UNITED STATES
GENERAL ACCOUNTING OFFICE

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

Methodology Used In Lease-Versus-Purchase Decision For Tracking And Data Relay Satellite System

National Aeronautics and Space Administration

NASA's decision to acquire the Tracking and Data Relay Satellite System by lease was predicated, in part, on its analyses which show that the cost of leasing is not significantly different than the cost of purchasing.

NASA's methodology in comparing lease and purchase costs is in general accord with widely used and accepted procedures. Because NASA is evaluating cost proposal data received from two bidders, such data was not made available to GAO.

LCD-76-127

JULY 15, 1976

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-185698

The Honorable Frank E. Moss, Chairman
Committee on Aeronautical
and Space Sciences
United States Senate

Dear Mr. Chairman:

As you requested, here is our interim report on the acquisition of the Tracking and Data Relay Satellite System by the National Aeronautics and Space Administration (NASA).

This report relates solely to our evaluation of NASA's overall methodology in making its lease or purchase comparison. We will resume our review and submit a final report after NASA completes its evaluation of bidders' proposals and selects the winning bidder. As you know, NASA has not given us access to bidders' cost data, pending the completion of its analysis and bidder selection process.

We have requested and received informal NASA review of our report but have not, as you directed, requested formal comments.

This report is also being sent today to Congressman John W. Wydler.

If you have any questions or if we can be of further service pending our final report, please advise.

Sincerely yours,

Comptroller General
of the United States

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-185898

The Honorable John W. Wydler
House of Representatives

Dear Mr. Wydler:

As you requested, here is our interim report on the acquisition of the Tracking and Data Relay Satellite System by the National Aeronautics and Space Administration (NASA).

This report relates solely to our evaluation of NASA's overall methodology in making its lease or purchase comparison. We will resume our review and submit a final report after NASA completes its evaluation of bidders' proposals and selects the winning bidder. As you know, NASA has not given us access to bidders' cost data, pending the completion of its analysis and bidder selection process.

We have requested and received informal NASA review of our report but have not, as you directed, requested formal comments.

This report is also being sent today to the Chairman of the Senate Committee on Aeronautical and Space Sciences.

If you have any questions or if we can be of further service pending our final report, please advise.

Sincerely yours,

Comptroller General
of the United States

Contents

		Page
DIGEST		i
CHAPTER		
1	INTRODUCTION	1
	Procurement alternatives	2
	Technical characteristics	3
2	ECONOMIC ANALYSIS FOR LEASE-VERSUS-PURCHASE DECISIONS	5
	General lease-versus-purchase methodology	5
	Time value of money	6
3	NASA's METHODOLOGY	10
	Development of cost estimates	10
	Leased TDRSS	11
	Owned TDRSS	11
	Conversion of dedicated TDRSS lease estimate into purchase estimate	11
	Conversion of shared TDRSS lease estimate into purchase estimate	12
	Factors excluded from analyses	12
	Residual value	12
	Economic price adjustment clause	12
	Cost categories	13
	Taxes paid reduce TDRSS cost	15
	Observation	15
	Timing of expenditures	15
4	CONCLUSIONS	18
APPENDIX		
I	Letter from Congressman John W. Wydler dated February 6, 1976	19
II	Letter from Chairman, Senate Committee on Aeronautical and Space Sciences, dated February 19, 1976	20
III	TDRSS lease/purchase cost categories	22

ABBREVIATIONS

GAO	General Accounting Office
NASA	National Aeronautics and Space Administration
OMB	Office of Management and Budget
TDRSS	Tracking and Data Relay Satellite System

COMPTROLLER GENERAL'S REPORT

METHODOLOGY USED IN LEASE-VERSUS-PURCHASE DECISION FOR TRACKING AND DATA RELAY SATELLITE SYSTEM National Aeronautics and Space Administration

D I G E S T

The National Aeronautics and Space Administration (NASA) plans to lease the Tracking and Data Relay Satellite System by contracting with one of two communications firms. NASA's decision to lease was predicated, in part, on its analyses showing that the cost of leasing was not significantly different than the cost of purchasing. (See p. 1.)

On the basis of the information made available to GAO, the general methodology NASA used to compare the costs of leasing the system to those of purchasing is acceptable. (See p. 18.)

This review was to evaluate the acceptability of the general methodology NASA used to compare lease and purchase alternatives for acquiring the system, as requested by the Chairman, Senate Committee on Aeronautical and Space Sciences, and by Congressman John W. Wydler, and to provide an interim report. GAO will resume this review and submit a final report after NASA selects a bidder. (See p. 1.)

GAO was not given access to NASA's January 1976 analysis because cost data contained therein was based on contractor proposals. However, NASA officials explained that the methodology used in their 1976 analysis was similar to that used in their 1975 analysis. (See p. 1.)

This interim report, therefore, is GAO's evaluation of general methodology as explained by NASA officials and of the use of cost data from NASA's 1975 analysis to illustrate the methodology. (See pp. 10 to 17.)

GAO recognizes that the cost data used for illustration in this report may vary considerably from the cost data used in NASA's 1976 analysis and the contract amounts ultimately negotiated. (See p. 18.)

CHAPTER 1

INTRODUCTION

The National Aeronautics and Space Administration (NASA) plans to acquire services of a Tracking and Data Relay Satellite System (TDRSS) to carry out many of the functions now carried out by NASA's network of ground stations. TDRSS will consist of communications satellites and a ground station to relay voice and data transmissions between mission spacecraft and users during the period 1980-90. NASA plans to acquire the TDRSS communications service through a lease contract with one of two communications firms--Western Union Telegraph Company and RCA Global Communications, Inc.--which submitted proposals to furnish such service.

NASA's decision to acquire the TDRSS through a lease contract was predicated, in part, on NASA analyses which show that TDRSS' lease cost is not significantly different than its purchase cost.

Congressman John W. Wydler of the House Committee on Science and Technology (see app. I) and the Chairman of the Senate Committee on Aeronautical and Space Sciences (see app. II) have requested us to review NASA's methodology for making its decision on whether to lease or purchase TDRSS, and other related matters. The sole purpose of this part of our review was to evaluate the acceptability of NASA's methodology and to submit an interim report thereon to the Committees. We will resume our review and submit a final report after NASA selects the bidder.

We obtained our information from documents and interviews with officials at NASA headquarters and at its Goddard Space Flight Center. We examined guidance on making a lease-or-buy decision contained in executive branch circulars. As the Committees directed, we did not evaluate the accuracy of cost estimates NASA used.

The methodology NASA used in comparing the cost of the lease and purchase alternatives evolved in a series of analyses made between 1974 and 1976. The most recent analysis, made in January 1976, was based on data contained in the contractors' proposals. The methodology NASA used in this analysis was the subject of our review. At the completion of our review, in May 1976, NASA was evaluating two competing proposals and considered all proposal data to be restricted before contractor selection. Consequently we did not review the analysis data or the underlying contractor proposals.

For purposes of illustration, NASA cost estimates and other data contained in a 1975 NASA analysis are used in this report. We recognize this data may vary considerably from NASA's 1976 analysis data and the contract amounts ultimately negotiated.

PROCUREMENT ALTERNATIVES

NASA could acquire the TDRSS by lease or purchase. With either alternative private sector firms will manufacture and operate TDRSS and provide similar technical and communications services.

With a lease, NASA will contract for specified communications services. The contractor will design, manufacture, operate, and own the equipment and the facility which will constitute TDRSS. NASA will pay for the services provided in equal monthly installments over TDRSS' 10-year operational period which is expected to begin in January 1980.

To purchase TDRSS, NASA would contract with an aerospace industry firm for TDRSS' design, manufacture, and integration. NASA would then contract separately with another firm to operate TDRSS. Under this procurement alternative, NASA would own TDRSS.

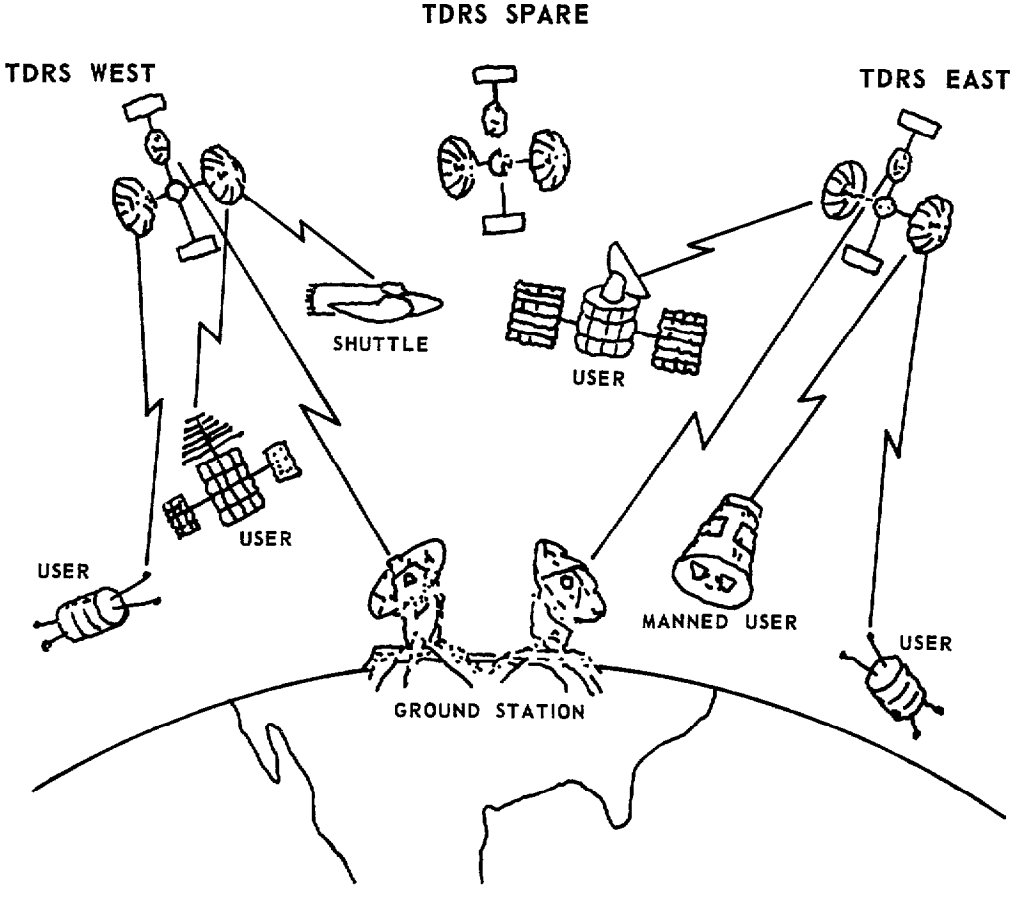
From NASA's view, the main differences between the two procurement alternatives, aside from TDRSS ownership, are the timing of expenditures and the total cost. With a purchased TDRSS, NASA would make substantial outlays during TDRSS' development phase (1977-79). With a leased TDRSS, NASA will make monthly lease payments to the prime contractor beginning in 1980 when TDRSS becomes operational. The effect of this difference on NASA's lease-purchase analysis is discussed beginning on page 6.

The other major difference between the lease and purchase methods from NASA's view is that, in absolute dollars, a leased TDRSS will require substantially higher outlays than would an owned TDRSS. According to NASA officials, the higher lease cost results from the higher return on investment to be paid to the contractor for financing TDRSS' development and for assuming increased risk in providing the communications service.

TDRSS is intended to provide nearly continuous communications with mission spacecraft at altitudes up to 12,000 kilometers (km.). NASA estimates that TDRSS will enable users to be in direct contact with the spacecraft a minimum of 85 percent of their total orbital times compared with only 15 percent for the present ground station network. The improved coverage will be due to the geosynchronous orbits of the TDRSS spacecraft, which will always be in view of the ground station, and to the high altitudes of the TDRSS spacecraft (36,000 km.), which will be within view of mission spacecraft most of or all the time.

TECHNICAL CHARACTERISTICS

Initially, three TDRSS communications spacecraft will be placed in geosynchronous earth orbit. 1/ Two of the spacecraft will provide operational communications service, and the third will be a backup in case of malfunction in one of the others, or in case of the need for increased capacity. A fourth spacecraft will remain on the ground as a standby in case one of those in orbit fails. Additional spacecraft are planned for manufacture as needed during the operational phase to replace the initial four craft. The number of TDRSS spacecraft built will depend on their life-span in service. The following diagram depicts the planned TDRSS.



1/A spacecraft in geosynchronous orbit is in a fixed position relative to a position on the earth's surface.

on the other hand, represent the total costs of the alternatives as of the present time, after considering the time value of money.

Thus a lease-versus-purchase cost comparison is done by identifying the types of costs that would be incurred under each alternative, estimating the magnitude and timing of such costs, converting each cost stream into its present value, and comparing the two present values.

TIME VALUE OF MONEY

The major aspect that complicates the comparison of the two ways of acquiring the use of an asset, that is, lease or purchase, is that the timing of the costs to be incurred under the two acquisition methods differs significantly. In a typical case, purchasing requires the immediate incurrence of a large one-time cost, whereas leasing involves a series of smaller annual costs that, in total, however, are greater than those of purchasing. The implication of this time difference, for the comparison of costs under the two methods, is that the costs to be incurred under each cannot be merely summed and compared, since to do so would imply that a unit of money, such as a dollar, has equal value regardless of when it is received or spent.

The fact that money, if invested, has earning power results in a dollar received now being of greater value than a dollar to be received at some time in the future. The reason for this inequality is that the dollar received now presumably can earn interest, with the result that, by the time the "future" dollar is received, the first dollar will have grown in worth to more than $1.

If it were appropriate to merely sum the costs of leasing and compare them with those of purchasing, the choice would generally be to purchase, since, in terms of total dollars, leasing normally requires a larger expenditure. Frequently, however, when the difference in value between a dollar received today and one received a year from now (that is, the time value of money) is recognized, the analysis may show leasing to be the less costly method.

When the party acquiring an asset chooses, on economic grounds, to lease rather than purchase, he has decided that he is willing to incur the greater total cost to lease because, by so doing, he will avoid the need for the immediate large outlay that would be required to purchase. Presumably, he has concluded that, as a result of not being required to borrow the funds for a purchase or of the return he can earn through alternative uses of the available funds that would

CHAPTER 2

ECONOMIC ANALYSIS FOR LEASE-VERSUS-PURCHASE DECISIONS

Before deciding whether to lease or purchase specific goods or services, Federal agencies frequently make comparative economic analyses of the two acquisition methods. This chapter discusses a major aspect of economic theory underlying such analyses and outlines a general approach to such comparisons.

GENERAL LEASE-VERSUS-PURCHASE METHODOLOGY

A cost comparison of lease and purchase alternatives involves several steps. The first step is identifiying all cost categories associated with each alternative during its economic life, which can become a difficult task. If the building or system to be acquired is highly complex, the number of cost categories in the comparison can be extensive.

The second step is to estimate the magnitude of each cost category and the time in which the costs, or a part of the costs, for each category will be incurred for each alternative. Any offsetting cash flows, such as Federal taxes, to be generated as a result of incurring these costs should be estimated as to their magnitude and timing, to provide accurate estimates of the net cost implications of each of the two alternatives. Costs whose timing and amount are the same under both alternatives may be omitted from the analysis since they would have no bearing on the relative economic attractiveness of the alternatives.

After the costs for the lease and purchase alternatives are identified and time phased, by year, over their useful lives, the annual cost figures should be converted into their present values--the third step in the process. Future-year costs are converted into their present value to show the time value of money, as discussed in the next section. After the costs for both alternatives have been converted into their present-value costs, they can be compared and the alternative with the lower present-value costs can be selected as the economically preferable choice.

In any economic analysis--either in the private sector or in the Government--it should be remembered that present-value costs are not the same as budget costs. Budgetary figures represent the funds that will be needed to cover the costs that actually will be incurred. Present-value costs,

order to provide enough funds to pay for that cost. For example, if the costs in the third year of a lease period were estimated to be $10,000, the present value cost associated with that third year would be an amount that, if invested at the present time, would total $10,000 in principal and interest by the third year. Thus the present value of a future cost is always an amount smaller than the estimated future cost. The further into the future the time period, the smaller the present value of any cost to be incurred in that period.

The relationship between length of time in the future at which a cost is to be incurred and its present value can be seen in table 1 which shows the present value at an interest, or discount, rate of 10 percent for $1,000 of cost to be incurred at the end of each of the next 5 years.

Table 1

Present Value of $1,000 of Cost at End of Each of 5 Years at a 10-Percent Discount Rate

End of year	Present value
1	$ 909
2	826
3	751
4	683
5	621
Total	$3,790

The reason why the present value of the cost to be incurred in year four is smaller than that of year two is that for year four there is a longer time in which the present amount can earn interest. Thus the amount of principal required to be invested to permit payment of the $1,000 cost obviously would be smaller.

The total present value of $3,790 shown in table 1 is the amount of money that, if invested at the present time at an interest rate of 10 percent, would generate a series of repayments of $1,000 a year for the 5-year period. Clearly, to convert any cost estimate into its present value it is necessary to use an interest rate to determine what amount would be required to be invested to meet that future cost. In such calculations, the rate used should be that rate, referred to in present-value or discounting calculations as the discount rate, that best reflects the time value of money to the party in whose interests the comparative analysis is being made.

have been used for the purchase, the interest costs he will avoid, will be greater than the amount by which total leasing costs exceed the total purchase costs. The party furnishing the goods or services, however, presumably believes that the lease payments he is to receive will adequately compensate him for the interest cost he will incur in financing his production or purchasing the goods or services involved.

To arrive at a decision as to the comparative economic desirability of leasing or purchasing, it is necessary to determine the opportunity (or time value of money) costs associated with the alternative methods of acquisition. Thus the inclusion in the analysis of the economic implications of the time value of money is one of the major aspects in any lease-versus-purchase comparison.

There are several ways in which the time value of money can be included in a comparative analysis of the costs of leasing and purchasing an asset. In all of these, however, it is necessary first, to identify the categories of costs to be incurred under each method and second, to determine the magnitude of each cost element and the period during which each cost element will be incurred.

These steps result in the development of two cost streams; the first would be incurred if the decision were to purchase and the second would be incurred if the decision were to lease. To compare the two cost streams, it is necessary to convert each cost stream into a single value that represents the total of that cost stream at a single point in time, that point being the same for both cost streams. The point in time chosen for the comparison could be any time. Conventionally, however, the time chosen is usually the present time, when "present" may be defined as the beginning of the period during which the costs would be incurred or the time when the decision to lease or purchase is to be made. Coverting the cost streams in this manner is referred to as calculating the present value of the costs, or discounting the costs.

To calculate the present value of a cost stream requires first, converting each estimate of cost to be incurred during a specific period, for example the third year of the lease period, into its present value, and second, summing all the individual present values to arrive at a total present value of costs.

The conversion of an individual cost estimate into its present value consists of calculating the amount that would be required to be invested at the present time in

CHAPTER 3

NASA's METHODOLOGY

The Office of Management and Budget (OMB) has provided general guidance to executive branch agencies for doing financial analyses of programs and projects which will require large Government investments. OMB Circular A-94 contains guidelines for doing cost-benefit analyses on proposed investment, to determine whether they should be made. Circular A-76 contains guidance for doing lease-versus-purchase analyses to determine whether commercial and industrial products and services and real property used by the Government are to be provided by private suppliers or by the Government. Circular A-76 specifies when agencies may provide commercial and industrial products and services in-house rather than rely on the private sector to supply their needs. NASA officials advised us that they used the guidance in these two circulars in making their analyses.

DEVELOPMENT OF COST ESTIMATES

NASA derived the cost estimates in the most recent TDRSS lease-versus-purchase analysis from bids made in January 1976 by the two prospective contractors, RCA Global Communications, Inc., and Western Union Telegraph Company, and from estimates of in-house costs associated with TDRSS that NASA will incur during development and operation of TDRSS. NASA deducted estimates of Federal corporate income taxes that would be recovered under both alternatives, to determine the net cost to the Government. To recognize the time value of money, the estimated undiscounted cost of the lease and purchase alternatives were discounted at two rates--8-1/4 and 10 percent. NASA officials told us that the 8-1/4-percent rate represented the average yield on Treasury bonds at the time of its analysis and that, for comparison, it had discounted the estimates at the 10-percent rate specified in OMB Circular A-94.

A composite lease-purchase ratio was computed on the basis of lease and purchase estimates derived from the two firms' proposals. NASA's analysis shows that, using a 10-percent discount rate, leasing TDRSS would be 2 percent less costly than purchasing. Using an 8-1/4-percent discount rate, leasing would be 6 percent more costly than purchasing.

The proposals contained cost estimates which included forward-pricing rates based upon the firms' projections of inflation. To provide a common basis for the lease-purchase comparisons, NASA required the firms to submit proposals in constant 1977 uninflated dollars, in addition to actual cost

As was the case of the present value of a future cost's being smaller the further into the future the time period involved, so is it the case of a future cost's being smaller the higher the discount rate used. The relationship between the discount rate applied to a cost estimate and the present value of that cost estimate is illustrated in table 2 which shows the present value of a cost of $1,000 to be incurred 10 years from now under each of a variety of discount rates.

Table 2

Present Value of a Cost of $1,000 to be Incurred 10 Years from Now at Each of Several Discount Rates

Discount rate	Present value
5%	$614
7	508
10	385
12	322
15	247
20	162

The present value is lower in calculations using higher discount rates since, at higher interest rates, the principal amount required to be invested to meet the future cost obviously would not be as great as would be required if a lower interest rate were in effect.

Conversion of shared TDRSS lease estimate into purchase estimate

NASA estimated the cost of equivalent owned-TDRSS equipment by deducting the cost of non-TDRSS equipment from Western Union's spacecraft and ground station cost proposals. For equipment common to provision of TDRSS and commercial services, NASA estimated the cost of items to be used by TDRSS on the basis of a NASA analysis of the TDRSS technical design contained in the Western Union proposal and NASA experience with comparable spacecraft systems. After estimating equivalent equipment costs, NASA deducted direct and indirect costs identified as unique to a lease. Similarly, NASA added profit and other indirect costs which would be incurred in a typical NASA purchase and the cost estimates for Government-furnished elements that would be associated with TDRSS development and operation.

Factors excluded from the analyses

NASA's lease-purchase analyses covers only TDRSS' developmental and operational phases through 1990 with costs expressed in constant 1977 dollars. Different assumptions regarding the TDRSS' lifespan and treatment of future years' inflation would change the amounts of the various cost estimates.

Residual value

In its lease-purchase analyses, NASA has assumed that TDRSS will have no residual value at the end of its 10-year operational period. According to a NASA official, this period was based primarily on estimates of the operational and technological life of TDRSS, which NASA obtained from a study of domestic satellite communications firms. For depreciation purposes the operational life estimated by these firms averaged 12 years. NASA estimated, on the basis of increased communications requirements of future missions, such as the orbiting space station planned for the late 1980s that TDRSS' technological life would become obsolete about 1990, assuming there would be no significant technical upgrading.

Economic price adjustment clause

TDRSS is planned to be acquired under a fixed-rate lease contract which will provide for 120 equal monthly payments beginning when TDRSS becomes operational,

proposals. The constant-dollar estimates are as of January 1977, the month TDRSS development is currently expected to begin. NASA required proposal cost data at a level of detail that would permit a comparison of lease costs with purchase costs.

Leased TDRSS

NASA's leased TDRSS cost estimates were derived from cost proposals the two prospective contractors submitted. The leased-cost estimates consist of cost estimates stated in constant dollars contained in the two proposals and an estimate of additional costs to be incurred by NASA under a lease arrangement, such as additional staffing for contract management.

Owned TDRSS

NASA derived two cost estimates for an owned TDRSS. One estimate was based on the RCA proposal for a TDRSS dedicated to NASA use only, and the second was based on the shared-service Western Union proposal for both NASA and commercial use.

Conversion of dedicated TDRSS lease estimate into purchase estimate

The basic hardware costs for an owned TDRSS were assumed to be the same as RCA proposed to pay its subcontractors. NASA deducted direct and indirect costs which it identified as unique to the lease acquisition, such as financing and insurance expenses, overhead, and lease contractor's return on investment (expressed in constant dollars). NASA added costs which would be expected in a typical NASA purchase using a systems contractor approach, such as overhead, administrative and other indirect costs, and profit. These estimated costs were based on current NASA aerospace contract costs. NASA also added cost estimates for Government-furnished elements that would be associated with development and operation of an owned TDRSS, such as additional civil service staffing and continuing system development costs. According to NASA officials, TDRSS ownership would require hardware acceptance, additional contract monitoring, and other related responsibilities, which would not be necessary under the lease approach.

Comparison of Estimated TDRSS Lease-Purchase Acquisition Costs

Cost categories	Estimated costs (note a) Purchase	Lease
	(millions)	
Phase I design contracts (note b)	$ 3.6	$ 3.6
Spacecraft	128.3	-
Launch vehicles	131.5	30.3
Ground station facilities	4.7	-
Ground station equipment	33.6	-
Ground station operation and maintenance	46.2	-
Lease payments	-	607.8
Supplemental network hardware (note b)	9.5	9.5
Supplemental network operation and maintenance (note b)	1.1	1.1
NASA communications network equipment (note b)	3.0	3.0
NASA communications network operation and maintenance (note b)	70.8	70.8
Project support (note b)	5.3	5.3
Continuing development	10.2	-
Civil service (NASA) personnel	32.4	21.5
Total	480.2	752.9
Less estimated recovery of Federal corporate income tax payments	24.0	113.1
Net undiscounted cost to the Government	$456.2	$639.8
Net cost to the Government, discounted at 10 percent (note c)	$245.2	$249.6
Net cost to the Government, discounted at 8 percent (note c)	274.2	296.8

a/In constant 1974 dollars.

b/Items with identical costs for both alternatives.

c/As stated on p. 10, NASA's 1976 analyses showed that the lease option was cheaper at a discount rate of 10 percent and more costly at a discount rate of 8-1/4 percent, whereas its 1975 analyses (above) computed on the same basis shows the purchase option to be cheaper at discount rates of 10 and 8 percent. We cannot explain this variance because we did not have access to the 1976 analyses cost data.

expected in January 1980. The contract price will reflect a forward-pricing or inflation-rate projection. This rate will have been determined through negotiation between NASA and the contractor selected to provide TDRSS.

The contract is expected to contain an economic price adjustment clause to provide for changes in contractor costs resulting from unanticipated inflation. The clause will apply to direct and indirect labor costs of the lease contract and its subcontractors and to launch service costs which include the cost of launch vehicles and associated material as well as labor. The contract may also contain an economic price adjustment clause for contractor interest costs.

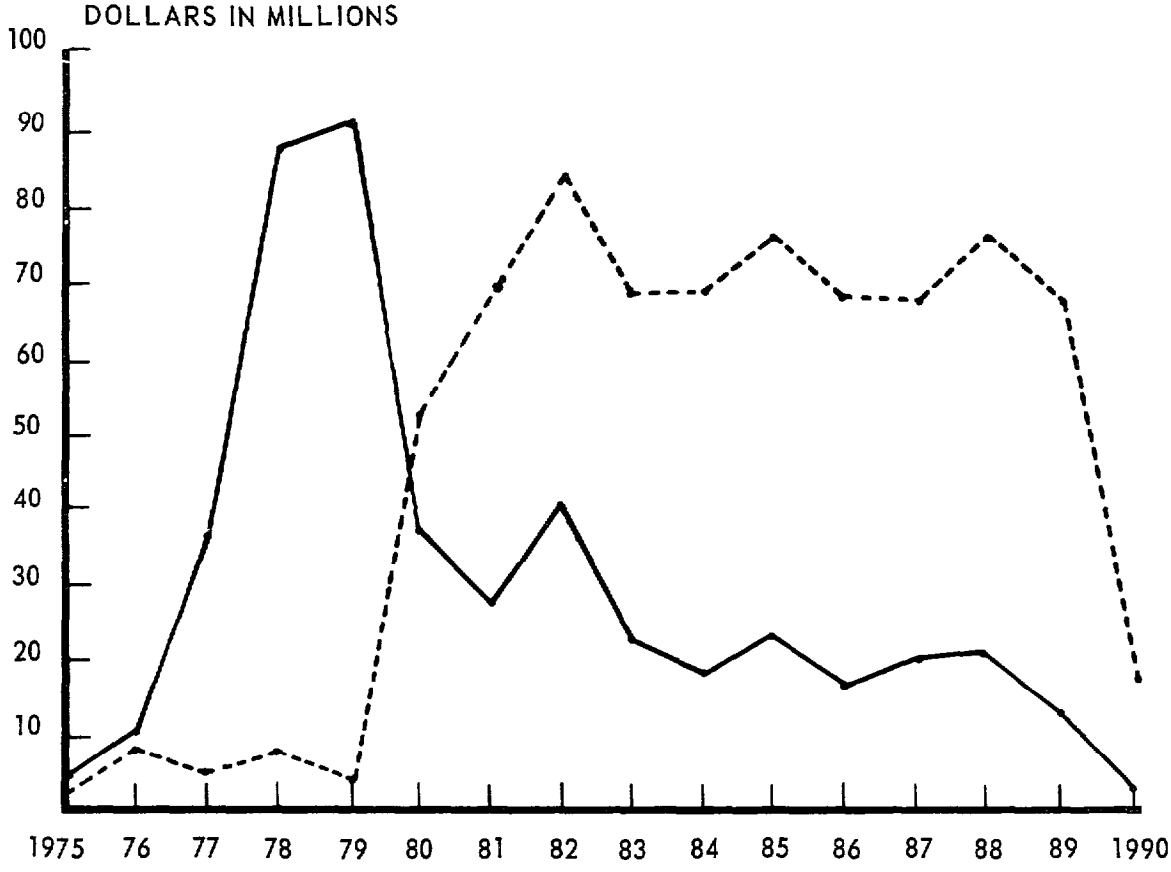
The adjustment under this clause will probably be calculated on a semiannual basis. The effect will be to increase or reduce the lease payment if the actual rate of inflation exceeds or is less than the rate projected in the contract.

Cost categories

The total cost of a NASA owned or leased TDRSS is composed of costs that would be incurred by contractors and NASA during TDRSS' developmental and operational phases. The categories used to group costs in the lease and purchase estimates of the 1976 analysis are described in appendix III. The following table gives the cost categories and related cost estimates, expressed in constant 1974 dollars, from NASA's 1975 analysis.

TDRSS expenditures are shown in the following chart which shows NASA's 1975 estimates of the time phasing of TDRSS lease and purchase expenditures.

TIMING OF GOVERNMENT EXPENDITURES FOR TDRSS SERVICE VIA A PURCHASE OR A LEASE METHOD (NOTE a)



[a]Data is from NASA's January 1975 lease-versus-purchase analysis which includes costs in constant 1974 dollars but does not reflect reduced costs due to Federal tax recoveries.

As shown in the chart, with a purchase procurement, nearly half of NASA's total expenditures for TDRSS (approximately 48 percent) would be made during 1977-79, the preoperational years. According to NASA officials, most of these expenditures would be in the form of progress payments to contractors, as is typical with other Government procurements. For a leased TDRSS, NASA would spend only about 4 percent of the total cost before 1980.

Taxes paid reduce TDRSS cost

To estimate the net cost of TDRSS to the Government, NASA deducted from both the lease and the purchase estimates estimated Federal corporate income taxes that would be paid.

Since prospective TDRSS contractors could use various proportions of equity and debt as a source of funds to finance the required TDRSS investment, estimates of Federal income taxes that NASA deducted from the leased TDRSS cost estimates were composed of two elements: income taxes paid by contractors and income taxes resulting from interest paid by contractors to lending institutions. Income taxes on the lease contractors' return on investment and the profits of the first-tier and major second-tier subcontractors were deducted at a 48-percent rate. NASA used a 48-percent standard corporate income tax rate because of its relative uniformity and the impracticability of determining the effective tax rate for each participating contractor. Income taxes on interest earned from contractor borrowing from taxed financial institutions were deducted from the lease alternative at a 55-percent rate (on interest paid by the contractor) based on a NASA study.

NASA also deducted estimates of income taxes that would be paid by the prime contractor and subcontractors from the cost estimates for an owned TDRSS at a 48-percent rate. NASA made no estimates of income taxes resulting from contractor borrowing because it assumed that periodic progress payments would eliminate the need for debt funding by contractors.

Observation

The assumed rate and timing of Federal corporate income tax payments may significantly affect the relative financial attractiveness of the lease and purchase alternatives. An additional analysis based on the proposal finally negotiated may be desirable to determine the sensitivity of the lease and purchase alternatives to the assumed rates of income tax recovery and to evaluate the validity of the assumed rates.

TIMING OF EXPENDITURES

A major difference between the lease and purchase methods of acquiring TDRSS is in the timing of NASA expenditures. For an owned TDRSS, large outlays would be required in the early years to finance the development, manufacture, and integration of its various components. After TDRSS becomes operational, NASA's expenditures would decline and would continue at a relatively stable level. Conversely, for a leased TDRSS, NASA will have relatively small outlays in the early years and larger fixed outlays during the operational period. These differences in the timing of

CHAPTER 4

CONCLUSIONS

On the basis of information made available to us by NASA officials, NASA's general methodology in comparing the costs of leasing the TDRSS to those of purchasing it is an acceptable method of making such comparisons.

As the Committees directed, we did not evaluate the accuracy of cost estimates used by NASA in any of its analyses. The range of cost categories included in its analyses, however, seem to be complete, especially with regard to the categories that would differ between the two acquisition methods. Also NASA's offsetting of Federal taxes to be returned to arrive at the net cost to the Federal Government is an appropriate procedure.

The technique NASA used to consider the difference in timing of costs between the lease and purchase methods, that of converting each cost stream into its present value, is a widely used and accepted technique.

Although we agree with NASA's general methodology as explained by NASA officials, the detailed procedures and application to specific costs can be evaluated only when NASA's analysis is made available for our review. We recognize this cost data may vary considerably from the cost data used for earlier analyses and the contract amounts ultimately negotiated.

The deferred-expenditure characteristic of the lease procurement will permit NASA to pay for TDRSS over the same period that savings will occur from closing the ground stations to be replaced by TDRSS. According to NASA, this deferred expenditure will permit relatively level expenditures for supporting ongoing programs in space science and aeronautical research and technology within the relatively stringent budgets expected for 1977-80.

The total undiscounted cost to NASA of a leased TDRSS will be significantly more than for an owned TDRSS. According to NASA's 1975 estimates, a leased TDRSS would cost about $752.9 million in constant 1974 dollars compared with about $480.2 million for an owned one. Although the net undiscounted cost of a leased TDRSS ($639.8 million) is substantially more than the cost of an owned TDRSS ($456.2 million), the difference between the two in the lease-purchase analysis is decreased when the time value of money is considered. Under a lease procurement the bulk of NASA's expenditures will be incurred during the TDRSS' operational phase, but under purchase procurement, almost half of the cost will be incurred before 1980. Consequently, when the lease and purchase expenditure flows are discounted, the lease alternative cost is reduced relatively more than that of the purchase alternative. The table below illustrates the effect of discounting based on costs used in NASA's 1975 lease-purchase analysis.

	Purchase	Lease	Difference (note a)	Lease-purchase ratio
	(millions)			
Net undiscounted cost to Government	$456.2	$639.8	$183.6	1.40
Net cost to Federal Government after applying an 8-percent discount rate to adjust for time value of money	274.2	296.8	22.6	1.08
Net cost to Federal Government after applying a 10-percent discount rate to adjust for time value of money	245.2	249.6	4.4	1.02

a/Amount that the cost of a leased TDRSS exceeds that of an owned TDRSS.

APPENDIX II

United States Senate
COMMITTEE ON
AERONAUTICAL AND SPACE SCIENCES
WASHINGTON, D.C. 20510

B-185898

February 19, 1976

The Honorable Elmer B. Staats
Comptroller General
General Accounting Office
Washington, D. C. 20548

Dear Mr. Staats:

For the past few years the National Aeronautics and Space Administration, in its annual budget request, has proposed that it acquire a Tracking and Data Relay Satellite System (TDRSS) capability to upgrade its tracking and data acquisition capability for most earth orbital space missions. NASA has testified that the TDRSS capability is necessary to make maximum use of the Space Shuttle. NASA has further testified that it plans to acquire the TDRSS capability through a leased service arrangement. Under this method, the contractor would design, construct and operate the system and provide the service to NASA for a ten-year period. NASA funding would not be required until the service actually commences which is currently scheduled for January 1980.

Currently, two proposals are being reviewed by a NASA Source Evaluation Board with the selection of the contractor scheduled for early summer 1976, and contract award to follow in October, contingent upon receiving congressional approval to proceed with a leased service arrangement since the Congress has not agreed that the agency should acquire a TDRSS capability through leasing.

The Committee has made its position on this matter very clear in its reports on the annual NASA authorization bills. It has agreed that NASA could proceed with its studies on the TDRSS, and there is a provision in the annual NASA authorization bill to that effect.

When NASA first proposed the TDRSS to the Committee in 1974, NASA officials testified that the cost to NASA in 1973 dollars for a dedicated leased system would be $584 million for

APPENDIX I

COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
SUITE 2321 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, D.C. 20515

February 6, 1976

B-185898

Mr. Elmer B. Staats
Comptroller General of the United States
General Accounting Office
441 G Street
Washington, D.C. 21548

Dear Mr. Comptroller General:

The National Aeronautics and Space Administration has issued a request for proposal and has received bids on a Tracking and Data Relay Satellite System (TDRSS). They are currently in the process of evaluating the two proposals received. It is the intent of NASA to lease the TDRSS services from one of the these two contractors. In examining this matter over the last several years as a Member of the Subcommittee on Space Science and Applications, I have been concerned with the relative merits of lease versus purchase of such a system by the government. NASA has given us assurance that prior to an award of a contract that they will be able to fully advise the Committee as to the relative costs of purchase for such a system as opposed to lease.

I wish to request that the General Accounting Office make a thorough review of the methodology employed by NASA in evaluating the bids for the TDRSS. I am particularly interested in the verification of the methodology in determining the relative merits of purchase versus lease and the effectiveness of evaluation in assuring that the public's best interest is served.

Since NASA is now completing a review of its proposals and will present their findings to the Subcommittee in the next several months, it is important that the analysis be completed by May, 1976.

Your assistance in this amtter will help the Committee to discharge its responsibility effectively.

Sincerely,

JOHN W. WYDLER
Member of Congress

TDRSS Lease/Purchase Cost Categories

Spacecraft--Development and manufacturing costs of the initial and backup satellites that will provide TDRSS communications service during its operational life.

Launch vehicles--Cost of vehicles and associated launch services such as labor, and materials. Launch of the initial spacecraft will be via either Delta or Atlas-Centaur vehicles. Launches of replacement spacecraft will be via the Space Shuttle.

Ground station facilities--Structures and utilities to support the system's tracking and data handling equipment.

Ground station equipment--Antennas, transmitters, receivers, computers and related software to provide required communications services between spacecraft and NASA users.

Ground station operations and maintenance--Contractor personnel costs to operate the equipment, maintain grounds, provide building services, and make minor repairs to structures and equipment.

Lease payments--This category includes the folowing cost categories shown separately in the estimate for an owned TDRSS: spacecraft, ground station facilities, ground station equipment, and ground station operations and maintenance. The category also includes the lease contractor's pre-tax-return on investment, subcontractors' before-tax profits, and overhead costs of the lease contractor and its subcontractors. Return on investment is a cost to NASA, and is composed of two elements--lease contractor's profit, and interest costs for financing that part of the system not financed with equity funds. In the 1976 analysis the bidders separately identified the profit and interest cost elements of return on investment according to a NASA official.

Supplemental network hardware--Cost of equipment to be located at four remote locations which will aid in determining exact positions of the TDRSS spacecraft. According to NASA, this cost category amount was the same in both estimates.

Supplemental network operations and maintenance--Cost for maintenance of the equipment at the remote locations. This category amount was the same in each cost estimate.

NASA communications network (NASCOM) equipment--NASA equipment at the TDRSS ground station which will provide

APPENDIX II

ten years of service. They testified that the cost of a NASA-owned (purchased) TDRSS (research and development plus ten years of operation) would be $229 million. In a recent appearance before the Committee, they testified that the lease-to-purchase cost ratio is now 0.98.

To assist the Committee in its understanding of this complicated matter, it is requested that the General Accounting Office: (1) review the NASA study on the lease vs. purchase cost comparison, particularly the procedures used in the analysis; (2) examine the regulatory matters associated with a communications service such as will be provided by TDRSS, leased or purchased (a recent report on this was prepared by Mr. Bernard Strassburg for NASA); (3) provide a report on (1) and (2) to the Committee.

Sincerely,

Ted Moss

Frank E. Moss
Chairman

FEM:par

compatability between TDRSS signal characteristics and the transmission signal requirements of the communication common carrier's equipment. NASA will lease communication transmission services from carriers such as the American Telephone and Telegraph Company to link the ground station with NASA users at various locations. The same amount was used in the lease and purchase estimates for this cost category.

NASCOM operations and maintenance--NASA lease payments to communications carriers for use of their ground-based and/or domestic satellite-based communication facilities. As with NASCOM equipment, both estimates used the same amount for this category.

Project support--Costs of NASA study efforts to aid NASA users of TDRSS services to be compatible with its operational and technical characteristics, and to optimize the systems equipment and operational procedures to support users. This cost category was the same in both cost estimates.

Continuing development--Cost of future improvements to TDRSS equipment and software to incorporate state-of-the-art advances in order to meet required user needs. This category applies to the purchase cost estimate only. With a leased system, the contractor would be responsible for this function.

Civil service--NASA personnel costs during the developmental and operational phases of TDRSS. According to NASA, during the developmental phase of an owned TDRSS, agency employees would be involved in preparation of equipment technical and operational specifications, review of prospective suppliers' system proposals, and monitoring and reviewing system development. We were told that with the lease arrangement, civil service costs would be less because NASA specifies only the service needed, and monitors system development only to the extent necessary to assure itself that the system will provide the desired service when needed. An official said that during the developmental period the contractor would perform the other tasks that NASA personnel would perform under a purchase arrangement.

During the operational phase, some NASA employees would be required at the ground station and for TDRSS-related duties at Goddard Space Flight Center. According to an official, the number of NASA employees required during the operational phase would be approximately the same with either procurement alternative.

AN EQUAL OPPORTUNITY EMPLOYER

UNITED STATES
GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
U. S. GENERAL ACCOUNTING OFFICE

THIRD CLASS