Office
GAO	General Accounting Office
NASA	National Aeronautics and Space Administration
OMB	Office of Management and Budget

Introduction

NASA's fiscal year 1990 budget request proposed using private funds to help develop seven space shuttle and space station projects. This proposal was a key initiative in encouraging private sector investment in space activities. The commercialization of space projects is intended to actively involve the private sector in developing them into profitable ventures and in sharing the government's development costs and risks. In return, private firms would receive a share of potential revenues.

If successful, such initiatives would also have a moderating effect on the rate of growth in NASA's budget, which has been increasing significantly in recent years. The growth trend is expected to continue in the 1990s. Figure 1.1 shows the growth in NASA's budget from its fiscal year 1988 level of \$9 billion to an estimated request for \$19.3 billion in fiscal year 1993.

Figure 1.1: NASA's Budget and Budget Requests, Fiscal Years 1988-93



Note: Data estimated for fiscal years 1990-93.
Source: Budget of the U.S. government, fiscal year 1991.

Descriptions and Estimated Development Costs of Candidate Projects

NASA proposed private financing for four facility construction projects and three development projects. The four construction projects included

- an advanced solid rocket motor production facility, to be located in Yellow Creek, Mississippi. It will manufacture improved solid rocket motors used to help power the space shuttle into orbit. The advanced rocket motors are expected to be more powerful and reliable than the ones currently used.
- a neutral buoyancy (weightlessness) laboratory, consisting primarily of a large tank of water, which will simulate the weightless environment in which astronauts will build, operate, and maintain the space station. The laboratory will be built at the Johnson Space Center, near Houston, Texas, headquarters for astronaut training.
- a space station payload processing facility, to be located at the Kennedy Space Center on Florida's east-central coast. It will be used to inspect and prepare elements of the space station for launch and assembly in orbit. Later, the facility will perform a similar function for cargo carried to and from the space station.
- an observational instruments processing laboratory, to be located at the Jet Propulsion Laboratory in Pasadena, California. The laboratory will be used to develop and assemble instruments for a wide array of missions, including earth observation, planetary exploration, and astronomical studies.

The three development projects included

- a space station flight telerobotic servicer that will be attached to the space station. This mobile robotic arm will be used to perform maintenance and other activities outside the station.
- a space station docking system that will join the shuttle or other vehicles to the space station to allow the transfer of personnel and supplies.
- a cryogenic pallet for the extended duration orbiter. The pallet will be carried in the space shuttle's cargo bay to provide additional supplies of liquid oxygen and liquid hydrogen for power generation and life support. This pallet is a part of a set of modifications to a shuttle orbiter that will extend the current limit on shuttle flights from about 10 days to 16 days.

NASA estimated the development cost of these seven projects at \$794 million between fiscal years 1990 and 1994 if they are fully funded by the government (see table 1.1).

Table 1.1: NASA's Estimated Development Cost for the Seven Projects
(Fiscal Years 1990-94)

Dollars in millions						
Facilities ^a	Fiscal year					Total
	1990	1991	1992	1993	1994	
Advanced solid rocket motor production facility	\$60	\$60	\$60	\$93	\$0	\$273
Weightlessness laboratory	30	0	0	0	0	30
Space station payload processing facility	43	41	0	0	0	84
Observational instruments processing laboratory	14	0	0	0	0	14
Projects						
Flight telerobotic servicer arm	45	45	50	45	45	230
Space station docking system	7	27	28	45	13	120
Extended duration orbiter cryogenic pallet	25	15	3	0	0	43
Total	\$224	\$188	\$141	\$183	\$58	\$794

^aThe facilities' estimates do not include capital equipment.

Source: NASA.

During budget discussions with the Office of Management and Budget (OMB), NASA agreed to seek private financing for the seven projects. OMB then deducted most of the projects' estimated development costs from NASA's budget request and budget estimates for fiscal years 1990 through 1994, a reduction of approximately \$747 million. The reduction in the fiscal year 1990 budget alone was \$208 million. The President's budget request to Congress for fiscal year 1990 mentioned these projects as private financing initiatives.

Objectives, Scope, and Methodology

We examined NASA's efforts to determine the feasibility and appropriateness of obtaining private financing for the seven space projects. We interviewed NASA headquarters, OMB, and Congressional Budget Office (CBO) personnel to gain an understanding of the initiatives, the basis for their selection as candidate projects, and the results of NASA's and CBO's analyses of these projects. We also interviewed an OMB economist who is an expert on OMB Circular A-104, which sets out the factors involved in deciding whether to lease or purchase an asset and presents a model for conducting a present value analysis.¹

¹A present value analysis compares the relative values of alternative actions that have different timing patterns to their flows of revenues and/or costs. This technique takes into account the time value of money and allows alternative actions to be compared on an equal economic basis.

We obtained detailed information about specific projects and their current status from NASA program office personnel at headquarters and at field centers. In addition, we discussed the initiatives with officials from NASA's Office of the Comptroller and Congressional Relations Office to determine how the initiatives had affected NASA's budget.

We visited NASA's Johnson Space Center, Houston, Texas, and Marshall Space Flight Center, Huntsville, Alabama. At Johnson Space Center, we obtained information from program and procurement officials responsible for the weightlessness laboratory and the extended duration orbiter. At Marshall Space Flight Center, we discussed with program and procurement officials the efforts to privately finance the advanced solid rocket motor production facility and reviewed a NASA analysis of the private financing proposal for the facility. We also obtained information from Kennedy Space Center officials about their attempts to find private financing for the space station payload processing facility.

NASA and OMB comments on a draft of this report are included as appendixes I and II, respectively. These comments are addressed, where appropriate, throughout the report. Our review was performed between August 1989 and March 1990 in accordance with generally accepted government auditing standards.

Most Initiatives to Obtain Private Financing for Space Projects Were Unsuccessful

The candidates for private financing in fiscal year 1990 were selected and removed from NASA's budget request before their commercial viability was determined and the cost-effectiveness of using private financing was properly evaluated. Except for the extended duration orbiter cryogenic pallet, the projects failed to attract private investment because (1) commercial demand for the services to be offered by the projects did not exist, (2) some projects were too far along in their development to be considered for commercialization without incurring redesign costs and causing delays, and (3) the risks of successful development within estimated costs were too high. Furthermore, private financing would have significantly increased the government's cost for some projects. In addition, NASA's safety concerns about two of the projects caused it to limit consideration of potential investors to the current contractors.

Ultimately, the unsuccessful commercialization projects were reincorporated into NASA's budget, and some of them have been delayed because significant fiscal year 1990 funding has not been found for them.

NASA has agreed to a proposal from its current orbiter contractor to privately finance the extended duration orbiter cryogenic pallet, and NASA's analysis of the proposal shows that the plan is cost-effective. The plan allows NASA to defer paying the pallet's development costs.

NASA analyzed a proposal for private financing of the advanced solid rocket motor production facility, concluded it was a viable option, and was moving in that direction before being stopped by congressional action. NASA's analysis did not adequately address the government's exposure to the short-term interest rate risk. A rate increase could have lead to substantial additional cost to the government for that facility under the private financing option.

Commercialization Projects Were Selected Before Being Adequately Evaluated

OMB and NASA jointly agreed to the seven projects for commercialization during budget discussions in late 1988 to reduce NASA's fiscal year 1990 budget request and to help achieve the goal of increasing private investment in space. The projects were removed from NASA's budget request before their suitability for commercialization had been adequately evaluated. Subsequent evaluations by NASA personnel and consultants showed that six of the seven projects were not good candidates for private financing. (See table 2.1.)

Chapter 2
Most Initiatives to Obtain Private Financing
for Space Projects Were Unsuccessful

Table 2.1: Reasons Why Projects Were Not Good Candidates for Commercialization

	Lack of commercial demand	Projects too far along in development	High technical risk	Private financing significantly more costly
Advanced solid rocket motor production facility	X			
Weightlessness laboratory	X			X
Space station payload processing facility		X		X
Observational instruments processing laboratory	X	X		X
Robotic arm	X	X	X	
Space station docking system	X		X	

In addition, NASA officials were concerned about the potential safety implications of introducing new contractors for the extended duration orbiter cryogenic pallet and the space station docking system. Consequently, NASA limited its search for private developers on these projects to the contractors already engaged.

Lack of Commercial Demand

Commercial demand for the services the projects would offer is vital to establishing a long-term financially successful operation and to the sharing of the future financial burden on the government, which would otherwise be the projects' sole customer. A lack of commercial demand affected five projects. NASA found that commercial aerospace, construction, and finance companies were not willing to invest in four projects because they perceived that few or no commercial markets existed. For example, there are no specific commercial applications for the robotic arm, and prospective investors' market surveys found no practical commercial markets to justify investment. Also, NASA's market survey found no interest in joint use or shared ownership of the weightlessness laboratory. Although four commercial firms expressed interest in lending the government the money for the facility, NASA did not accept these proposals because they would have cost significantly more than government financing.

NASA also determined that one of the five projects—the observational instruments processing laboratory—was not amenable to shared use and, therefore, decided not to seek private financing.

Some Projects Too Far Into Development

NASA had approved conceptual designs and begun detailed designs on four projects when they were selected as commercialization candidates. To modify three of these projects for commercial uses, developers would have had to do redesign work. This could have added costs and delayed the projects. For example, at the time NASA initially solicited private interest in the space station payload processing facility, the design was 60 percent complete. Three firms that indicated an interest in shared use stated that the facility design would have to be modified. They felt that the space NASA had allocated for commercial use would not be large enough to meet their needs.

In the case of the observational instruments processing laboratory, NASA had already completed preliminary engineering designs, selected a site at the Jet Propulsion Laboratory in Pasadena, California, hired an architect and engineer, and invested \$1 million in the design process by the time the project was selected as a commercialization candidate. Bringing aboard a private investor at that stage could have delayed construction and resulted in additional design costs if design changes were required to adapt the facility to commercial use.

High Technological Risk

NASA also found that potential private sector investors were not willing to invest in the robotic arm and the space station docking system because they believed the technical risk was too high. Technical risk factors include whether equipment can be developed to accomplish the stated task, whether development problems will arise and increase costs, and whether the equipment developed will perform reliably. NASA's consultants concluded that the high technological risks of developing the robotic arm and the space station docking system would frighten away most investors, who could invest in other, less chancy ventures.

Space station funding problems and schedule delays also create uncertainty that discourage private investment. One NASA consultant stated that the space station docking system and the robotic arm are perceived as highly risky from a business point of view because the "parent" program, the space station, is perceived as vulnerable to budget cuts and schedule delays. A potential developer of the space station payload processing facility also confirmed this view.

**Private Financing Would
Be Significantly More
Costly to the Government**

NASA inquiries stimulated private financing proposals for five of the commercialization projects—the advanced solid rocket motor production facility, the weightlessness laboratory, the space station payload processing facility, the observational instruments processing laboratory, and the extended duration orbiter cryogenic pallet. Except for the extended duration orbiter cryogenic pallet, the proposals did not offer to invest in the projects, but rather to develop them for NASA in return for long-term leases or mortgages.

NASA's economic analyses of these five projects showed that the private financing offered for three of them would be significantly more expensive than government financing. NASA, therefore, rejected the private financing proposals for these projects.

NASA concluded that the private financing proposals for the solid rocket motor production facility and for the extended duration orbiter cryogenic pallet were viable options and pursued them. These proposals are discussed later in this report.

**Only Current Contractors
Acceptable for Safety-
Critical Projects**

Two of the projects, the space station docking system and the extended duration orbiter cryogenic pallet, had critical safety considerations that caused NASA to limit consideration of private development contractors to those already working on the projects. NASA believed that using other private developers would have created unacceptable safety risks.

Some commercial demand is forecast for the extended duration orbiter cryogenic pallet, and NASA has negotiated a private financing arrangement with its orbiter contractor. In return for financing pallet development, the contractor will share in revenues generated from commercial, extended duration shuttle flights. So far, NASA has identified one large-scale commercial flight, which is scheduled for 1994. According to NASA, there are also numerous potential smaller shared payloads.

After determining that no commercial demand existed for the space station docking system, NASA officials opted not to seek private financing.

Commercialization Efforts Delayed Some Space Projects and May Discourage Future Attempts

Except for the extended duration orbiter cryogenic pallet, the commercialization projects have been ruled out for private financing. All of the unsuccessful commercialization projects were returned to NASA's budget, and NASA is funding them, or will attempt to do so. NASA's budget request for fiscal year 1990 totaled \$13.3 billion without significant funding for the commercialization projects. Although NASA's appropriation for fiscal year 1990 ultimately included funding for some of the projects,¹ the total appropriation was only \$12.4 billion. Thus, NASA had to contend with a lower-than-requested appropriation and, at the same time, had to attempt to find money for the unfunded projects.

Four of the unsuccessful commercialization projects—the space station docking system, the weightlessness laboratory, the space station payload processing facility, and the observational instruments processing laboratory—may not receive any significant funding in fiscal year 1990. These projects have been delayed, and any significant funding for them has been put off to fiscal year 1991.

In addition to having an adverse effect on individual projects, the poor results from the commercialization efforts could hamper future initiatives, and good commercialization candidates could languish. As pointed out by a NASA consultant,

If NASA pursues non-commercially feasible systems on a commercial basis for political or other reasons, viable alternative candidates for commercial projects may not be pursued. . . .

Industry may perceive that NASA is supporting token commercial space development and only because of "off-budget financing" or other benefits to the agency. Industry may be disillusioned with the possibility of real commercialization, refusing to propose privately operated services.

We agree with these observations.

¹For example, Congress appropriated \$90 million for the advanced solid rocket motor production facility and \$80 million for the robotic arm.

Problems With the Analyses of the Private Financing Proposal for the Advanced Solid Rocket Motor Production Facility

As previously noted, NASA received private financing proposals for the four facility construction projects, but rejected three of them because private financing would have cost the government significantly more than government financing. In the case of the advanced solid rocket motor production facility, however, NASA analysts concluded after a comprehensive evaluation that, although private financing was more expensive than government financing, the difference was not significant because it was well below the threshold of accuracy, given the methodology and data used. Therefore, they recommended private financing. However, we found that, although the final analysis of the government's financing options for the advanced solid rocket motor production facility was, for the most part, properly done, it did not adequately address the government's interest-rate risk. This risk could have exposed the government to far higher costs than anticipated.

Also, in some cases, NASA's analyses implied that private borrowing would cost less than U.S. government borrowing. History consistently shows, however, that U.S. government borrowing is less costly than private borrowing for the same borrowing period.

Private Financing Recommended for the Advanced Solid Rocket Motor Production Facility

NASA's request for proposal for the advanced solid rocket motor production facility required offerors to propose development and construction of the production facility using government financing and private financing. NASA's Source Evaluation Board made a detailed analysis of cost proposals for each financial approach. The Board used a model that a NASA consultant developed based on OMB's requirement for a "present value" cost analysis.

From its analysis, the Board determined that private financing would cost the government more than government financing on a present value basis, but that the additional cost was insignificant given the overall cost of the facility. NASA recommended the private financing option because OMB had excluded funding for the motor facility from NASA's budget request. NASA did not consider it possible to get additional appropriations and wanted to avoid delaying the project. Project managers also noted that during tight budget periods, government-funded programs are often stretched out to reduce current year outlays. Stretching out funding for the advanced solid rocket motor production facility would have delayed production and increased the cost of the advanced motor. It would have also required NASA to use more of the current, less capable motors. According to NASA, continued use of the current motor would increase the overall cost of the shuttle program.

The private financing proposal for the facility featured a buy-now, pay-later plan, under which the contractor would borrow the money needed to finance the facility's development and construction. For the first 2.5 years of the project, the government would pay only the contractor's interest cost on the borrowed funds. Then, over the following 5 years, the government would pay back the loan in equal installments, including related interest. Under this private financing option, NASA estimated that the government's cost for the facility would total about \$686 million over 7.5 years. If the government directly financed the facility, NASA estimated the government's cost at approximately \$527 million over a 5-year period. Thus, the total project cost to the government under the private financing option would be about \$159 million, or 30 percent, higher than under the government financing option. However, because the timing of the government's costs under each option would be different, NASA continued its evaluation and examined the present value of each.

NASA's present value analysis contained assumptions about private and government costs of borrowing funds. An interest rate is used to estimate the cost at which the private sector will loan money, and a discount rate is used to estimate the amount of money that would have to be currently invested to produce the funding needed to meet future years' payments. We believe that the discount rate used to evaluate NASA's options for financing its projects should represent the government's cost of borrowing because investment options must be viewed from a government-wide perspective. Since most government funding requirements are met through the Treasury, its estimated cost to borrow (or estimated savings from not having to borrow) is a proper basis for establishing the discount rate in NASA's present value analysis.

NASA's analysis included sensitivity testing of a wide range of private and government interest rates to show the potential impact if the basic rate assumptions did not hold. The private interest rates NASA used ranged from 6 percent to 16 percent, and the government interest rates ranged from 9 percent to 11 percent.

The analysts concluded that private financing was a viable alternative and that the government's cost advantage under the government financing option was insignificant. They also concluded that private financing would avoid program delays and permit faster use of the more reliable and powerful motors.

**NASA's Analyses Used an
 Incorrect Relationship
 Between Private and
 Government Interest Rates
 and Did Not Adequately
 Address Interest Rate Risk**

NASA's economic analyses contained an incorrect relationship between the private and government costs of borrowing and did not adequately address the government's risk of using short-term, variable-rate financing.

In the baseline case for its initial present value analysis, NASA used a private interest rate of 8.6 percent and a government interest rate of 9.1 percent. Based on these assumptions, the present value of private financing was only \$1 million more than that of government financing. However, an assumption of a lower private interest rate (8.6 percent) than government interest rate (9.1 percent) is not realistic. Historically, the government's borrowing rate has been lower because the government is less likely to default on its debts. For example, figure 2.1 shows the consistently lower cost of the government's 3-month borrowing during the last 15 years.

Figure 2.1: Comparison of Short-Term Commercial and Short-Term Treasury Interest Rates, 1974-89



Source: Federal Reserve Bulletin and Annual Statistical Digest.

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Most Initiatives to Obtain Private Financing
for Space Projects Were Unsuccessful

In its final present value analysis, NASA's baseline case used a private interest rate of 10 percent and a government interest rate of 9.1 percent to convert each year's payment to a present value. (See table 2.2.)²

Table 2.2: NASA's Present Value Cost Estimates for the Advanced Solid Rocket Motor Production Facility

Year	Financing option	
	Government	Private
1	\$41	\$1
2	108	9
3	122	19
4	90	99
5	44	91
6	0	79
7	0	67
8	0	56
Total	\$405	\$421

Source: NASA.

The analysts concluded that the present value cost difference of \$16 million in favor of government financing was not material. However, NASA's analysis did not adequately address the interest rate risk to the government from using short-term, variable-rate financing. Also, NASA's final analysis presented alternative cases that continued to use the incorrect relationship between private and government interest rates.

The private financing alternative NASA considered called for financing project construction cost with short-term money (30- to 180-day commercial paper), which would be refinanced when due, at prevailing rates. This proposed approach meant that the private interest rate would be subject to adjustment at least twice a year, or a minimum of 15 times during the 7.5-year payback period.

Although NASA's analysis included sensitivity tests that used a variety of private and government interest rates, it did not directly highlight the inherent risk to the government of using short-term, variable-rate financing. The government's cost for financing additional debt would depend on the prevailing short-term private interest rate. The government would gamble that commercial rates would not increase during the

²Representatives of the Senate Committee on Commerce, Science, and Transportation requested correction of the interest rate/discount rate relationship.

period when the project was privately financed because any such increase would increase the government's overall cost, perhaps by a significant amount.

The gravity of the government's risk can be seen in the seesawing of commercial interest rates that can occur over much shorter periods of time than the 7.5-year period for the private financing option for the advanced solid rocket motor production facility. For example, from 1987 to 1989, the 3-month commercial borrowing rate increased by more than 2 percentage points. NASA's final analysis showed that every percentage point increase in the commercial borrowing rate would increase the government's cost by about \$15 million over a 7.5-year period.

In addition to the baseline case, NASA presented two alternative cases in its final present value analysis. These alternative cases continued to rely on the incorrect relationship between private and government interest rates. One case was based on equal rates of 10 percent for both private and government borrowing. The other case used a higher government borrowing rate (11 percent) than private borrowing rate (10 percent). These alternative cases reduced, and then eliminated, the baseline case's cost advantage of government financing.

Under the equal 10-percent analysis, the government financing cost advantage in the baseline case was cut in half—from \$16 million to \$8 million. Under the analysis using a higher government interest rate than private interest rate, the cost advantage of the government financing option disappeared, and there was a slight cost advantage of \$2 million for the private financing option. Presenting such alternative cases gives them an aura of legitimacy that they do not deserve. More important, they can inappropriately influence management's decision. Only feasible alternative cases should be presented.

Private Financing for the Extended Duration Orbiter Cryogenic Pallet

As previously mentioned, NASA has agreed with its current orbiter contractor to privately finance the extended duration orbiter cryogenic pallet. The contractor offered to develop the pallet and to allow NASA to defer paying for it. The contractor will recover its cost of financing pallet development by collecting a surcharge from certain users of the extended duration orbiter.

Specifically, the arrangement calls for the contractor to pay \$53 million for developing the pallet and to receive credit for about a \$15 million investment, representing its cost to finance that development. NASA will

repay the development costs in three equal annual installments, beginning in fiscal year 1992. The contractor will have the opportunity to recoup its investment, and perhaps more, from a surcharge on commercial customers' use of the extended duration orbiter over a period of about 2 or more years.

The surcharge will be applied to commercial extended missions up to the date that the Space Station Freedom is ready for human occupation (currently scheduled for April 1996), or no later than December 1997. The contractor could recover its \$15 million investment from the one dedicated commercial extended duration mission currently scheduled for fiscal year 1994, provided that all 8 additional days in orbit are used as presently planned. There are also numerous potential shared commercial payloads, according to NASA. Surcharge revenues from all commercial extended duration missions during the period would go to the contractor. Overall, the contractor is taking the risk that the commercial use of the extended duration orbiter will generate sufficient surcharge revenues to recover its investment in the cryogenic pallet plus a reasonable profit.

According to a NASA manager, the orbiter pallet surcharge would be in addition to the costs NASA charges to recoup its shuttle operations costs, and the surcharge would not affect NASA's pricing policy of charging customers for costs of operations.

Conclusions

OMB and NASA jointly selected the seven projects for commercialization to reduce NASA's fiscal year 1990 budget request and to help achieve the goal of increasing private sector involvement in space projects. However, the efforts to privately finance these seven projects did not increase the commercial sector's involvement in space to the extent desired.

Private financing of space projects may have the potential of increasing commercial investment in space at an acceptable cost to the government. The projects selected, however, were not a fair test of that potential primarily because they were not properly screened; that is, neither their suitability for commercialization nor the economic consequences of seeking private financing for them were adequately evaluated before selection. Only after selection were the evaluations and market tests done showing that most of them were not viable candidates for private financing. Decisions to remove projects from the budget and to seek

their commercial development should be made only after careful screening to determine whether adequate commercial demand exists, development risks are commercially acceptable, and the cost-effectiveness of such a decision is acceptable. Both NASA and OMB decided prematurely to remove these projects from the budget. Such premature removal can unduly pressure NASA program personnel to justify the pursuit of private financing. Ultimately, such action can cause project delays and increased costs when unsuccessful commercialization candidates must subsequently be returned to the budget.

Numerous space projects are continually being planned and developed by the government and, as long as there is a goal of increasing commercial space activities, some of them may seem to offer opportunities for private investment. An evaluation of candidates for private investment early in their development, with the primary focus on their suitability and cost-effectiveness as commercial ventures, would help prevent inappropriate selections and preclude significant development delays.

Assessments of the economic impact of changing from government to private financing should use only realistic assumptions and should specifically address those risks that have potentially significant economic consequences. Although very comprehensive in scope, NASA's present value analyses of a proposal for privately financing the advanced solid rocket motor production facility did not adequately do so. NASA needs to see that economic analyses are correctly done to ensure appropriate comparisons of government and private financing options for future commercialization projects.

Recommendations

We recommend that the Administrator, NASA,

- establish and consistently apply appropriate screening criteria to identify projects for commercialization;
- in consultation with OMB, keep such projects in the budget until they are adequately evaluated and determined to be private financing candidates and private financing is found or judged to be highly likely; and
- ensure that financing options for future commercialization projects are properly analyzed.

Agency Comments and Our Evaluation

NASA and OMB generally believe that our analysis and report provides a useful review of these space commercialization efforts. This review will be helpful in the future, given the newness of such activities and the

Chapter 2
Most Initiatives to Obtain Private Financing
for Space Projects Were Unsuccessful

broad variety of available financing options. OMB did not directly comment on the recommendations, while NASA objected to being the sole addressee of the recommendation in our draft report to keep projects in the budget until they are adequately evaluated as private financing candidates. NASA suggested that we either withdraw the recommendation or address it to OMB.

We recognize that OMB is a key player in approving NASA's budget. The recommendation in the draft report was addressed only to NASA because of its primary responsibility to justify its budget. However, because of OMB's position that withholding the seven projects from the budget request was part of a deliberate strategy to show the Administration's commitment to pursue commercial financing, we modified the recommendation to NASA to include its consultation with OMB.

In stating that withholding funding was part of an overall strategy to attract serious private financing proposals, OMB invited us to comment on that strategy and to suggest how it might be made more effective. OMB described this strategy as obtaining expressions of interest and then soliciting financing proposals, if the private interest was there.

We believe that all of our recommendations will help improve the future implementation of this strategy without unnecessarily interrupting ongoing research and development. Under our suggested approach, weak or clearly unacceptable candidates would be screened out, and private financing would be sought only for projects highly likely to attract it. Then, a clear statement in the solicitation of private financing on each candidate project could outline how the government would withdraw its funding when private financing became available. We believe that this process would send a strong signal of the government's intent. Certainly it is a better approach than abruptly terminating budget funding requests on projects before their commercial viability is known.

The full text of the NASA and OMB comments are included in appendixes I and II, respectively, together with our responses to the agencies' comments other than those summarized above.

Comments From NASA

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



National Aeronautics and
Space Administration

Washington, D.C.
20546

Office of the Administrator

June 28, 1990

Mr. Frank C. Conahan
Assistant Comptroller General
of the United States
General Accounting Office
Washington, DC 20548

Dear Mr. Conahan:

Thank you for your May 16, 1990, letter soliciting NASA's comments on the draft GAO report entitled SPACE PROJECTS: Improvements Needed in Selecting Future Projects For Private Financing. NASA has expended significant efforts to attract investment and make privatization a viable alternative. We appreciate the additional insights and guidance that GAO has provided by this report in exploring the process of selecting candidates for increasing private sector participation in civilian space activities.

The GAO analysis will prove useful in future situations considering the lack of useful precedents and the almost limitless variety of financing arrangements that must be considered prior to the receipt of actual private sector proposals. The candidate analysis and selection process is a complex one that NASA must conduct in parallel with ongoing research, development and technical progress.

Finally, we do not agree with GAO's determination that all of the recommended corrective actions are within the control and authority of the NASA Administrator to implement. Specifically, NASA is not entirely a free agent in the decision processes involved in formulating the content of the President's Budget. Accordingly, we request that GAO reconsider and withdraw that recommendation, or, alternatively, consider making the recommendation to the Office of Management and Budget.

Enclosed are specific comments which we believe will add to the usefulness of the report.

Sincerely,

John E. O'Brien
Assistant Deputy Administrator

Enclosure

Appendix I
Comments From NASA

NASA Comments On GAO Draft Report Entitled "SPACE PROJECTS:
Improvements Needed in Selecting Future Projects For Private
Financing"

The following specific comments are organized in the same format as the subject draft report in order to facilitate cross-referencing.

PRINCIPAL FINDINGS

See comment 1.

The report does not recognize the significant efforts that NASA expended to try to make commercialization of these facilities a viable alternative. This is particularly true of the Extended Duration Orbiter (EDO), which was successfully commercialized, and the facility projects. The docking system and Telerobotic Servicer were not good candidates as it turned out; however, neither of these projects was adversely affected by their consideration, as the privatization efforts were conducted in parallel to their ongoing technical progress.

See comment 2.

There is an implied assumption throughout the report that the projects which were proposed for private financing were adversely affected by this process. Specifically, on page 4, the report notes that four of the projects have been delayed from our original proposal. If they had not been proposed for private financing, the report suggests that they would have been funded, and retained their original schedules. This is not necessarily the case.

See comment 1.

The report also does not acknowledge that major efforts were undertaken by NASA to attract private sector investment in the facility projects and that the detailed cost benefit analyses conducted by NASA prior to requesting formal proposals recognized the specific need for potential investors to take an equity interest in the projects to make them cost beneficial to the Government.

Most Projects Were Not Good Candidates

See comment 3.

We do not agree with the conclusion that some of the facility projects were too far into development to be considered for private sector investment. Deliberate decisions were made by NASA to carry out the final design of the Space Station Processing Facility and the Neutral Buoyancy Laboratory to ensure that the extremely stringent technical and operational safety requirements were fully met and to permit earlier construction start dates if successful offers were received.

Enclosure

Problems With the Analyses of the Rocket Motor Plant Proposal

See comment 4.

The draft report states that NASA did not adequately address the interest rate risk associated with financing a long-term project utilizing short-term money sources, and includes cases where the private-borrowing rate was assumed to be lower than the Government's rate. The analysis of the successful Advanced Solid Rocket Motor (ASRM) offerors proposal, which was a part of the Source Evaluation Board (SEB) evaluation, considered risks associated with interest rate fluctuations over the life of the project. Comparison charts were included which reflected an interest cost range comparison reflecting financing costs for a variety of interest rate changes. The assumed lower rates, when compared to Government rates, were based on the contractor's proposal and reflected plans to sell short-term notes at the most favorable market rates for varying maturities from 30 up to 180 days in lieu of the 180-day Government maturity period. The discount rate utilized represented the rate determined based on criteria established by OMB Circular A-104 at the time of the contractor's proposal. Therefore, the analyses included a variety of interest and discount rate assumptions, and were based on the best data, and methodology that was available.

DESCRIPTIONS AND ESTIMATED DEVELOPMENT COSTS OF CANDIDATE PROJECTS

See comment 5.

The purpose of the Extended Duration Orbiter Cryogenic Pallet is to provide additional consumables for power generation and for life support. These additional consumables consist of storage tanks containing liquid oxygen and liquid hydrogen. The pallet, along with the other modifications to the Orbiter, will extend mission duration, beginning on day 9, to 16 days.

MOST INITIATIVES TO OBTAIN PRIVATE FINANCING FOR SPACE PROJECTS WERE UNSUCCESSFUL

See comment 4.

The third paragraph is incomplete. The NASA analyses identified the exposure to financing risk in terms of both real year cost and present value. GAO was consulted prior to receipt of proposals for analytical techniques that might be used, but no guidance was offered. However, certain GAO data were included in the models.

COMMERCIALIZATION PROJECTS WERE SELECTED BEFORE BEING ADEQUATELY EVALUATED

See comment 6.

The report states that there only one potential EDO flight. More accurately, there is currently only one dedicated commercial flight and numerous potential shared payloads (primarily Spacehab).

Enclosure

PROBLEMS WITH ANALYSES OF THE PRIVATE FINANCING PROPOSAL FOR THE
ADVANCE SOLID ROCKET MOTOR FACILITY

The second sentence should be clarified. That is, the net present value difference was not significant because it was well below the threshold of accuracy of the best OMB and GAO data and methodology that was available at that time.

Private Financing Recommended for the Advanced Solid Rocket Motor Facility

See comment 7.

It should be noted that the insignificance of the present value analysis differential was due to the accuracy threshold of the analytical model. Whereas the various present value analyses showed differences on the order of 4 percent, the methodology and data are probably no better than 10-15 percent. GAO should also note that continued use of the current motors is expected to be more costly than the ASRM, and that ASRM stretch-out would, therefore, increase the ASRM cost and the total Shuttle cost as well. The fifth paragraph under this section should be changed to note that NASA's present-value analysis contained a wide range of assumptions about interest and discount rates.

NASA's Analyses Used an Incorrect Relationship Between Private Interest and Government Discount Rates and Did Not Adequately Address Interest-Rate Risk

See comment 8.

NASA believes that this statement is incorrect and should be deleted. As noted previously, appropriate data were utilized and reflected in NASA's analyses.

In the second paragraph, the conditions used in the baseline case were, in fact, the conditions existent at the time the proposal was received. A wide variety of other cases were compared, some at the request of Congressional staff members. NASA's reports stated emphatically that (a) the actual cost of financing would be greater for private financing, (b) the net present value analyses, for all cases, resulted in differentials that were below the threshold of significance based upon analytical accuracy, and (c) interest rate variation risk was accommodated in the budgeting.

PRIVATE FINANCING PLAN FOR THE EXTENDED DURATION ORBITER PALLET

See comment 9.

GAO reports that all seven projects were reinstated in the budget. The EDO project was not reinstated, and a successful commercial agreement was negotiated. The report should be updated to reflect that this agreement has since been completed (see also pages 15 and 21). NASA's pricing policy for the extended duration of orbiter was established in May, 1990.

Enclosure

The following are GAO's comments on NASA's letter dated June 28, 1990.

GAO Comments

1. We believe the report adequately summarizes such efforts on all the projects, considering that they were mostly carried out after the projects were removed from the budget request. Had the projects been screened in advance, most of them would probably not have been selected as private financing candidates.

2. NASA is correct. To what extent, if any, these projects would have been funded in fiscal year 1990 cannot be known. However, in its fiscal year 1990 budget request, NASA generally presented these projects as being worthy of funding and indicated that it would attempt to commercialize them as part of its efforts to provide opportunities for private investment in space infrastructure. But, by prematurely deleting them from the budget request before their viability as commercial projects was adequately understood and reasonably established, NASA was—in effect—gambling that private investors could be found. NASA lost that gamble on these four projects. On the other hand, if the projects had been properly screened for commercialization potential and, as a result, had remained in the budget, the Congress would have been able to consider them along with all of NASA's other funding needs in judging the size, content, and pace of NASA's 1990 activities.

3. After considering NASA's comment, we have deleted reference in the report to the weightlessness laboratory's being too far into development. In the case of the processing facility, three firms indicated interest in shared use if it could be modified to accommodate their needs. One firm said that 100,000 to 150,000 additional square feet might be needed to enhance joint commercial and government use of the facility. The classification of "too far into development" relates to the costs associated with redesigning the already partly designed, smaller facility.

4. Our report recognizes that NASA's analysis included sensitivity testing on a wide range of private interest and government discount rates. NASA's analysis showed that the cost of private financing would be about \$16 million more than government financing in present value dollars and noted that interest costs would increase about \$15 million in undiscounted dollars for every 1 percent increase in the interest rate. But NASA's final analysis did not highlight the present value impact of these potential interest rate changes—specifically, that a private interest rate increase of 1 percent, applied over the life of the loan, would cost the

government \$27 million more for private financing, with all other factors constant. We believe such an analysis would have put the government's interest rate risk in a more appropriate perspective. The government's potential exposure to periodically redetermined interest rates was significant. It should have been more directly and thoroughly addressed in NASA's analysis, since it helps illustrate the impact of that exposure and the effect of potential private investors' shifting risk normally assumed by them to the government. Also, it is not an inconsiderable amount of money.

5. We revised and expanded the description of the extended duration orbiter pallet.

6. We included NASA's comment in the report.

7. We have revised the report to incorporate NASA's comment that the net present value difference was not significant because it was well below the threshold of accuracy, given the data and methodology. NASA's concern about the estimating error is precisely why sensitivity testing is so important. It helps to illustrate our point about the importance of presenting the results of such testing in ways that clearly provide a measure of the potential effects if basic assumptions about interest rates fail to hold, as discussed in comment 4.

NASA stated that continued use of the current motors is expected to be more costly than using the advanced motors and that stretching out the transition to the advanced motors would increase total shuttle program costs. We included this statement in the report. NASA suggested that the fifth paragraph of this section of the report should note that NASA's present value analysis contained a wide range of assumptions about interest rates. The referenced paragraph was already clear in that regard.

8. We continue to believe that the statement in our report is correct. The basic issue is how data were presented in NASA's report. NASA should have recognized the inappropriate relationship between the private and government interest rates and should have more clearly identified and discussed the additional interest rate risk and potential additional cost of the private financing option.

9. We have included the more current information in the report.

Comments From OMB

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

JUN 29 1990

Mr. Frank Conahan
Director
Federal Management Issues
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Conahan:

Thank you for the opportunity to comment on the draft GAO Report entitled, Space Projects: Improvements Needed in Selecting Future Projects for Private Financing. The Administration is strongly committed to encouraging the commercial use of space through a wide range of activities. The GAO has chosen to review one commercial space issue that we deem very important, i.e., private sector participation in space infrastructure.

I would like to make three general observations on the Report, as well as several specific comments.

1. The Experience of the Private Financing Proposals for the Seven Space Infrastructure Projects Must be Considered within the Context of the Overall National Commercial Space Policy. Policies and programs to encourage the commercial use of space is relatively new. Consequently, some failures can and should be expected. Even though six of the seven projects proposed for private financing were not successful, it is important to note that a number of important successes have been achieved in other areas of commercial space policy.

- o Federal agencies are now procuring launch services provided by the private sector.
- o NASA is in the process of procuring commercial services for a payload module for the Space Shuttle.
- o NASA has signed agreements to make the Shuttle External Tanks available to private interests.
- o The Centers for the Commercial Development of Space have made great progress in attracting private sector participation in developing projects with potential commercial applications.

The Administration believes very strongly in the importance of developing a commercial space industry through these and other initiatives. The National Space Council is planning a review of Federal commercial space policy with the aim of building upon the Nation's successes and learning the lessons from unsuccessful ventures.

2. The Key to Private Participation in Space Infrastructure Projects is the Potential for Alternative use, and the Government Must Develop Effective Strategies to Evaluate and Encourage Multiple Use of Such Assets. The actions taken by NASA and OMB were part of an overall strategy to assess the potential for alternative use of the projects and the feasibility of private financing. This strategy consisted of: first, obtaining expressions of interest; and second, if such expressions were received, to proceed with a solicitation for financing proposals. Federal funding for the seven projects was withheld from the budget in order to demonstrate the Administration's commitment to pursue private financing, and to encourage private firms to commit the time and effort necessary to develop serious proposals. The draft report raises criticisms of, and makes specific recommendation on, certain elements of this strategy. However, the report fails to address the efficacy of the overall strategy. For example, the draft report recommends that funding for future candidate projects be retained in the budget, without addressing the possible negative implications for private firms that might otherwise have an interest in participation. We believe that the final report should address the overall strategy, and, we would welcome any suggestions for making it more effective.

3. The Principal Purpose of the Seven Proposals was to Increase Private Sector Participation in the Space Program, Not to Reduce the Federal Budget. The draft report may leave the impression that these projects may have been proposed for private financing only as a way of reducing the budget. These proposals were not proposed as budget savers. In fact, the FY 1990 budget proposals contained in the February 8th "Building a Better America" included a 22 percent increase for NASA. Had the seven proposals been included in the budget, the increase would have been only slightly higher.

The primary objective of the proposals was to achieve increased private sector participation in the planning, management, financing and operation of national space infrastructure.

Specific Comments

The GAO review is most thorough. However, we wish to point out several problems with the report.

- o The fundamental conclusion of the report is that none of these projects were successfully commercialized. This is not true. Private financing of the Extended Duration Orbiter Cryogenic Pallet was successfully concluded, and a viable proposal for the Observational Instruments Laboratory (at the Jet Propulsion Laboratory) was received. However, Congress would not grant permission for this project to proceed.

See comment 1.

Appendix II
Comments From OMB

See comment 2.

- o The report notes that "over half of the projects were believed to be too far along in development to modify them for commercial use without added expense and delay". Yet, all of these projects were proposed in the FY 1990 budget which, by definition, means that they were in the preliminary stages of definition and/or development. The Report does not resolve these seemingly contradictory statements. In fact, NASA made every effort to insure that commercial considerations could be taken into account in a timely way.

See comment 3.

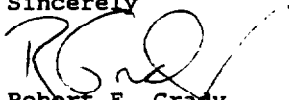
- o There is also an implied conclusion that these projects were somehow adversely affected by proposals to seek private financing, and if private financing had not been sought, the projects would have been funded and would have proceeded "on schedule". We point out that the projects were selected with full consideration of the schedule implications. Moreover, Congress had not funded two of the projects in previous budgets, and even when provided with an opportunity to do so in FY 1990, Congress did not fund the two Space Station facilities.

See comment 4.

- o The report concludes that private investment was not forthcoming because the private sector perceived few or no commercial markets for them. This conclusion is overstated. NASA received many expressions of interest in the two Space Station facilities, and received specific proposals on five of the seven projects. Unfortunately, in most cases, the proposals were not economically viable because of the unwillingness of the private sector to accept an appropriate level of risk.

We believe that the GAO report represents a useful review of the proposals to seek private financing for space infrastructure, especially considering how few the precedents and how many the permutations of financing arrangements. We expect that there will be continued Administration and Congressional interest in space commercialization where it is feasible, and we look forward to receiving GAO's final recommendations in that regard.

Sincerely


Robert E. Grady
Associate Director for
Natural Resources, Energy
and Science

The following are GAO's comments on the OMB letter dated June 29, 1990.

GAO Comments

1. There is no such "fundamental conclusion" in the report. The report clearly recognizes that NASA has successfully commercialized the extended duration orbiter cryogenic pallet. Private financing for the observational instruments processing laboratory was rejected because NASA officials decided that the facility would not be amenable to shared use. Also, bringing a private investor aboard after preliminary engineering had been completed could have delayed construction and increased costs in order to adapt the design to accommodate commercial uses. Furthermore, private financing would have been about 10 percent more costly than government financing.

2. OMB is correct in pointing out that all the projects were in some stage of development; however, that fact does not contradict the classification of some of them as being "too far along in development." That classification refers to those projects where significant design costs had already been incurred, and modifications to adapt them to commercial uses would have meant possibly incurring redesign costs and, perhaps, schedule delays also. For example, a potential private developer of the space station payload processing facility suggested possibly increasing the total square footage of the facility by more than 20 percent in order to accommodate potential commercial users.

3. To what extent, if any, these projects would have been funded in fiscal year 1990 cannot be known. However, had they remained in the budget request, the Congress would have been able to consider them along with all of NASA's other funding needs in judging the size, content, and pace of NASA's 1990 activities.

4. Our report clearly recognizes the extent to which private investors expressed interest in the projects. However, the financing proposals were almost exclusively limited to lending the government money. The potential private investors were generally not interested in an ownership interest because, in part, they perceived insufficient or no commercial markets for the projects. If they had, they would have been more likely to have developed proposals indicating a willingness to accept an "appropriate level of risk."

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