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BY THE U.S. GENERAL ACCOUNTING OFFICE

Report To The Secretary Of Transportation

Cost Effectiveness Of Life-Cycle Process In Buying Transit Vehicles Questionable

Transit vehicles traditionally have been purchased using the low bid process, but for fiscal year 1982 the Congress required that operating and maintenance costs as well as the purchase price (life-cycle costs) be evaluated before awarding vehicle procurement contracts. While the use of the life-cycle costing process was made optional in 1983, some transit systems continue to use it. GAO found that

--The cost effectiveness of the life-cycle cost process for transit vehicles is unknown

--Transit systems generally lack the information, resources, and technical expertise needed to evaluate life-cycle costs effectively

Although the Urban Mass Transportation Administration has covered some aspects of the life-cycle cost process as part of its research program, it has not addressed the above problems. GAO is recommending that a systematic scheme of research projects be developed to determine if the life-cycle cost process is beneficial for transit procurements and to remove the obstacles barring the process effectiveness.

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

RESOURCES COMMUNITY,
AND ECONOMIC DEVELOPMENT
DIVISION

B-211849

The Honorable Elizabeth H. Dole
The Secretary of Transportation

Dear Madam Secretary:

This report discusses the use of life-cycle costs in buying transit vehicles and makes recommendations concerning steps the Urban Mass Transportation Administration could take to improve the effectiveness of this procedure. We made this review because of concerns that the lack of adequate data and technical expertise in the transit industry would reduce the industry's ability to effectively carry out this procedure. Although life-cycle cost evaluations are now optional rather than mandatory, some transit systems continue to use this process, and the problems and obstacles to its effective use still exist.

This report contains recommendations to you on page 20. As you know, 31 U.S.C. §720 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the Senate Committee on Governmental Affairs and the House Committee on Government Operations not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

In addition to sending copies to the committees mentioned above, we are sending copies of this report to the Chairmen of the House Committee on Public Works and Transportation and the Senate Committee on Banking, Housing and Urban Affairs and the Director, Office of Management and Budget. Copies are also being sent to your Assistant Secretary for Administration.

Sincerely yours,

for J. Dexter Peach
Director

GENERAL ACCOUNTING OFFICE
REPORT TO THE SECRETARY
OF TRANSPORTATION

COST EFFECTIVENESS OF LIFE-CYCLE PROCESS IN BUYING TRANSIT VEHICLES QUESTIONABLE

D I G E S T

Historically, transit systems that received Federal funds to purchase vehicles have used the low bid process in procurements. However, because of concerns that this process did not always ensure that the most cost-effective vehicle was purchased, the Congress required in 1982 that the factors of performance, standardization, and life-cycle costs (the operating and maintenance costs in addition to the acquisition cost) be evaluated when purchasing transit vehicles. While the passage of the Surface Transportation Assistance Act in January 1983 made the use of the life-cycle cost process optional, some transit systems continue to use it.

GAO reviewed the use of life-cycle costing for transit vehicles and found that there are major obstacles and concerns related to using this process for purchasing transit vehicles. Specifically, GAO found that

--its use in making transit vehicle procurement decisions has not been proven to be cost effective and

--transit systems generally do not have the information, resources, or technical expertise needed to use the process effectively.

As of February 1983 only 43 transit systems had started procurement actions using the life-cycle cost process and only 24 of these systems had completed the process and awarded contracts for the vehicles.

COST EFFECTIVENESS OF USING LIFE-CYCLE COSTING TO BUY TRANSIT VEHICLES IS QUESTIONABLE

The cost effectiveness of using the life-cycle cost process to buy transit vehicles is unknown because the Urban Mass Transportation Administration (UMTA) does not have the means to determine if the benefits realized offset the additional costs resulting from its use.

GAO found that the life-cycle cost procurement process involves expenses not present in the low bid process. These expenses are explained below.

Higher administrative costs--33 of the 43 transit systems with life-cycle cost experience reported higher costs because of additional staff hours and outside technical and legal assistance needed to complete the process. (See p. 8.)

Delays in completing the procurement--23 of the 43 systems reported delays ranging from several weeks to several months because of the additional time needed to prepare the bid package and complete the bid evaluation; 5 systems reported delays of up to a year to resolve manufacturers' formal protests. (See p. 9.)

Higher initial vehicle costs--in 6 of the 24 completed life-cycle cost procurements, the award was made to the bidder with a higher initial cost after evaluating the impact of the life-cycle costs. In one instance, the transit system paid almost $4,000 more per bus. (See pp. 10 and 11.)

Higher costs for the manufacturers--bus manufacturers must develop and maintain test and experience data to meet the varying demands of each transit system's bid package. (See p. 10.)

The delays experienced also increase costs because of the extra maintenance needed to keep the buses that are being replaced in service longer. Using these less reliable buses longer also affects service. (See pp. 9 and 10.)

Benefits gained from using the life-cycle cost process have not been calculated by either UMTA or the transit systems. Savings have been claimed based on the manufacturers' cost estimates. However, the general lack of standardized tests in the transit industry and the limited operating experience data available make these projections unreliable. The five transit systems that had received their vehicles as of February 1983 were not keeping detailed records on vehicle performance to prove or disprove the cost projections. (See pp. 11 to 13.)

While it would be impractical to completely evaluate the effectiveness of the life-cycle cost process because of the inability to determine the performance costs of the vehicles not selected, GAO believes that provisions should be made for gathering performance cost data for the vehicles purchased to assess the validity of the cost projections used in making the selection.

DATA AND PERSONNEL LIMITATIONS HAVE AN IMPACT ON EFFECTIVE USE OF LIFE-CYCLE COSTING

Transit systems generally do not have the information, resources, or technical expertise needed to make effective life-cycle cost procurement decisions. They often lack (1) data to identify major cost factors, (2) data to independently verify manufacturers' cost submissions, (3) qualified personnel to evaluate manufacturers' data, and (4) objective evaluation criteria. UMTA has not taken steps to help transit systems overcome these problems.

GAO sent questionnaires to a statistical sample of transit systems that received Federal financial assistance, and based on the results of the survey, GAO determined that most transit systems would have difficulty preparing a life-cycle cost bid package and evaluating life-cycle cost projections because

--80 percent do not summarize most major cost factors by bus model;

--75 percent had essentially manual record-keeping systems, making summarization of the necessary cost data a time-consuming and costly process; and

--50 percent would need additional staff to collect and analyze data. (See pp. 13 and 14.)

The general lack of independent standardized tests for transit vehicles and transit systems' limited technical expertise makes it difficult to design the request for bids and evaluate bid submissions. Most of the 43 transit systems with life-cycle cost experience had problems specifying the type of data to be provided and verifying data submitted. Of the 24 transit systems that completed bid evaluations, 4 reported that they did not or

could not verify manufacturers' representations and 5 reported manufacturer protests over either the definition of standardization and/or performance or the basis used for evaluating these factors. (See pp. 15, 16, and 18.)

In addition, the transit systems generally have not considered the time value of money in making the life-cycle cost evaluations. (See p. 11.) GAO believes that present value analysis should be used in making cost comparisons of alternatives when the cash expenditures will extend for 3 or more years.

GAO believes that these problems must be overcome before transit systems can effectively use the life-cycle cost process to procure transit vehicles.

UMTA's RESEARCH ON LIFE-CYCLE COSTING

As part of its research program, UMTA has funded various projects on life-cycle costing. This work, however, has not addressed the issue of the overall usefulness of the process for transit systems. (See pp. 18 and 19.) GAO believes that a systematic approach with a limited number of transit systems is needed to address the specific problems identified.

RECOMMENDATIONS

GAO recommends that the Secretary of Transportation direct the UMTA Administrator to develop research and demonstration projects with selected transit systems to

--document the costs associated with using the life-cycle cost process to buy transit vehicles;

--keep operating and maintenance cost records for the vehicles bought to determine the validity of the cost projections used in making the contract award; and

--identify ways to overcome the obstacles to using the life-cycle cost procurement process by addressing the problems of availability of adequate data, selection of verifiable cost factors, failure to consider the present value of the projected costs, development of fair evaluation processes, and

expertise needed to adequately evaluate cost projections. (See. pp. 20 and 21.)

AGENCY COMMENTS AND GAO's EVALUATION

The Department of Transportation did not disagree with GAO's findings and stated that it had raised the same problems at the time life-cycle costing was mandated by the Congress. It believes, however, that UMTA's life-cycle cost program addresses GAO's concerns. The Department also stated that UMTA has been reviewing the fairness of life-cycle costs for rolling stock in pursuing its commitment to fairness in procurements.

GAO recognizes that UMTA cited similar problems with the life-cycle cost process for transit vehicles. However, as the report shows, these problems are still present and some transit systems continue to use the process. UMTA's life-cycle cost program is a series of research and development activities focusing on reducing the life-cycle costs of bus vehicles and components. GAO believes that the program addresses only part of the problems but does not make a comprehensive analysis of the entire process. Lastly, GAO found no evidence that UMTA has reviewed the fairness of the life-cycle procurements to date. (See pp. 21 and 22.)

Contents

ABBREVIATIONS

DOD	Department of Defense
DOT	Department of Transportation
GAO	General Accounting Office
GFC	Grumman Flxible Corporation
GMC	General Motors Corporation
GSA	General Services Administration
UMTA	Urban Mass Transportation Administration

CHAPTER 1

INTRODUCTION

Life-cycle costing is a method of evaluating proposed procurements which considers not only the initial acquisition cost of equipment but also the cost of operating and maintaining that equipment over its useful life. The lowest composite cost, which reflects not only how much it will cost to buy the equipment but how much it costs to own the equipment as well, is used as the basis for awarding a contract to the successful bidder. Life-cycle costs can also be applied indirectly with other procurement processes by incorporating design features in a bid specification to assure a lower life-cycle cost, or during the design process itself where life-cycle costs of competing design alternatives are assessed.

In the past, transit systems generally used a low bid process to purchase vehicles (such as buses, rapid rail cars, etc.). With this process, the manufacturer submitting the bid with the lowest initial purchase price received the contract.

While the use of life-cycle costing is new to transit systems, the Department of Defense (DOD) and the General Services Administration (GSA) have used the process for many years. These agencies' experiences, however, provide little assistance to the transit systems because of the different conditions under which they must use the process.

LIFE-CYCLE COSTING CAN BE USED IN DIFFERENT WAYS

Life-cycle costing can be used in three general ways--directly, indirectly, or as a design tool. When life-cycle costing is used directly in a procurement, a transit system determines the factors which account for the major operating and maintenance expenses for its vehicles under its specific operating and environmental conditions. Each manufacturer bidding on the contract submits data on the projected operating and maintenance costs for each of these factors. For example, fuel is the major cost factor for transit buses. The manufacturer would calculate this cost for its specific vehicle by multiplying the projected mileage per gallon of fuel (under the operating profile spelled out in the bid request) by the cost per gallon and the number of miles (usually 500,000) the bus will be operated over its 12-year life. After validating the manufacturer's information, the total life-cycle cost is computed for each manufacturers' vehicle to determine which vehicle would be the least costly for that transit system to own and operate. The contract is awarded to the manufacturer with tne lowest total life-cycle cost.

Indirect application of life-cycle costing also identifies major cost factors for operating and maintaining a vehicle. These factors, however, are incorporated into design specifications by listing certain components or subsystems for the vehicle which

have been determined to be more cost effective to operate or maintain. For example, based on engineering studies a transit system determined that a specific engine and transmission configuration was best suited for its operating conditions. By specifying this configuration in the request for bid, the impact of these components on the cost of operating that vehicle is taken into consideration.

Lastly, life-cycle costing can be used as a tool when designing items such as a piece of equipment or a building. The projected ownership costs for competing design alternatives are assessed to identify features that add excessively to future costs.

Because the life-cycle cost process is comparing costs which will occur over time (in effect deciding whether it is better to pay more now for a bus that will cost less to operate and maintain over its life), the costs of each alternative should be compared at their present values. This comparison is necessary because money has earning power over time--postponing spending a dollar until next year provides an opportunity to earn interest on that dollar or otherwise productively use it for the 1-year period. The present values can be calculated by determining the cash flows over the life of each alternative and multiplying each year's projected cash flow by that year's discount rate factor. The alternatives can then be evaluated on an equal economic basis. We believe that present value analysis should be used in any cost comparison where cash flows will extend for 3 or more years.

TRANSIT SYSTEMS HAVE GENERALLY USED THE LOW BID PROCESS IN PROCUREMENTS

Since fiscal year 1964, the Federal Government has provided financial assistance to purchase more than 50,000 transit buses, 3,800 rapid transit cars, and 500 light rail cars. The Federal Government funds up to 80 percent of the cost of the vehicle procurement. In fiscal year 1982 over $400 million was provided for buses and $112 million for rail vehicles. Until fiscal year 1982, the transit industry generally used the low bid method in buying vehicles. With this method, the manufacturer that submits the lowest purchase price receives the contract.

Over the years some transit systems have raised concerns about the use of the low bid process because

- --it does not consider lifetime operation and maintenance costs which amount to more than the initial cost of the vehicle;
- --operation and maintenance costs are not considered, manufacturers are not encouraged to include design features that lower the operation and maintenance costs if they also raise the initial price of the vehicle; and
- --when standardization is not considered, vehicle fleets might eventually include many different models by different manufacturers which multiply the cost of spare parts inventories and operation and maintenance training.

While these concerns can be addressed under the low bid process, the direct life-cycle costing procurement method requires an evaluation of operation and maintenance costs and thereby forces transit systems to consider the above concerns when purchasing vehicles.

LIFE-CYCLE COSTING REQUIREMENTS SPECIFIED IN TRANSIT LEGISLATION

Since fiscal year 1980, the Congress has imposed various requirements on the use of the factors concerning performance, standardization, and life-cycle costs in procuring transit vehicles. For the first 2 years, transit systems were required only to consider these factors, but in fiscal year 1982 they were required to evaluate them before awarding a contract for transit vehicles. In 1983 the use of these factors once again became optional. With all of the various requirements, UMTA has adopted a hands-off approach and allowed the transit systems to develop their own processes to comply with the requirements.

Life-cycle costs must be considered when buying transit vehicles with 1980 and 1981 funds

In the Department of Transportation's (DOT's) 1980 and 1981 appropriation acts (Pub. L. Nos. 96-131 and 96-400) the Congress stated that grants awarded for contracts for the acquisition of transit vehicles shall only be awarded based on consideration of performance, standardization, and life-cycle costs. This requirement stemmed from the Congress' concern over the lack of emphasis on standardization in UMTA's procurement policies.

UMTA contended that its procurement practices then in effect already contained consideration of performance, standardization, and life-cycle cost factors. UMTA's procurement policy, at that time, was to require transit authorities to use the Baseline Advanced Design Transit Coach Specifications (generally referred to as the White Book) when buying advanced design buses.[1] The White Book, published by UMTA, was a standard specification to be used in soliciting bids for these buses. In addition to the standard features contained in the specification, new bus features that could affect operating and maintenance practices (such as independent suspension, reduced floor height, and the use of acrylic windows) could be included as options. To induce manufacturers to provide these options, price adjustments were made to the manufacturer's bid when such items were included.

In continuing to adhere to its White Book specifications, UMTA was using an indirect life-cycle costing method of procurement. UMTA continued implementation of the life-cycle cost requirement in this manner through 1981.

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[1]Advanced design buses are the bus models the manufacturers introduced in the late 1970's as replacements for the "new look" models that had been available since 1959.

Life-cycle costs must be evaluated when buying transit vehicles with 1982 funds

During DOT's 1982 appropriation hearing before the Subcommittee on Transportation, House Committee on Appropriations, UMTA discussed eliminating the White Book specification for buying buses. The subcommittee stated its concern that this proposal would eliminate standard equipment design and life-cycle cost information in buying transit vehicles and forsake procedures developed to cut costs. As a result, the Congress strengthened the life-cycle costing requirement by mandating in the fiscal year 1982 appropriation act (Pub. L. No. 97-102) that contracts for transit vehicles be awarded only after an evaluation of performance, standardization, and life-cycle costs had been made.

Instead of using White Book specifications where low life-cycle costing features could be incorporated into the design specifications, grantees now had to develop a life-cycle costing model by which each manufacturer's bus was to be evaluated. This changed procurement procedures from awarding to the bidder with the lowest initial cost to awarding to the bidder whose vehicle has the lowest total life-cycle cost.

Although grantees were now required to evaluate bids by using a life-cycle costing model, UMTA did not give specific guidance on how to develop the model or what information should be included in it. UMTA's February 1982 Federal Register notice regarding the new requirement stated that specific procedures for implementing the requirement would not be imposed in order to allow grantees maximum flexibility. Additionally, UMTA stated that any protests involving life-cycle cost procurement methods would be considered a local issue and should be resolved by the parties to the procurement.

Because of the flexibility allowed, the life-cycle cost processes developed by the transit systems have varied, but in general they have attempted to evaluate the lifetime costs for fuel, engine oil, preventive maintenance, engine, transmission, brakes, and air conditioning. The ways performance and standardization have been addressed have also varied. Performance can cover things such as delivery of the vehicles, training for the system's mechanics and operators, or the availability of service representatives, while standardization can cover the extent to which additional spare parts inventories and maintenance tools will be needed for the new vehicles.

Use of life-cycle costing becomes optional for purchases with 1983 funds

In January 1983 the Congress enacted the Surface Transportation Assistance Act of 1982 (Pub. L. No. 97-424), which made the use of life-cycle costing optional by stating that a competitive procurement process could be used in lieu of low bid or life-cycle costing. In conflict with this was DOT's 1983 Appropriation Act (Pub. L. No. 97-369) enacted in December 1982, which carried the same language as the 1982 act requiring grantees to evaluate life-cycle costing in awarding contracts.

After examining the two conflicting laws, UMTA determined that the Surface Transportation Assistance Act, making life-cycle costing optional, was to be applied because it was passed most recently and was clearly intended to loosen the requirement. As a result, UMTA's "Guidelines for UMTA Applicants," dated February 2, 1983, was sent to UMTA's regional offices stating that:

> "Life-cycle cost factors are not a separate method of procurement. Grantees may procure vehicles by a competitive bidding/lowest price procedure or by a competitive negotiation procedure. In either case they are free to include life-cycle cost factors if they so choose."

Transit systems must use the life-cycle costing process if they use 1982 funds to buy vehicles, and some systems using 1983 funds are continuing to use the process.

USE OF LIFE-CYCLE COSTING BY OTHER FEDERAL AGENCIES

While DOD and GSA have used life-cycle costing for several years, transit systems must use life-cycle costing under entirely different conditions. (App. IV contains a list of our prior reports on the use of life-cycle costing by DOD and GSA.)

DOD uses life-cycle costing in designing items, such as tanks, missiles, or other weapon systems, to determine which components to use. Transit systems, however, use life-cycle costing to compare the operating performance of existing vehicles.

GSA, which has used life-cycle costing since 1974 to purchase typewriters, heaters, ranges, air conditioners, and freezers, relies on either standardized data from industry tests or its own tests as the basis of its life-cycle cost evaluation. Standardized cost data on transit vehicles, for the most part, does not exist, and transit systems generally do not have the staff and facilities to conduct their own vehicle tests.

OBJECTIVES, SCOPE, AND METHODOLOGY

We reviewed the direct use of life-cycle costing by transit systems to determine their capability to implement the fiscal year 1982 legislative requirement, to evaluate the effectiveness of UMTA's implementation of the requirement, and to identify what actions are needed to ensure that life-cycle costing is used efficiently and fairly. While there is no longer a legislative requirement that the transit systems use life-cycle costing, we identified several problems with the process that should be corrected for transit systems that exercise the option of using life-cycle costing.

In conducting this review, we interviewed officials of UMTA's Office of Grants Management and Chicago regional office to determine the guidance provided to transit systems on the use of life-cycle costing and the oversight conducted by UMTA on life-cycle cost procurements. We also contacted each of the 10 UMTA regional

offices by telephone to obtain information on which transit systems were using life-cycle costing in buying vehicles. In addition, we interviewed GSA and DOD officials to obtain information on their use of life-cycle costing.

To obtain detailed information about transit systems' capability to use life-cycle costing, we sent a questionnaire to a statistical sample of transit systems that received Federal financial assistance. (A copy of the questionnaire used for bus systems is included in app. II. An expanded questionnaire was used to obtain similar data by type of vehicle for multimodal systems that also operate rapid transit, streetcars, or trolley buses.) Our sample was designed so that results could be projected with a sampling error that will not exceed 4 percent at the 95-percent confidence level. (App. III describes the statistical sampling process.) In the questionnaire, we asked for information on the transit systems' recordkeeping systems, their use of life-cycle costing, and their knowledge of the process.

Using information obtained from each of UMTA's regional offices, contacts with the American Public Transit Association, and responses from the questionnaire mailed to a statistical sample of the transit systems, we identified 43 systems that had actual experience with life-cycle costs. We contacted each of these systems to obtain information about how they used the process. In addition, we visited four systems that had awarded a contract based on life-cycle cost projections. During these visits we obtained information on what impact the use of life-cycle costs had had on the bid award, the types of evaluation done on the bid submissions, the time needed to process the procurement, and the availability of cost data or studies made on buses procured with the process.

We also contacted the major bus manufacturers in the country--General Motors Corporation (GMC), Grumman Flxible Corporation (GFC), and Neoplan U.S.A.--to determine the impact of life-cycle cost procurements on the manufacturers.

Our review was performed in accordance with generally accepted government auditing standards.

CHAPTER 2

UMTA HAS NOT YET DEMONSTRATED THAT THE LIFE-CYCLE COST PROCESS CAN BE USED EFFECTIVELY TO PURCHASE TRANSIT VEHICLES

Higher costs and unproven benefits associated with using the direct life-cycle cost process for buying transit vehicles make its use questionable. Both manufacturers and transit systems that have used the life-cycle cost process report higher costs. Neither UMTA nor the transit systems, however, have the means to determine whether the benefits claimed for the use of life-cycle costs--that is, getting the vehicle with the lowest operating costs--will actually be realized for the vehicle purchased and placed in service or that the benefits will offset the additional costs incurred. As a result, the cost effectiveness of the life-cycle costing process for transit vehicle procurements has yet to be proven.

Moreover, various obstacles must be eliminated in order for transit systems to effectively carry out life-cycle cost evaluations. Experience with life-cycle costing under the mandatory requirement in fiscal year 1982 shows that transit systems generally do not have adequate data to identify major cost factors, verifiable data to calculate cost projections, qualified personnel to evaluate the data, or objective evaluation criteria.

USING THE LIFE-CYCLE COST PROCESS IS MORE EXPENSIVE THAN THE LOW BID PROCESS

Transit system administrative costs have increased with the use of life-cycle costing techniques, and additional costs have resulted from the delays experienced using the process. In comparison to the cost of the low bid procurement process, 33 of the 43 transit systems with actual life-cycle cost experience had higher administrative costs because of the additional staff hours and the technical and legal assistance needed to complete the life-cycle cost procurement process, and 23 reported delays ranging from a few weeks to several months. While neither UMTA nor the transit systems have calculated or documented these costs, the following sections show that there are additional costs and delays, when compared with the low-bid process.

Because this was the first time the transit systems have used the life-cycle cost process, some of these additional costs were the result of developing a new procedure. Subsequent procurements for these systems should not be as costly to administer, but the additional steps and reviews needed for life-cycle cost evaluations will always result in some additional administrative costs. The additional costs and delays related to learning a new procurement procedure have been compounded because of the approach taken by UMTA in implementing the life-cycle cost requirement. Although UMTA provided general guidance on what cost factors might be considered, it did not specify the process to be used and was silent

on how the transit systems should evaluate the life-cycle cost data submitted by manufacturers. While this approach does give each transit system the flexibility to develop a process that addresses its concerns and problems, it also has required more time and effort by each transit system to come up with a workable process.

Transit systems' administrative costs increased with the use of the life-cycle cost process

The 33 transit systems reported that preparing requests for bids and evaluating manufacturers' bid submissions using the life-cycle cost process resulted in additional administrative costs because

--additional staff hours were required (31 transit systems),

--outside technical assistance was required (10 systems), and

--outside legal assistance was required (3 systems).

Preparing a life-cycle cost bid package has increased transit systems' costs because additional time is needed to (1) identify the major vehicle operating cost factors, (2) specify the type of cost and support information the manufacturers are to submit, and (3) design the process that will be used to evaluate the data submitted. For example, to obtain information on the major cost factors to be used for its first life-cycle cost procurement, Phoenix, Arizona, summarized and analyzed 2 years of operating and maintenance costs for a sample of 140 buses. This effort alone took over 2 months to complete.

Because of their unfamiliarity with the life-cycle cost process, 36 of the 43 transit systems with life-cycle cost experience have also required technical and legal assistance from outside their systems. The table below shows the sources of outside assistance the 36 transit systems used during the development of their life-cycle cost procurements.

Source of outside support	Number of transit systems
UMTA	22
Other transit systems	21
Private consultants	7
American Public Transit Association	12

While in some instances there is no charge for this assistance, the time involved in getting the assistance imposes a certain cost in terms of the effort needed to obtain, assess, and use the information as well as adding to delays caused by the process.

While under the low bid process all a transit system need do is determine if the manufacturer is meeting the vehicle specifications and select the low bidder, the use of life-cycle costing

requires additional time and staff resources to analyze and evaluate manufacturers' bid submissions. Transit systems must examine the cost projections submitted; evaluate the procedures used to prepare them; accept, adjust, or reject the data; and calculate the impact on the total cost. Out of 24 transit systems completing life-cycle cost procurements, 19 systems contacted other transit systems for cost experience data to aid them in evaluating manufacturer life-cycle cost data and some also requested additional data or support from bidders.

Use of the life-cycle cost process increases costs because of the delays incurred

The additional time involved in using the life-cycle cost process delays the overall procurement. The transit systems, as a result, must continue to operate their older vehicles that require extra maintenance.

The Greater Bridgeport Transit District, for example, reported that using life-cycle costing added 30 to 60 days to the process for specification development and an additional 30 days for evaluation of the life-cycle cost data prior to opening the price offer. The Dallas Transit System added 5 weeks to the process to evaluate life-cycle cost data and conduct in-service performance tests of the vehicles being offered.

In two procurements, we found that the process was delayed when the transit systems threw out the initial bid submissions because they did not feel the bids were responsive and started the process over again.

Transit systems also experienced delays because of manufacturers' questions and formal protests regarding their life-cycle cost bid packages, evaluations, and contract awards. Manufacturers protested the life-cycle cost bid package on 5 of the 43 transit systems that have experience with the process--in 3 cases the protests involved cost factor definitions and/or the evaluation methodology, and the others involved contract provisions to protect the transit systems if the vehicles do not live up to manufacturers' life-cycle cost representations. The five transit systems experienced delays ranging from 4 months to 1 year.

Of 24 procurements awarded using life-cycle costing techniques, only 6 resulted in awards to the bidder that had not submitted the low initial price bid. The losing manufacturer protested the life-cycle cost award decisions in three of these six cases. While the protests were dropped eventually in all but one pending case, the transit systems were still delayed (in two cases this delay amounted to 6 months).

While the additional staff costs resulting from the life-cycle cost process could have been calculated, the delays experienced when it is used have a hidden cost related to the fact that the transit system will not receive its new vehicles as soon as they would have if the low bid had been used. As a result transit systems have to continue to operate the vehicles that were to be

replaced for additional periods of time. While even new buses require regular maintenance, these buses that are being replaced usually require extraordinary maintenance and expense to keep them in service. Even with the extra maintenance these buses could be unreliable and result in service interruptions, which can affect customer use.

The Dallas Transit System stated that it will have to keep its older buses in operation 6 additional months because of the delays experienced with the procurement process. As a result, these buses will have to be used during the warmer months, which the system anticipates will require additional maintenance on the air conditioning systems. This would not have been necessary if the buses had been replaced as planned. The Southern California Rapid Transit District estimates it will keep older buses that incur higher maintenance costs in service an additional 4 months because of manufacturers' protests of their life-cycle cost bid package.

Manufacturers' costs are also greater using the life-cycle cost process

Bus manufacturers that have participated in the life-cycle cost procurement process state that, while not quantified, their administrative costs have increased with the life-cycle cost procurement process. The manufacturers' costs associated with the life-cycle cost bid process are incurred whether they win the bid or not.

More paperwork is required because manufacturers must develop and maintain test and experience data on their buses in order to prepare bid submissions. Because operating conditions and major cost factors can vary between transit systems, manufacturers have had to prepare different life-cycle cost support data to meet the varying demands of each transit system's bid package.

Unique requirements imposed by transit systems in the bid package also add to manufacturers' costs. The Dallas transit system's request for bid, for example, asked bidders to provide one of their buses for a 4-week evaluation of the vehicle in actual passenger service. In that same procurement, the Dallas system also requested the manufacturers to provide guarantees regarding life-cycle cost submissions, which would add to the winning bidder's costs.

Using life-cycle costing can mean paying a higher vehicle purchase price

Costs associated with the life-cycle cost procurement process are not only administrative but can involve additional moneys whenever the low price bidder does not receive the award. While under the low bid process the award is made to the bidder who has the lowest acquisition price, using the life-cycle costing process can result in the transit system paying more for its new vehicles. Manufacturers that did not submit the low initial price bid

were awarded six contracts based on life-cycle costs and other factors.

Bid evaluation information from the Houston life-cycle cost procurement award illustrates the price differentials involved.

Cost factors	General Motors Corporation	Grumman Flxible Corporation	Neoplan USA
Unit price	$149,784	$156,957	**$146,800**
Delivery charges	1,932	1,181	1,200
Life-cycle costs	164,929	163,309	180,126
Performance (-)	(8,475)	(5,210)	(4,595)
Standardization	0	250	450
Total	**$308,170**	$316,487	$323,981
100 buses to be purchased	$30,817,000	$31,648,700	$32,398,100

Although Neoplan bid the lowest initial price ($146,800 per bus), the contract was awarded to GMC based on the lowest total life-cycle cost ($308,170). Houston, therefore, paid out about $370,000[1] more than it would have had to pay if the contract had been awarded to the low initial bidder. On the other hand, Houston could save about $1.5 million over the life of these buses if the life-cycle cost projections are accurate.

This life-cycle cost evaluation did not consider the present value of the operating and maintenance costs. In addition these costs were projected using current labor and materials costs. We found that the transit systems that have completed life-cycle cost evaluations generally have not considered the time value of money in making their life-cycle cost evaluations. Only one transit system included a factor in its evaluation to recognize the difference between costs to be paid right now and costs that will be incurred over the life of the vehicles.

UMTA DOES NOT HAVE THE MEANS TO CALCULATE THE BENEFITS OF LIFE-CYCLE COSTING

Actual benefits resulting from the use of life-cycle costs in buying transit vehicles have yet to be documented by either UMTA or the transit systems. In theory, the benefit of using the process is that the transit system gets a more cost-effective vehicle than it would have if the award had been based on the lowest initial bid price. However, due to questions about the validity of bidders' projections for operating and maintenance costs and the

[1]Since the award was made to GMC, Houston paid $151,716 per bus ($149,784 unit price plus $1,932 delivery charges) versus the acquisition cost of $148,000 ($146,800 plus $1,200 delivery charges) for the Neoplan bus. This difference amounts to $3,700 per bus or $370,000 for the 100 buses purchased.

lack of documentation by transit systems for these costs once the vehicle is purchased, there is little evidence that this is actually being realized. In addition, for most of the completed life-cycle cost procurements, the winning bidder would also have gotten the contract if the selection had been made based on the lowest initial bid.

In spite of the additional time and money involved in the life-cycle cost process, the transit systems in most cases got the same buses that they would have gotten if the contract had been awarded based on the lowest initial bid. As of February 1983, the winning bidder in 18 of the 24 completed life-cycle cost procurements had submitted both the lowest initial cost and the lowest total life-cycle cost bid. In addition, the procurements were generally for the advanced design model buses, which manufacturers say have not been changed as a result of the life-cycle cost process.

Validity of cost projections questionable

The validity of the cost projections is questionable because of the lack of standardized test data and limited operating experience data for these vehicles. On page 15 we discuss the difficulties transit systems have had in both deciding what type of data the bidders are to submit and evaluating and verifying the data received. The problem is partly related to the relative newness of the bus model being bought. The first advanced design buses were produced in 1977, and modifications of some of the buses' major components are even more recent. As a result, only limited performance data is available for these buses. In the procurement process, however, the operating and maintenance costs must be estimated for the projected 12-year life (or 500,000 miles of operation) of the vehicle.

Because transit systems are concerned about the reliability of the cost projections submitted by bidders and their inability to validate these projections, the systems have tried various strategies to protect themselves if the vehicles fail to perform as asserted by the manufacturer.

Two systems tried unsuccessfully to insert a life-cycle cost performance protection provision in the bid package, only to have it protested by manufacturers. In Flint, Michigan, the contract was eventually awarded without a 5-year warranty clause requested by the transit system. In the second case, UMTA told the Southern California Rapid Transit District that withholding 10 percent of the contract award amount for 6 months after delivery of vehicles to monitor actual bus performance against manufacturer's life-cycle cost representations was not an acceptable provision in a federally assisted procurement.

In another approach, the Dallas transit system requested a bus from each bidder for a 4 week in-service evaluation. In addition, Dallas obtained a supplemental letter from one bidder making certain guarantees regarding the bid data. If these guarantees--90 percent of expected brake lining life for 3 years,

timely delivery of parts for 2 years, and 95 percent of expected fuel economy for 1 year--are not realized, the manufacturer will reimburse the transit system on an agreed basis for additional costs incurred.

Accuracy of cost projections not being assessed

Neither UMTA nor the transit systems are taking steps to assess the accuracy of the cost projections for the vehicles purchased. Transit systems that have received vehicles purchased using life-cycle costs are not documenting operating and maintenance costs to assess the validity of the cost projections. As of February 1983 only five transit systems which evaluated life-cycle costs in buying vehicles had received these vehicles. Three of these systems have been operating their vehicles for less than 1 year, and the other two systems have operated their vehicles for about 2 years. While the buses have not been in service long enough to prove or disprove the life-cycle cost projections, these systems have not kept detailed records on their buses' performance that would enable them to even begin such an assessment.

A complete picture of the cost effectiveness of the life-cycle cost process would require a comparison of the actual performance of all the vehicles under similar operating conditions. Since performance data from different transit systems could not be truly comparable because of the varying operating and environmental conditions, gathering such data would involve the transit system's obtaining and operating vehicles from both the winning and losing bidders. This could be impractical because the related cost increases for spare parts and operator and mechanic training would distort the cost of using the life-cycle cost process. While a complete evaluation of the cost effectiveness of the life-cycle cost process is impractical, documenting whether the vehicles of the winning bidder performed as expected would give some indication of the value of the process that could be compared with the related costs imposed.

OBSTACLES TO USING LIFE-CYCLE COSTING EFFECTIVELY MUST BE OVERCOME

Transit systems generally do not have adequate information on operating and maintenance costs, sufficient resources, or the level of technical expertise necessary for effective life-cycle cost evaluations.

Inadequate operating and maintenance cost records

The transit industry historically has not kept extensive performance or maintenance records. As a result, most transit systems do not have readily accessible data on their major cost factors for specific vehicle models. This causes problems in developing an effective life-cycle cost procurement bid package and evaluating life-cycle cost projections submitted by bidders.

Most transit systems record operating and maintenance cost data by individual bus. While some systems summarize this cost data for their entire fleet, we found that over 80 percent of the 346 bus transit systems did not identify and summarize major cost factors by bus model. The table below shows the bus model cost data kept by the transit systems.

Transit Systems That Keep Cost Data by Bus Model

Operating and maintenance cost factors	Number	Percent
Fuel	86	25
Tires	49	14
Engine oil	63	18
Brakes	40	12
Transmission	44	13
Engine	44	13
Air conditioning	36	10
Preventive maintenance	41	12
Chassis	35	10

While transit systems also keep frequency of occurrence records for maintenance activities, the number of systems that summarized this data by bus model was about the same as the number of systems that summarized cost data by bus model.

Moreover, about 75 percent of the bus transit systems had essentially manual recordkeeping systems. Manual recordkeeping systems make collection and summarization of the specific data needed for life-cycle cost evaluation a time-consuming and costly process. For example, the Phoenix, Arizona, transit system keeps its operating and maintenance records on a manual basis. In order to obtain information on its major operating cost factors for a life-cycle cost procurement bid package, the transit system sampled and analyzed its experience for a 2-year period. About 50 percent of the bus transit systems indicated they would need additional assistance (either from hiring more people, using overtime, or using consultants) to collect and summarize local operating and maintenance data.

In addition, not all transit systems kept operating and maintenance cost data or kept the data by all major cost factors, making it more difficult to prepare a life-cycle cost bid package.

The 16 transit systems with rapid rail cars, street cars, and trolley buses also have mostly manual recordkeeping systems and only a few systems keep operating and maintenance data by vehicle model, making it difficult to prepare for a life-cycle cost procurement. Most of these systems indicated that they would have difficulty carrying out a life-cycle cost procurement.

Transit systems using the life-cycle cost process have had problems with the design and evaluation of bids

Most of the 43 bus transit systems with life-cycle cost experience had problems in the design and evaluation of bids. In addition to identifying cost factors to be evaluated, the life-cycle costs bid package must specify the type of data acceptable as support for the proposals and the method of evaluation that will be used. A general lack of independent standardized testing of vehicles in the transit industry has made it difficult to design an effective request for bids as well as to validate and evaluate bid submissions.

Lack of specificity of the type of data that would be acceptable in supporting manufacturers representations of life-cycle cost factors complicates or frustrates the evaluation process. In some instances transit systems have been faced with attempting to compare manufacturers' representations for a cost factor that were calculated by completely different procedures. For example, the Phoenix transit system received manufacturers' representations on fuel consumption where support from one was based on road experience and support from another was based on computer simulations of fuel usage.

Six of the 24 transit systems that completed life-cycle cost bid evaluations told us that they ended up throwing out certain cost factors in the evaluation because the information provided was not usable. The Columbus, Ohio, transit system canceled its first life-cycle cost procurement because the bid submission data received was of such poor quality that it was not considered responsive. Although the data received for some cost factors was not much better when the procurement was offered for bids again, Columbus believed that it must follow through on the procurement or lose its grant funds.

Four of the 24 transit systems which completed bid evaluations for life-cycle cost procurements stated that they did not or could not verify manufacturer representations. In one case the manufacturer told the transit system that the information supporting the life-cycle cost representations was proprietary. As a result, the transit system threw out those factors that could not be validated.

Some systems do not have the technical and engineering expertise needed to evaluate manufacturer submissions. Ten out of 43 bus transit systems with life-cycle cost procurement experience needed outside technical assistance to effect their life-cycle cost procurements. One transit system reported that it did not validate the manufacturer's representations because it lacked the staff and resources and had to award the contract before the end of the year or lose State funding. Of the 186 bus transit systems responding to our survey, 105 systems stated that they would need additional technical assistance in order to evaluate bid submissions. Similarly, most of the transit systems with rapid rail cars, street cars, and trolley buses also indicated that they

would need additional assistance to carry out a life-cycle cost procurement.

Lack of usable operating data or acceptable test data for some cost factors also limits efforts to validate manufacturer representations. The transit systems' own records often cannot be used because they do not operate the bus models being bid in their own fleet. When the transit system does operate the bus models being bid, only limited data may be available (for example, the advanced design buses have been in production only since 1977) and the manufacturer may cite improvements to earlier versions of the bus model that negate a comparison with the transit system's experience.

Obtaining data from other transit systems that operate the models being bid also may not be usable for validation because of a lack of standardized recordkeeping. For example, one system may define road calls as any breakdown which requires a repairman to be dispatched to the vehicle, whereas another system may define road calls as vehicle breakdowns which require tows to the garage for repair. In addition, experience from another transit system may not be comparable because of differences in the conditions under which the vehicles are operated. For example, buses that are to be used in a dense downtown area will experience significantly different operating costs from buses that are used on suburban commuter routes.

While transit authorities for 20 of the 24 completed life-cycle cost procurements stated that they validated the life-cycle cost data, the most common method of validation was acceptance of experience from comparable transit systems. Based on information obtained from our visits to four transit systems with completed life-cycle cost bus purchases, we found that the validation process consisted mainly of a review for reasonableness of costs compared to actual experience and/or other manufacturer bid submissions.

The table on the next page shows that for the procurements of these four systems, relatively small differences existed between the vehicles' life-cycle costs and that fuel costs accounted for over 80 percent of the total life-cycle cost estimates. During these procurements, however, there was no standardized testing for this factor. This raises questions about using the life-cycle cost process when there is no way to verify major portions of the total cost projections. A difference of even one-hundredth of a mile per gallon can result in a $5,000 increase or decrease in the life-cycle cost estimate (0.01 x 500,000 miles over the life of the bus x $1 per gallon).

Transit system	Bidder	Life-cycle cost estimates per bus				
		Fuel	Percent	All other costs	Percent	Total
Houston, Tex.	GMC	$139,860	84.8	$25,069	15.2	$164,929
	GFC	135,722	83.1	27,587	16.9	163,309
	Neoplan	147,059	81.6	33,068	18.4	180,127
Dallas, Tex.	GMC	142,045	81.9	31,438	18.1	173,483
	GFC	137,665	82.8	28,586	17.2	166,251
Spokane, Wash.	GMC	150,102	80.5	36,414	19.5	186,516
	GFC	141,632	80.5	34,354	19.5	175,986[a]
Columbus, Ohio	GFC	121,093	91.7	10,931	8.3	132,024
	GMC	129,563	93.4	9,214	6.6	138,777

[a]Spokane also included a factor for the time value of money which increased GFC's total cost estimate to $197,769, making GMC the successful bidder for this procurement.

The remaining life-cycle cost categories present equally difficult assessment problems for the transit systems but account for very small differences in the life-cycle costs of a vehicle as can be seen from the table below.

Transit system	Bidder	Percent of individual factor cost to total life-cycle cost estimate						
		Fuel	Oil	Brakes	Air conditioning	Preventive maintenance	Transmission	Engine
Houston, Tex.	GMC	84.8	0.5	4.4	0.7	4.0	1.8	3.6
	GFC	83.1	0.5	4.6	0.8	5.1	1.8	4.1
	Neoplan	81.6	0.4	4.9	1.8	6.1	1.9	3.3
Dallas, Tex.	GMC	81.9	0.4	9.2	0.7	2.7	1.6	3.5
	GFC	82.8	0.4	7.6	0.8	2.9	2.0	3.5
Spokane, Wash.	GMC	80.5	0.6	5.6	0.7	3.2	5.5	3.9
	GFC	80.5	0.6	4.3	0.9	3.7	5.9	4.1
Columbus, Ohio	GFC	91.7	-	-	0.8	7.4	0.1	-
	GMC	93.4	-	-	1.0	5.5	0.1	-

UMTA has recently completed an independent standardized test of fuel usage for buses and is planning to develop such tests for other cost factors in the future. Whether these tests will be accepted by the transit industry or accurately predict vehicle fuel usage for a given transit system's operating conditions are questions that remain to be answered.

Since life-cycle costs are just "estimates," the statistically insignificant differences between life-cycle costs should not be permitted to control the selection process, unless the soundness of the projections can be validated or unless assurances

can be built into the procurement process that allow the transit system to recover the additional costs of faulty life-cycle cost projections.

Definition and evaluation of performance and standardization factors also caused difficulties

The lack of guidance on definitions for standardization and performance has also complicated the consideration and use of these factors in life-cycle cost procurements. The 43 transit systems with life-cycle procurement experience indicate the following problems with these factors:

	Number of transit systems	
	Performance factor	Standardization factor
Had problems defining	24	22
Had problems evaluating	21	21

Performance was considered by some transit systems to be the vehicle's road call experience, while other systems requested information on the manufacturer's ability to provide vehicle parts and service. Standardization considerations by transit systems varied. Some systems included costs of tools, parts, maintenance facilities, and training requirements for mechanics and drivers, while other transit systems did not consider maintenance facilities or training requirements.

Of the 43 transit systems with life-cycle cost procurement experience, 5 reported manufacturer bid protests over either the definition of these factors or the basis used for evaluating them.

Bid protests concerning	Number of transit systems
Performance definition	3
Standardization definition	3
Evaluation process for performance factors	4
Evaluation process for standardization factors	2

UMTA RESEARCH ON THE LIFE-CYCLE COST PROCUREMENT PROCESS

As part of its research program for bus systems (which amounted to over $6 million in fiscal year 1983), UMTA has funded various projects related to life-cycle costing--for example, the Phoenix and Rhode Island transit systems' studies on the use of life-cycle costing and the recent fuel economy tests of buses. The Phoenix and Rhode Island projects involved actually using a life-cycle cost process to buy buses. The fuel economy tests involved operating buses manufactured by six firms on a test track

simulating three different operating profiles. For example, the phase measuring fuel economy for downtown operations was conducted at a top speed of 20 miles per hour with seven stops per mile.

Ongoing studies include projects to monitor the performance of articulated buses[2] bought under the life-cycle cost process and to track the maintenance history of specific components such as electronic transmissions, bonded brake linings, and air conditioners.

These projects randomly address individual parts of the problem, but they do not make a comprehensive analysis of the entire process. The Phoenix and Rhode Island projects, for example, concentrated on developing the process for evaluating life-cycle costs, but they neither documented the costs of using the process nor determined the actual benefits realized for the buses bought. The fuel tests provide information on the specific models tested but do not help the transit system that might be buying buses with different components (such as different transmission or engine configurations).

CONCLUSIONS

Transit systems using the life-cycle cost process to purchase transit vehicles incur higher costs compared with the low bid process, and it has not been proven that these costs are offset by the fact that transit systems are getting a more cost-effective vehicle. Although the vehicle selected appears to be the most cost effective based on the projected costs, the lack of standardized test data and the limited performance data for these vehicles raise questions about the reliability of these projections. Furthermore, transit systems have not documented performance costs for the vehicles purchased to assess the validity of the cost projections.

While a comprehensive evaluation of the cost effectiveness of the life-cycle cost process is impractical because of the difficulty in documenting performance costs for the vehicles that did not win the bid, we believe that it is essential that performance costs be collected and analyzed for the vehicles purchased to determine whether the basis for the selection was reasonable. If subsequent performance does not confirm the validity of the projections and a more reliable basis is not developed, the continued use of the life-cycle cost process should be questioned because of the additional costs involved.

Because UMTA did not prescribe specific methods for implementing the life-cycle cost requirement in order to allow grantees the maximum flexibility possible, each transit system developed its own life-cycle cost process. With all the processes developed, we identified several common problems that must be overcome

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[2]Buses with segmented bodies joined by an articulated joint which allows them to bend for maneuverability. These buses can carry almost as many passengers as two standard-sized buses.

if life-cycle costing is to be used effectively to procure transit vehicles. These problems include

--inadequate information on transit vehicle operating and maintenance costs,

--difficulties selecting verifiable cost factors and specifying the type of information needed to support cost projections,

--lack of transit personnel with the expertise needed to evaluate life-cycle cost projections,

--failure to calculate the present value of the projected operating and maintenance costs so that they are compared with the acquisition costs on a common economic basis, and

--lack of objective evaluation criteria.

While UMTA has funded research projects on aspects of the life-cycle cost process, it has not addressed the overall usefulness of the process for transit vehicles in terms of the benefits realized versus the costs incurred. In addition UMTA has not addressed ways to overcome all of the obstacles to using the process effectively.

While the use of life-cycle costs is now optional, we believe that UMTA should undertake research projects with a limited number of transit systems to (1) determine the additional costs incurred by using the process, (2) document performance costs for the vehicles procured to get some idea of the value associated with using the process, and (3) identify ways to remove the obstacles that limit transit systems abilities to use the process effectively. These research projects should include a mix in terms of the different-sized transit systems involved and the different vehicles procured.

RECOMMENDATIONS TO THE SECRETARY OF TRANSPORTATION

We recommend that the Secretary of Transportation direct the UMTA Administrator to develop research and demonstration projects with selected transit systems to

--document the costs associated with using the life-cycle cost process to buy transit vehicles;

--keep operating and maintenance cost records for the vehicles bought to determine the validity of the cost projections used in making the contract award; and

--identify ways to overcome the obstacles to using the life-cycle cost procurement process by addressing the problems of the availability of adequate data, selection of verifiable cost factors, failure to consider the present value of

the projected costs, development of fair evaluation processes, and expertise needed to adequately evaluate cost projections.

AGENCY COMMENTS AND OUR EVALUATION

The Department of Transportation in commenting on the report (see app. I) did not disagree with our findings that there are insufficient information, resources, and technical expertise in the transit industry for effective life-cycle cost evaluations. It points out that these concerns were raised by UMTA and the transit industry at the time the life-cycle cost procurement evaluations were mandated by the Congress. DOT believes, however, that UMTA's life-cycle cost program addresses the concerns contained in the report. DOT also commented that UMTA, because of its commitment to fairness in third-party procurements,[3] has been especially careful in reviewing the fairness of life-cycle costs for rolling stock because it has not been able to obtain access to sufficient and fully reliable information on which to base life-cycle cost awards that would, in all cases, determine with absolute clarity how awards should be made.

We recognize that UMTA cited many of the same objections when the mandatory life-cycle cost requirement was imposed. As shown in this report, however, the problems still exist; and, although the use of life-cycle costing is now optional, some systems are continuing to use this process. We continue to believe that the use of a more costly process such as life-cycle costing is questionable unless UMTA is taking steps to (1) demonstrate that real benefits are achieved that outweigh the additional costs and (2) develop adequate data to provide a fair and supportable basis for making the award determination. As indicated by DOT in its comments, these conditions do not yet exist.

UMTA's life-cycle cost program consists of a series of technical assistance activities focusing on the reduction of life-cycle costs of bus vehicles and components. UMTA groups these activities in five areas:

--Information exchange - documentation of the various life-cycle cost procurement procedures used by transit systems and dissemination of this information to the transit industry.

--Productivity/efficiency tests - fuel economy testing of standard-sized transit vehicles (as discussed on p. 18) and planned tests on articulated and small buses, transmissions, brakes, air conditioners, and fare collection equipment.

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[3]Third-party procurements are the grantees' procurement of supplies, equipment, construction, and services under UMTA assistance programs.

--Methodology - selection of automated maintenance information systems to provide usable life-cycle cost data on bus components and development of data formats to assure that the life-cycle cost data will be uniformly recorded.

--Reliability/maintainability demonstrations - collection of information on the performance experience and maintenance costs of equipment using the maintenance information systems.

--Documentation and review - distribution of life-cycle cost briefs highlighting results of the test and demonstration grants.

As discussed on page 19, we believe, however, that these projects address only individual parts of the problem but do not make a comprehensive analysis of the entire process. In addition, the most promising segments of the program, in our opinion--the methodology and the reliability/maintainability demonstrations--are only in the initial stages. It is impossible to determine at this time if they will develop the type of data needed for effective life-cycle cost evaluations.

We also disagree that UMTA has carefully reviewed the fairness of life-cycle cost procurements. We found no evidence that UMTA has directly reviewed the life-cycle cost procurements to date except when asked to resolve questions or protests. In those cases, its review has concentrated on the specific point being questioned. We found no instance where UMTA reviewed or questioned the cost factors being evaluated, the evaluation procedure followed, or the adequacy of the data used as the basis for making the award decision.

Six of the eight transit systems asked to review the accuracy of the data in the report submitted comments. The transit systems in Bridgeport, Columbus, Dallas, and Los Angeles found the report to be accurate. The Spokane system commented that the data in the report was representative of the problems experienced by transit systems, but it pointed out one clarification needed to the chart on page 17, which has been added. The Los Angeles system also noted that until a fully supportable data base on bus components is available, the use of life-cycle costing as a procurement process is premature. The Phoenix transit system commented that the report accurately presents the difficulties experienced with the life-cycle costing process to date, but stated that it believed the tone of the report seemed unnecessarily negative. It also noted that many of the difficulties are experienced only the first time that the process is used. We agree that some of the problems are related to the lack of experience with the process, but we believe the lack of data and evaluation criteria will be continuing problems that will prevent effective use of the process until these problems are resolved.

U.S. Department of Transportation

Assistant Secretary for Administration

400 Seventh St S W
Washington D C 20590

AUG 8 1983

Mr Oliver W Krueger
Associate Director, Resources, Community and Economic Development Division
U.S General Accounting Office
Washington, D C 20548

Dear Mr Krueger

This is in response to your letter requesting Department of Transportation (DOT) comments on the General Accounting Office (GAO) draft report, "Life Cycle Costing in Buying Transit Vehicles -Is It Cost Effective?" RCED-83-184, dated June 28, 1983 It was agreed with your staff that written comments would be transmitted in lieu of oral comments These comments are enclosed for your information

The GAO report underscores the very concerns raised by the Urban Mass Transportation Administration (UMTA) and the transit industry at the time Life Cycle Cost (LCC) procurement evaluations were mandated by Congress We do not disagree that there is insufficient information, resources, and technical expertise in the transit industry necessary for effective LCC evaluations GAO recommended that UMTA develop and research projects with selected transit systems to

- o document the costs associated with using the LCC process to buy transit vehicles,
- o keep operating and maintenance costs records for the vehicles bought to determine the validity of the cost projections used in making the contract award, and
- o identify ways to overcome the obstacles to the effective use of the LCC procurement process by addressing the problems of the availability of adequate data, selection of verifiable cost factors, failure to consider the present value of the projected costs, development of fair evaluation processes, and expertise needed to adequately evaluate cost projections

With the concerns subsequently raised by GAO in mind, UMTA has developed an LCC Program The program has as its stated goal To provide the Bus Transit community and its suppliers with LCC methodologies and data for use in designing and acquiring new bus vehicles and equipment and in retrofitting existing equipment, thus promoting the introduction of bus technology with improved productivity, efficiency, reliability, maintainability, and initial cost attributes " We believe that this program addresses the concerns contained in the GAO report

[GAO NOTE: Page numbers have been changed to correspond with page numbers in the final report.]

APPENDIX I

We would like to stress that UMTA s commitment to fairness in third party procurements has always been firm For that reason, UMTA has been especially careful in reviewing the fairness of LCC for rolling stock, because UMTA has not been able to obtain access to sufficient and fully reliable information on which to base LCC awards that would, in all cases, determine with absolute clarity how awards should be made

If we can be of further assistance, please let us know

Sincerely,

Karen S. Lee

for Robert L Fairman

Enclosure

Department of Transportation's Reply
to a GAO Report

Dated June 28, 1983

Titled LIFE CYCLE COSTING IN BUYING TRANSIT VEHICLES--IS IT COST EFFECTIVE?

Summary of GAO Findings and Recommendations

The GAO report underscores the very concerns raised by UMTA and the transit industry at the time Life Cycle Cost (LCC) procurement evaluations were mandated by Congress. We do not disagree that there is insufficient information, resources, and technical expertise in the transit industry necessary for effective LCC evaluations. GAO recommended that UMTA develop and research projects with selected transit systems to:

- document the costs associated with using the LCC process to buy transit vehicles;
- keep operating and maintenance costs records for the vehicles bought to determine the validity of the cost projections used in making the contract award; and
- identify ways to overcome the obstacles to the effective use of the LCC procurement process by addressing the problems of the availability of adequate data, selection of verifiable cost factors, failure to consider the present value of the projected costs, development of fair evaluation processes, and expertise needed to adequately evaluate cost projections.

Summary of DOT Position

With the concerns subsequently raised by GAO in mind, UMTA has developed an LCC Program. The program has as its stated goal "To provide the Bus Transit community and its suppliers with LCC methodologies and data for use in designing and acquiring new bus vehicles and equipment and in retrofitting existing equipment, thus promoting the introduction of bus technology with improved productivity, efficiency, reliability, maintainability, and initial cost attributes." We believe that this program addresses the concerns contained in the GAO report.

We would like to stress that UMTA's commitment to fairness in third party procurements has always been firm. For that reason, UMTA has been especially careful in reviewing the fairness of LCC for rolling stock, because UMTA has not been able to obtain access to sufficient and fully reliable information on which to base LCC awards that would, in all cases, determine with absolute clarity how awards should be made.

APPENDIX I

Position Statement

Our specific comments regarding the report are

1. The report Digest appears to reflect differing standards of reliability in acccepting projections of added expenses, delays, etc., to conclude that LCC is more costly (page 1) while dismissing projections of benefits by simply characterizing them as unreliable (page ii).

   [GAO COMMENT: We disagree that we have used differing standards of reliability. While we have been unable to quantify the additional costs incurred because of the lack of records kept by the transit systems, we have been able to determine from the systems that additional staff time was expended, legal expenses were incurred, and procurements were delayed, each of which has a cost attached even though not quantified. Conversely, the only basis for projecting benefits are unsupported cost projections which no one is making an effort to prove or disprove.]

2. The Digest statement "UMTA has not taken steps to assist transit systems in overcoming these problems" is unsupported by the text, particularly given the exhibit on page 8 of the report showing that UMTA is the leading source of outside support to the transit authorities which use LCC. We are uncertain how much it would cost to obtain thoroughly reliable information from the various rolling stock and bus manufacturers. We would appreciate from GAO an estimate of the resources in money and effort that would have to be committed by UMTA to achieve reliable information along the lines desired by GAO.

   [GAO COMMENT: While the chart on p. 8 reflects that 22 of the 36 transit systems who needed outside assistance asked UMTA for help, in most instances the systems also reported that they did not find the assistance received to be of much help. In addition, the statement in the digest refers to assistance needed to overcome such problems as the lack of data to verify manufacturers' cost submissions and the lack of objective evaluation criteria. UMTA does not currently have access to the type of data needed to resolve these specific problems.]

3. The statement on page 7, Chapter 1, "...UMTA did not give specific guidance on how to develop the (LCC) model or what information should be included in it" is not entirely correct.

   UMTA developed and made available a simplified LCC procedure for use by transit agencies in the procurement process. The procedure identified seven factors to be evaluated, an identification of the data required for the evaluation, and a step-by-step calculation work sheet. In addition, UMTA developed an example of an LCC procurement, using hypothetical operating costs, addressing

a. The compilation of vehicle operating cost data and a projection of future costs,

b. The estimation of salvage value,

c. Adjustments for inflation, the time value of money, and fleet availability rates, and finally

d. The determination of total LCCs.

This information, along with documentation of LCC procedures used by the transit industry, was incorporated into a report distributed to the UMTA regional offices, for use by UMTA grantees seeking assistance.

[GAO COMMENT: UMTA guidance consisted of a life-cycle cost model developed by a consultant, the simplified procedure, and a compilation of all the life-cycle cost bid packages of the transit systems that have used the process. While the bid packages from other systems gave examples of different approaches, UMTA did not evaluate these approaches to provide information on such things as provisions that resulted in protests by the manufacturers, bid specifications that were not specific enough to generate the type of data wanted, or cost factors that were eventually dropped because no way could be found to fairly evaluate the data submitted. Furthermore, both the simplified procedure and these bid packages were not distributed directly to the transit systems (all of which were required to use the process at that time), but instead were given to UMTA regional staff to use if they got requests for assistance.]

4. Chapter 2, page 7, begins with the statement that "UMTA has not yet demonstrated that Life Cycle Costing can be used effectively in purchasing transit vehicles."

UMTA has never stated nor taken the position that Life Cycle Costing could be used effectively to purchase transit vehicles. Quite to the contrary. Most of the points cited in the GAO draft report addresssing the questions of cost-effectiveness of LCC purchases and specific problem areas were made known by UMTA and well publicized in an attempt to persuade Congress not to take legislative action to mandate LCC procedures for rolling stock procurements.

[GAO COMMENT: We recognize that UMTA has never claimed that life-cycle costing can be used effectively to purchase transit vehicles and in fact opposed the mandatory requirement that the process be used for the procurement of transit vehicles. Nevertheless, at the current time, UMTA is continuing to permit transit systems, at their option, to use a process that we have found (1) to be more costly to administer and (2) could result in a higher Federal investment in the purchase, without any assurance that future cost savings will be realized. We therefore believe that UMTA's failure to address this issue does not adequately protect Federal interests in these procurements.]

5. Chapter 2, page 7, last paragraph. The statement that "The additional costs and delays experienced with the use of life cycle costing have been compounded because of the approach taken by UMTA in implementing the life cycle cost requirement" is unsupported. The report implies that an UMTA mandated approach would have precluded these added expenses. We simply disagree. Further, UMTA's approach is fully consistent with long-standing government-wide policies opposing a federally mandated procurement approach, by OMB (A-102) and GAO (Federal Procurement Regulations do not apply to grantees).

[GAO COMMENT: We agree that the report could have been misinterpreted to imply that all the additional costs and delays are attributable to UMTA. We have revised page 7 to make it clear that we are referring to only those costs related to setting up the new process. We do not agree that the report proposes a federally mandated procurement approach to be followed by all grantees. We are merely suggesting that UMTA could have provided more guidance on potential approaches to be followed and pitfalls to be avoided to assist the grantees in using this new and more complicated process.]

6. Chapter 2, page 9. It does not appear appropriate to include the costs already invested in maintenance of the existing transit buses in an evaluation of LCC on procurement of new buses. However, if GAO chooses to do so it would be appropriate to balance those costs (maintenance) with the savings to the U.S. Treasury attributable to the 6 months delays in invoicing, which in turn precluded the necessity for payment of interest on Treasury borrowing in like amount. In other words, is the incremental cost of maintenance greater than or less than the interest cost on the price of a new bus for the same period?

[GAO COMMENT: We do not consider the extraordinary maintenance costs that will have to be incurred to keep these over-age vehicles in service for the extra period needed to complete the life-cycle cost procurement action as "costs already invested in maintenance." We believe that these costs represent a valid cost associated with using the new procedure. Regarding tne comment of recognizing the savings in interest payments to the Federal Government resulting from the delay in disbursing the grant funds for the bus purchase, we agree that it would be appropriate for UMTA or the grantees to consider this offsetting value when they evaluate the appropriateness of using the life-cycle cost process for a particular procurement.]

7. Chapter 2, page 10, of the draft report indicates that Dallas, Texas, will have to keep its old buses in operation 6 additional months because of delay experienced with the procurement process. The implication is that the delay was caused by the LCC process. However, the fact of the matter is that Dallas initiated procedures to have Grumman Flxible Corporation declared a non-responsible bidder and eliminate it from the competition. When this matter was finally turned over to UMTA for resolution of the manufacturer's protest, it was concluded expeditiously within the required time frame. Thus the Dallas delay was the result of its own activities and was not the result of a LCC procurement. The same situation would have arisen in a standard low bid procurement.

[GAO COMMENT: We disagree that this situation would have also arisen in a standard low bid procurement. The circumstances that led to the system declaring one bidder nonresponsive were directly related to the life-cycle cost evaluation. Dallas in fact requested certain guarantees because it was doubtful about the cost projections submitted. When Grumman declined to comply with this request, it was declared nonresponsive.]

8. Chapter 2, page 10. It is unclear what is meant by "increased" guarantees.

[GAO COMMENT: The word "increased" was deleted.]

9. Chapter 2, page 11. In that the $370,000 shown represents potential additional capital cost on 100 buses, it would seem appropriate to show the comparable savings of $1,500,000 as potential savings on 100 buses rather than showing a single vehicle savings of $15,000. As noted under Digest, above, cost and savings are not being presented on an objectively equal footing. In this case, $3,700 cost is to $15,000 savings, and $370,000 is to $1,500,000 NOT $370,000 in cost to $15,000 in savings.

[GAO COMMENT: We agree, and the report has been changed so that comparable figures are used in the comparison.]

10. Chapter 2, page 12. The draft report states that UMTA told the Los Angeles transit system that procurement law prohibited the system from implementing a retainage of 10 percent of contract award until bus performance could be compared with manufacturers representations.

To our knowledge, this is not a violation of procurement law and was not so stated by UMTA. In a letter to John Dyer, General Manager of SCRTD, Robert H. McManus, UMTA Associate Administrator for Grants Management, stated that withholding of funds for the purpose of validating LCC claims is not an acceptable provision in a federally assisted procurement. Among the several qualifying reasons were the following:

APPENDIX I

a. Withholding funds for lengthy periods forces contractors to incur extra cash borrowing costs for the withholding period. At the time this letter was written, the cost of money was and continues to be critical to manufacturers.

b. Contractors will increase their pricing due to added cost of uncertainty and borrowing.

c. Subjectivity involved in evaluating satisfaction of the LCC requirements opens the subject to disputes between parties and possible costly litigation and additional project expense.

d. Any award would be based on a future providing of data rather than on facts existing at time of award.

[GAO COMMENT: The report was revised to indicate that this provision was not an acceptable provision in a federally assisted procurement.]

APPENDIX II

U S GENERAL ACCOUNTING OFFICE

USE OF LIFE CYCLE COSTING FOR ROLLING STOCK PROCUREMENTS

This survey is being conducted by the U.S General Accounting Office (GAO), an agency of the United States Congress responsible for evaluating the efficiency, economy, and effectiveness of Federal agencies. The purpose of this questionnaire is to learn about the experiences of transit systems to perform life cycle costing for the procurement of transit vehicles. Our objective is to survey transit systems to determine their present capabilities and actual experiences in conducting life cycle cost procurements, and to identify implications for future procurements.

Depending upon the complexity of your transit system, the questionnaire can be completed in about 30 minutes. Most of the questions can be easily answered either by checking a box or filling in blanks A few questions may require a short written answer. Where records or figures are not readily available, we would like to have your best estimate.

Please help us in this important study. A self-addressed stamped envelope is provided for returning the completed questionnaire. We would appreciate it if you would complete the questionnaire no later than 10 days after receiving the questionnaire. If you have any questions, please call Clement Preiwisch or David Hoffman of the GAO at (312) 353-0514. Thank you for your cooperation.

PLEASE MAIL THE COMPLETED QUESTIONNAIRE TO.

Mr. David Hoffman
U S General Accounting Office
5th Floor
10 West Jackson Boulevard
Chicago, IL 60604

I. IDENTIFICATION

FOR IDENTIFICATION PURPOSES PLEASE PROVIDE THE FOLLOWING INFORMATION. PLEASE DO NOT ABBREVIATE.

1. What is the name of your transit system?

_____

2. Who is the person responsible for purchasing new fleet vehicles?

Name_____
Title_____
Street Address_____
City/State_____
Telephone_____

CARD01 (1-2)
ID001 (3-5)

3. Is your transit system eligible for Federal capital grant funds for purchasing new vehicles?

1 [ ] Yes 2 [ ] No (6)

IF YOU ANSWERED "NO" TO QUESTION 3 DO NOT COMPLETE THIS QUESTIONNAIRE
PLEASE ANSWER THE ONE QUESTION APPEARING IN THIS BOX AND THEN RETURN
THE QUESTIONNAIRE IN THE ENCLOSED SELF-ADDRESSED STAMPED ENVELOPE

WHAT IS THE NAME OF THE TRANSIT AUTHORITY WHICH PURCHASES VEHICLES FOR YOUR TRANSIT SYSTEM USING FEDERAL CAPITAL GRANT FUNDS?

NAME OF TRANSIT AUTHORITY_____
NAME OF CONTACT PERSON_____
TITLE OF CONTACT PERSON_____
STREET ADDRESS_____
CITY/STATE_____
TELEPHONE NUMBER_____

THANK YOU FOR YOUR ASSISTANCE

4. During the period of October 1, 1981 to September 30, 1982 (fiscal year 1982), did your transit system receive an Urban Mass Transit Administration (UMTA) Act Section 3 or Section 5 Federal capital assistance grant for purchasing transit rolling stock? That is, during fiscal year 1982 was a Section 3 or Section 5 Federal capital assistance grant approved for rolling stock? (CHECK ONE BOX)

1. [ ] Yes, a Section 3 grant was received
2 [ ] Yes, a Section 5 grant was received
3 [ ] Yes, both a Section 3 and Section 5 grant were received
4. [ ] Neither a Section 3 nor a Section 5 grant were received .. . . SKIP TO QUESTION 6

(7)

5. For which of the following types of vehicles was this Federal capital assistance grant(s) for purchasing rolling stock used or will be used? (CHECK ALL THAT APPLY) (CONSIDER THE DEFINITIONS PROVIDED IN THE SECTION 15 REPORTING REQUIREMENTS WHEN ANSWERING THIS QUESTIONNAIRE)

1. [ ] Motor buses (8)
2. [ ] Rail rapid transit cars (9)
3. [ ] Street cars (10)
4 [ ] Trolley buses (11)
5 [ ] Service vehicles (12)
6 [ ] Demand response vehicles (13)
7. [ ] Other rolling stock vehicles (SPECIFY)_____ (14)

6 Are motor buses operated by or under contract to your transit system?

1 [ ] Yes CONTINUE TO QUESTION 7
2 [ ] No SKIP TO QUESTION 37

(15)

II. DESCRIPTION OF BUS TRANSIT SYSTEM (EXCLUDING DEMAND RESPONSE BUSES--E.G., DIAL-A-RIDE)

7. How many motor buses are operated by or under contract to your transit system?

_____Number of buses (16-19)

8. How many motor bus manufacturers are represented in your motor bus fleet?

_____Number of manufacturers (20-21)

9. How many motor bus models are represented in your motor bus fleet?

_____Number of models (22-23)

10. On the average considering all bus models, about how old are your motor buses? (ANSWER IN WHOLE YEARS.)

_____Years (24-25)

11. For each of the following fiscal years, how many motor buses does or did your transit system plan to purchase? (That is, funds approved or will be requested in each of the following fiscal years.)

Transit System Fiscal Year	Number of Motor Buses	
1. Fiscal year 1982	_____	(26-28)
2. Fiscal year 1983	_____	(29-31)
3. Fiscal year 1984	_____	(32-34)
4. Fiscal year 1985	_____	(35-37)
5. Fiscal year 1986	_____	(38-40)

12. When is the ending date of your next fiscal year? (FOR EXAMPLE, 06 30 83.)

(41-46)

Month Day Year

III. RECORD KEEPING SYSTEM FOR MOTOR BUSES (EXCLUDING DEMAND RESPONSE BUSES)

QUESTION 13 TO QUESTION 15 CONCERN THE AVAILABILITY OF COST RECORDS FOR MOTOR BUS OPERATING AND MAINTENANCE COSTS. PLEASE EXCLUDE COSTS ASSOCIATED WITH SUCH FACTORS AS DRIVERS' WAGES, RENTS, INSURANCE, PLANT MAINTENANCE, ETC. WHEN ANSWERING QUESTION 13 TO QUESTION 15.

13. Considering all motor bus operating and maintenance factors which of the following best describes the way your cost records are kept? (CHECK ONE BOX.)

1. [ ] No operating and maintenance cost records are kept...SKIP TO QUESTION 16
2. [ ] Only manual operating and maintenance cost records are kept
3. [ ] Mostly manual and some computerized operating and maintenance cost records are kept (47)
4. [ ] Mostly computerized and some manual operating and maintenance cost records are kept
5. [ ] Only computerized operating and maintenance cost records are kept

14. For each of the following motor bus operating and maintenance factors, please indicate whether or not your transit system keeps its operating and maintenance cost records by individual bus, bus model, and/or total fleet. (FOR EACH OPERATING AND MAINTENANCE FACTOR CHECK THE TYPE(S) OF COST RECORDS KEPT. CHECK ALL TYPES OF COST RECORDS THAT APPLY.)

CARD02 (1-2)
ID002 (3-5)

Operating and Maintenance Factors	Type of Cost Records Kept: Individual Bus	Bus Model	Total Fleet	
1. Fuel	____	____	____	(6-8)
2. Tires	____	____	____	(9-11)
3. Engine oil	____	____	____	(12-14)
4. Brakes	____	____	____	(15-17)
5. Transmission	____	____	____	(18-20)
6. Engine	____	____	____	(21-23)
7. Air conditioning	____	____	____	(24-26)
8 Preventive maintenance	____	____	____	(27-29)
9 Chassis	____	____	____	(30-32)
10 Other (SPECIFY) ____	____	____	____	(33-35)
11. Other (SPECIFY) ____	____	____	____	(36-38)

15 Overall for the cost data kept, does your transit system keep operating and vehicle maintenance cost records for the life of the motor bus or less than the life of the motor bus? (CHECK ONE BOX)

1 [ ] Less than the life of the motor bus

2 [ ] Life of the motor bus (39)

QUESTION 16 TO QUESTION 18 CONCERN THE AVAILABILITY OF FREQUENCY OF OCCURRENCE RECORDS FOR MOTOR BUS OPERATING AND MAINTENANCE COSTS PLEASE EXCLUDE COSTS ASSOCIATED WITH SUCH FACTORS AS DRIVERS' WAGES, RENTS, INSURANCE, PLANT MAINTENANCE, ETC WHEN ANSWERING QUESTION 16 TO QUESTION 18

16 Considering all motor bus operating and maintenance factors which of the following best describes the way your frequency of occurrence records are kept? (CHECK ONE BOX)

1 [ ] No operating and maintenance frequency records are kept SKIP TO QUESTION 19

2 [ ] Only manual operating and maintenance frequency records are kept

3 [ ] Mostly manual and some computerized operating and maintenance frequency records are kept (40)

4 [ ] Mostly computerized and some manual operating and maintenance frequency records are kept

5 [ ] Only computerized operating and maintenance frequency records are kept

17. For each of the following motor bus operating and maintenance factors, please indicate whether or not your transit system keeps its operating and maintenance frequency of occurrence records by individual bus, bus model, and/or total fleet. (FOR EACH OPERATING AND MAINTENANCE FACTOR CHECK THE TYPE(S) OF FREQUENCY RECORDS KEPT. CHECK ALL TYPES OF FREQUENCY RECORDS THAT APPLY.)

CARD03 (1-2)
ID003 (3-5)

Operating and Maintenance Factors	Type of Frequency Records Kept: Individual Bus	Bus Model	Total Fleet	
1. Fuel				(6-8)
2. Tires				(9-11)
3. Engine oil				(12-14)
4. Brakes				(15-17)
5. Transmission				(18-20)
6. Engine				(21-23)
7. Air conditioning				(24-26)
8. Preventive maintenance				(27-29)
9. Chassis				(30-32)
10. Other (SPECIFY) _____				(33-35)
11. Other (SPECIFY) _____				(36-38)

18. Overall for the frequency data kept, does your transit system keep operating and vehicle maintenance frequency of occurrence records for the life of the motor bus or less than the life of the motor bus? (CHECK ONE BOX.)

1. [ ] Less than the life of the motor bus
2. [ ] Life of the motor bus

(39)

IV. LIFE CYCLE COST PROCUREMENTS (EXCLUDING DEMAND RESPONSE BUSES)

19. How difficult will it be for your transit system to prepare a LCC procurement bid for motor buses given the cost data your transit system currently maintains? (CHECK ONE BOX.)

1. [ ] Little or no difficulty
2. [ ] Some difficulty
3. [ ] Moderate difficulty
4. [ ] Great difficulty
5. [ ] Very great difficulty
6. [ ] Impossible
7. [ ] No cost data kept

(40)

20. How difficult will it be for your transit system to prepare a LCC procurement bid for motor buses given the frequency data your transit system currently maintains? (CHECK ONE BOX.)

1. [__] Little or no difficulty
2. [__] Some difficulty
3. [__] Moderate difficulty (41)
4. [__] Great difficulty
5. [__] Very great difficulty
6. [__] Impossible
7. [__] No frequency of occurrence records kept

21. To what extent do you or your transit system's staff understand the current process of life cycle costing (LCC) requirements used in the procurement of motor buses? (CHECK ONE BOX.)

1. [__] Limited understanding. . .. .SKIP TO QUESTION 25
2. [__] Some understanding
3. [__] Moderate amount of understanding (42)
4 [__] Great amount of understanding
5. [__] Thorough understanding

22 To what extent do you favor or oppose the current LCC procurement requirements for motor buses? (CHECK ONE BOX)

1 [__] Very greatly favor
2 [__] Greatly favor
3 [__] Somewhat favor
4 [__] Neither favor nor oppose (43)
5 [__] Somewhat oppose
6 [__] Greatly oppose
7 [__] Very greatly oppose

23 If LCC procurement procedures were required only of large transit systems, how many motor buses should be used to identify the transit systems for which LCC procurement procedures would be required?

_____Number of motor buses (44-47)

24 In your opinion, which of the following changes (if any) would you want in order to improve the LCC procurement process for motor buses? (CHECK ALL THAT APPLY)

1 [ ] In my opinion, no changes are needed (48)

2. [ ] Limit factors used in the LCC procurement process to those where non-judgmental (can be verified) test data were available (49)

3 [ ] Modify the UMTA Act Section 15 reporting requirements so that most of the information used in the LCC procurement process is available (50)

4. [ ] Limit LCC procurements process only to large transit systems (51)

5. [ ] Encourage the use of LCC procurement process (over low-bid price procurement process) by offering more Federal funds to those transit systems using LCC (52)

6. [ ] Encourage the use of particular equipment and design feature specifications which assure low LCC (using the low-bid price procurement process) (53)

7. [ ] Encourage procurements which offer 3 to 5 year manufacturer warranties (54)

8. [ ] Other (SPECIFY)_____ (55)

_____

25. In comparison to low bid procurements, to what extent have the LCC requirements (as currently designed) delayed or altered your transit system's process of procuring motor buses? (CHECK ONE BOX.)

1. [ ] No plans to procure motor buses. . SKIP TO QUESTION 27

2. [ ] Little or no delay/alteration SKIP TO QUESTION 27

3 [ ] Some delay/alteration

4. [ ] Moderate delay/alteration (56)

5. [ ] Great delay/alteration

6. [ ] Very great delay/alteration

26. In what ways have your plans to procure motor buses been delayed or altered?

_____

_____ (57-58)

_____

27. Has your transit system decided not to procure motor buses because of the LCC requirements?

1. [ ] Yes.... .. CONTINUE TO QUESTION 28

2. [ ] No . SKIP TO QUESTION 29 (59)

28 Please explain how the LCC requirements affected your transit system's decision to procure motor buses

_____

_____ (60-61)

V. SPECIFIC MOTOR BUS LCC PROCUREMENTS (EXCLUDING DEMAND RESPONSE BUSES)

29. Has your transit system made or is your transit system currently in the process of making a LCC procurement for motor buses? (CHECK ONE BOX.)

1. [ ] Transit system has made a LCC procurement for motor buses

2. [ ] Transit system is currently in the process of making a LCC procurement for motor buses (approval for funds may or may not have been granted)

(62)

3 [ ] Transit system has both made a LCC procurement and is currently in the process of making a LCC procurement for motor buses (approval for funds may or may not have been granted)

4 [ ] Transit system has never made and is not currently making a LCC procurement for motor buses... . ....SKIP TO QUESTION 36

5 [ ] Other (SPECIFY)_____

30 Including those LCC procurements currently in progress and those completed, how many LCC procurements for motor buses has your transit system made?

_____Total number of LCC procurements for motor buses (63)

31 For your most recent LCC procurement for motor buses, which of the following stages best represents the stage your LCC procurement has reached? (CHECK ALL THAT APPLY)

1 [ ] Preparing bid package (64)

2 [ ] Issuing bid package (65)

3 [ ] Awaiting receipt of bids (66)

4 [ ] Evaluating bids received (67)

5 [ ] Answering protests (68)

6 [ ] Awarding the contract (69)

7 [ ] Contract awarded (70)

8 [ ] Other (SPECIFY)_____ (71)

32. Which of the following types of assistance (if any) did your transit system receive during the development of your most recent LCC procurement for motor buses? (CHECK ALL THAT APPLY.)

CARD04 (1-2)
ID004 (3-5)

1. [__] UMTA assistance was requested (6)
2. [__] UMTA assistance was received (7)
3. [__] Other transit systems with LCC experience provided assistance (8)
4. [__] Private consultants provided assistance (9)
5. [__] American Public Transit Association (APTA) (10)
6. [__] Developed without any outside assistance...SKIP TO QUESTION 35 (11)
7. [__] Other (SPECIFY)_____ (12)

33. Please describe the nature of the assistance your transit system received during the development of your LCC bid package for motor buses.

_____

_____ (13-14)

_____

34. For each of the following aspects of the LCC procurement process for motor buses, please answer the following questions. How helpful was the assistance you received from UMTA? (FOR EACH ASPECT OF THE LCC PROCUREMENT PROCESS CHECK ONE ANSWER.)

ASPECTS OF THE LCC PROCUREMENT PROCESS	NO HELP REQUESTED	HOW HELPFUL WAS UMTA? LITTLE OR NO	SOME-WHAT	MODER-ATELY	GREATLY	EX-TREMELY	
	1	2	3	4	5	6	
1. Developing bid package	____	____	____	____	____	____	(15)
2. Defining performance	____	____	____	____	____	____	(16)
3. Defining standardization	____	____	____	____	____	____	(17)
4. Identifying LCC factors	____	____	____	____	____	____	(18)
5. Evaluating performance	____	____	____	____	____	____	(19)
6. Evaluating standardization	____	____	____	____	____	____	(20)
7. Evaluating LCC factors	____	____	____	____	____	____	(21)
8. Determining how to evaluate manufacturers representations	____	____	____	____	____	____	(22)
9. UMTA's overall written guidance for transit systems on the LCC procurement process	____	____	____	____	____	____	(23)
10 Other (SPECIFY) _____	____	____	____	____	____	____	(24)

35. To what extent (if at all) did your transit system experience problems with each of the following tasks which are involved in the LCC procurement process for motor buses? (FOR EACH TASK OF THE LCC PROCUREMENT PROCESS INDICATE THE EXTENT OF YOUR PROBLEMS, IF ANY.)

TASKS OF THE LCC PROCUREMENT PROCES	TASK NOT CONSIDERED 1	TASK NOT PERFORMED 2	NUMBER OF PROBLEMS (IF ANY) NONE 3	FEW 4	SOME 5	SEVERAL 6	MANY 7	A LOT 8	
1.Identify which factors should be included in a LCC procurement	____	____	____	____	____	____	____	____	(25)
2.Determine how to evaluate LCC procurement manufacturers' information	____	____	____	____	____	____	____	____	(26)
3.Defining performance	____	____	____	____	____	____	____	____	(27)
4.Determining how to evaluate performance	____	____	____	____	____	____	____	____	(28)
5.Defining standardization	____	____	____	____	____	____	____	____	(29)
6 Determining how to evaluate standardization	____	____	____	____	____	____	____	____	(30)
7 Obtaining UMTA assistance	____	____	____	____	____	____	____	____	(31)
8.Other (SPECIFY) _____	____	____	____	____	____	____	____	____	(32)

36. According to a 1980 UMTA-sponsored publication of LCC procurement guidelines (May 30, 1980 report by Advanced Management Systems, Inc. on procurement procedures), transit systems "must have the ability to identify, measure, and evaluate the factors affecting its current operating and maintenance costs." Also, personnel are required to evaluate the LCC representations included in manufacturer's bid submissions.

For each LCC procurement task listed below and considering your current personnel, please indicate those types of personnel where additional assistance would be needed in order to meet these requirements for motor bus procurements. For example, this may be accomplished by hiring more personnel, having current personnel work overtime, or obtaining help from other government or non-government sources. (FOR EACH LCC PROCUREMENT TASK CHECK ALL ADDITIONAL TYPES OF PERSONNEL NEEDED.)

LCC PROCUREMENT TASKS	TYPE OF PERSONNEL: LEGAL 1	TECHNICAL/ MAINTENANCE 2	ADMINISTRATIVE/ FINANCIAL 3	CLERICAL/DATA PROCESSING 4	OTHER (SPECIFY) 5	
1. Collect and summarize local operating and maintenance data	____	____	____	____	____	(33-37)
2. Prepare invitation for bid packages	____	____	____	____	____	(38-42)
3. Conduct pre-bid conferences	____	____	____	____	____	(43-47)
4. Conduct evaluation of bid submissions and related proposal cost and adjustments	____	____	____	____	____	(48-52)
5. Other (SPECIFY) _____	____	____	____	____	____	(53-57)
						(58) blank

DATA ANALYSIS METHODOLOGY

Because we reviewed a statistical sample of transit systems, each estimate developed from the sample has a measurable precision or sampling error. The sampling error is the maximum amount by which the estimate obtained from a statistical sample can be expected to differ from the true universe characteristic (value) we are estimating. Sampling errors are usually stated at a certain confidence level--in this case 95 percent. This means the chances are 19 out of 20 that if we had reviewed the records of all transit systems, the results of such a review would differ from the estimates obtained from our sample by no more than the estimates' sampling error.

In statistical surveys, the implementation of a sampling design does not always proceed exactly as planned because one does not have complete control of the sample. In this review some of the transit systems either did not respond or were not eligible to receive Federal financial assistance funds; therefore, we adjusted our universe to reflect only the eligible transit systems that responded to our questionnaire. By this procedure, we are projecting to an adjusted universe while knowing nothing about either the ineligible transit systems or the nonrespondents. This is a common statistical procedure and provides conservative estimates since no statement is made about the characteristics (values) of the unknown segment of the universe.

Since the transit systems' bus fleet size varied considerably, we used a stratified random sample design based on four categories of fleet size. Consequently, the estimates shown in this report are weighted for the four categories of fleet size and are shown at 95-percent confidence level.

Table 1

Adjusted Sample Design for Transit Systems

Bus fleet size	Initial universe	Initial sample	Deletions due to non-response	Ineligibles deleted	Adjusted sample	Adjusted universe
Less than 25	165	69	3	5	61	146
25 to 99	137	69	6	2	61	121
100 to 999	70	54	1	2	51	66
Over 1000	13	13	0	0	13	13
Total	385	205[a]	10	9	186	346

[a]Two transit systems that do not operate buses were also sent questionnaires.

Using the information provided by the transit systems on the number of buses operated, we estimated the total number of buses operated by the universe of 346 transit systems eligible to

receive Federal financial assistance to purchase buses. The following results were obtained:

Estimate of the total number of buses operated	Sampling error (+/-)	95-percent confidence limit	
		low	high
50,843	1982	48,861	52,825

PRIOR GAO REPORTS ON LIFE-CYCLE COSTING

"Opportunities Exist To Achieve Greater Standardization of Aircraft and Helicopter Seats" (MASAD-82-22, Feb. 26, 1982).

"Evaluation of the General Services Administration's Use of Life Cycle Costing in the Procurement of Building Materials' (PLRD-82-41, Feb. 17, 1982).

"Logistics Planning for the M1 Tank: Implications for Reduced Readiness and Increased Support Costs" (PLRD-81-33, July 1, 1981).

"Evaluation of the General Services Administration's Effort To Implement Life Cycle Costing for Procurement of Commercial Products" (PSAD-81-14, Nov. 19, 1980).

"Impediments To Reducing the Costs of Weapon Systems" (PSAD-80-6, Nov. 8, 1979).

"Army Procurement of 10kW 60Hz Gas Turbine Generators Is Highly Questionable" (PSAD-79-95, Aug. 9, 1979).

"The Department of Defense's Application of the Design-to-Cost Concept" (PSAD-78-79, Mar. 20, 1978).

"Review of Life Cycle Cost Concept" (PSAD-78-74, Mar. 2, 1978).

"Life Cycle Cost Estimating--Its Status and Potential Use in Major Weapon System Acquisitions" (PSAD-75-23, Dec. 30, 1974).

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