Economic Evaluation of Bus Maintenance Contracting

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The economics of contracting with private service providers for maintenance of transit buses is examined. Cost comparison analysis undertaken for 5 competitively awarded turnkey service contracts and 16 maintenance jobs suggests that contract hire of bus maintenance can prove a cost-saving option for many systems.

Recently, contracting has been widely advocated as a cost-effective way of providing service delivery and injecting the spirit of competition into the transit industry. A few studies in the past (1, 2) have supported this and illustrated that contracting transit service delivery offers the potential for savings. However, no similar evidence has yet been established for vehicle maintenance (VM), even though the notion of contracting in this area is not new.

The economics of contracting with private bus maintenance service providers is examined. To this end, a cost comparison between public in-house maintenance cost and contractor's bid for the two major modes of private-sector participation, contracting for overall fleet maintenance and for specific maintenance jobs (or services), was undertaken. The approach to and results of these cost analyses, which included evaluation of 5 competitively awarded turnkey service contracts and 16 maintenance jobs contracts, are discussed (3).

EVALUATION OF CONTRACTING FOR OVERALL BUS FLEET MAINTENANCE

Unfortunately, no clear-cut example of an urban public transit agency that has contracted out all of its fleet maintenance work is yet available. However, in the case of several recently awarded turnkey fixed-route service contracts, total maintenance of the vehicles involved in the particular service has been an integral part of the overall contracted functions. For cost comparison analysis, five such cases of competitively awarded turnkey service contracts were chosen: Dallas Area Regional Transit II (DART II, Dallas, Texas); Snohomish County Commuter Bus Services (Everett, Washington); Huntington Station Feeder Bus Services (Fairfax County, Virginia); Johnson County Services (Olathe, Kansas); and Yolobus Services (Woodland, California).

Approach to Maintenance Cost Comparison

The calculated magnitude of difference in the unit VM cost ($/revenue vehicle mile) of a private service provider and the

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average unit VM cost of public systems operating under similar conditions is considered here to indicate the potential level of cost savings. Statistically, it is a crude measure of savings because either each data point or the average value of a very small sample (five in this case) is compared with the average value of larger samples representing public transit systems. This particular limitation must be kept in mind when interpreting the results of this analysis. Moreover, positive cost differences cannot be treated as real savings because there are several expense items principally related to general administration of maintenance that remain unavoidable in the short run even though maintenance is partly or entirely contracted out.

Estimating Unit VM Cost of Private Service Providers

Under the assumption that the bid price represents the true value of a private service provider's fleet maintenance cost, cost proposals, including line item budgets and service agreements, of each of the five cases of service contracting were the main sources of information for estimating unit VM costs of each contractor. Because maintenance is a subfunction of the overall turnkey service contract, two major problems were encountered in separating the fleet maintenance costs of each service provider from the cost proposal.

The first problem arose in cases in which no explicit definition of certain line item expenses was available or expense items were lumped together and presented under a specific category such as maintenance subcontract cost. For each case under consideration, explanations provided by the contract manager were taken into account and, to some degree, personal judgment was exercised, both in interpreting the cost of each line item and in deciding whether to include it under the vehicle maintenance function.

The second problem was encountered when treating the line item expenses that are either unique or not incurred by a private service provider. Because taxes, profit, facility rental, and depreciation are unique to the private sector, first a "leveling of the field" exercise was undertaken for a fair comparison of public and private costs. According to the UMTA guidelines on fully allocated cost analysis (4) the profits charged by the private provider and the taxes and fees paid by the private provider are common costs of doing business with a private carrier, and therefore these were included in the private carrier's bid.

The cost of using capital assets such as facility, garage, and equipment become significant for private service providers.

Because public operators usually have access to low-interest capital, they can receive a federal grant to match up to 75 percent of their fund requirement. Moreover, in many cases, such capital expenses remain unreported under the maintenance administration function of the Section 15 reports submitted by public transit systems. Hence, for a fair comparison, it was thought that it was essential to isolate this expense item from the contractor's bid under consideration.

Only in the case of Johnson County was the facility rental cost explicitly specified. Under the Fairfax County contract, this expense is not incurred by the contractor because a well-equipped maintenance facility and garage are provided by the county. In the remaining three cases (DART II, Snohomish County, and Yolo County) the contractors' bids did not clearly specify either the rental or depreciation cost of capital facility and equipment use. Therefore, for the analysis, adjustments to the bid costs of these three contracts were made on the basis of a gross estimate of capital required to build a new facility with bus storage space and essential equipment (*1*). It was assumed that in each case the private service provider would contract out all body work, major overhauls, and paint jobs. For the estimation of capital cost, a unit area cost of $52/ft^2, derived from the Fairfax County estimates for a new facility, was applied.

Considering the current volatile nature of the insurance market, the premium for liability insurance is mostly treated as a pass-through expense item by private service providers. Hence, even though it is incurred by the contractor, usually it is neither declared in the cost proposal nor included under VM. However, under Section 15 reporting, the VM cost estimate for each public transit system includes the premium for physical damage insurance of revenue vehicles. Therefore it was essential to first estimate the premium expense incurred during 1984 by public transit systems and then to isolate its effect from the estimated cost difference.

For the estimation of liability premium rates during 1984, a sample of 45 public transit systems was taken from the 1984 Section 15 data. There is a wide variation in the premium paid per bus. Many transit systems (almost 26 percent of the sample) did not declare any premium expense, which may be due to the self-insurance option or the transit system's being covered under the umbrella insurance of the city or county it serves. However, for transit systems with fleets of fewer than 200 buses it was found that the annual premium ($/bus) varied within a range of from $340 to $800. There can be numerous reasons for the wide variations such as fleet size, risk management, liability limits, state laws, and insurance procurement policy. However, it appeared to be reasonable to assume that 6 percent of unit VM cost was physical damage (PD) insurance premium cost during 1984. The estimated premium rate was close to the rate indicated by the Wisconsin Municipal Insurance Commission for 1984 [i.e., $0.0324 per revenue vehicle mile (RVM)].

For the estimation of average unit cost over the contract period, first total bid cost was adjusted by deducting the rental/depreciation cost of the capital facility and equipment. Calculated yearly unit costs were then adjusted to 1984 prices.

Finally, the private service provider's unit VM cost (in $/RVM) was calculated after the effect of two important expense items was incorporated: PD insurance premium (6 percent of VM cost) and contract monitoring cost incurred by a contracting agency (5 percent of VM cost).

Estimating Unit VM Cost of Public Transit Systems

For the estimation of the average maintenance cost of public transit systems, the VM cost data of only those public transit systems that closely replicate the operating condition of the private service provider were considered. Using 1984 Section 15 report data, all single-mode properties were selected initially as the study group in order to avoid the complications of joint expenses that could be found with multimode properties.

The next step was to identify major factors influencing VM cost so that each private operator could be compared with similar public transit systems. Identification of the major factors that explain the intersystem variation in VM costs has been a subject of inquiry in the past. Though most of the attempts have been limited to the experiences of public transit systems, their findings have been generic in nature and hence applicable to general causes of VM cost differences. Earlier studies (*5–7*), generally based on statistical analyses (mainly regression analysis), have shown partial success only because the quantifiable factors included in these analyses explained no more than 50 to 60 percent of variation in the VM costs. Major factors identified as influencing the VM cost have been fleet size, mechanics' wages, speed of operation, peak-to-base bus requirements, and fleet age.

However, in recent years, the focus of such investigations has shifted toward issues related to maintenance management (*5, 8*), which are difficult to quantify but considered extremely important to the overall performance of the fleet maintenance function. Elements of internal maintenance management, such as preventive maintenance policies, management information systems, supervision, workload levels, skill of mechanics, training programs, management structure, and recruitment policies, have been recognized as issues that cannot be ignored.

Effects of geographic factors such as climate and terrain on maintenance cost have also been investigated. In the case of aggregated system data analysis, however, the overall impact of climatic factors is uncertain (*6, 7*).

Among the factors that influence VM cost, scale of operation and fleet age are the only two that could significantly influence the operating condition of a transit property. Because management is considered the key aspect of comparison between private and public service performance, no adjustments were necessary to exclude its effect on the average VM cost estimation of public transit systems. It is assumed that the effect of geographic features such as climate and terrain would be neutralized among transit systems and be insignificant if a large sample of transit systems representing both "sun belt" and "rust belt" regions was considered.

The diseconomies inherent in the scale of operations of bus services are considered applicable to both the public and the private sector. Similarly fleet age impact on overall VM cost appears to be important because, under all five turnkey service contracts, new fleets are in operation. Therefore, for the purpose of cost comparison, the average unit VM costs of public transit systems belonging to various fleet sizes and age groups were calculated using 1984 UMTA Section 15 report data.

Comparing Private and Public Transit Maintenance Costs

Approach 1

Under the first approach, the VM cost per RVM of the contractor's bid is compared with the estimated average VM cost per RVM of public transit systems that have fleets of similar size and average age.

A glance over the estimated cost differences, given in Table 1, indicates that in four of the five cases of contracting considered, maintenance contracting shows a lower cost. The level of

TABLE 1   ESTIMATED UNIT VEHICLE MAINTENANCE COST DIFFERENCES

System and Location	Fleet Size	Approach 1[a]	Approach 2[b]	Approach 3[c]
Yolo Bus, Yolo County	14	32.63	29.10	46.33
Huntington Feeder Service, Fairfax County	33	19.90	12.60	69.80
Commuter Service, Snohomish County	53	43.14	32.54	49.94
Commuter and Intra-County Service, Johnson County	21	-3.76	-6.90	43.70
DART II, Dallas	204	11.81		
Average		21.70	16.84	54.95

[a]Percentage savings: private operation versus public systems of similar age and fleet size.
[b]Percentage savings: private operation versus public systems in state with similar fleet sizes.
[c]Percentage savings: private operation versus nearest regional public system.

savings is observed to be as great as 43 percent. Only in the case of Johnson County does the contractor's unit cost appear to be a little higher than the observed average unit cost of public transit systems. In the cases of Yolo County, Fairfax County, and Snohomish County, which are all less than 55-bus operations, the observed cost differences lie within a range of 20 to 43 percent. For the DART II contract, which is the largest (204 buses) service contracting experience in the county, the estimated difference is almost 12 percent. Because there was only one public transit system that had a fleet less than 5 years of age and was in the 200 to 400 fleet size group (i.e., Salt Lake City system), the age restriction was relaxed and the industrywide average unit cost for a 200 to 400 bus operation was used for estimating cost differences with respect to DART II operation.

With only one observation available, it is difficult to infer that the level of savings drops with an increase in the scale of operation, but it is true that in large-scale operations like DART II contractor's expenses for procurement, storage, and distribution of parts and supplies and maintenance of maintenance information system data are substantial. Because these expenses are not excluded from the contractor's bid price, the level of savings in the case of DART II may be to some degree underestimated. However, comparison of average unit costs of all private operations with those of comparable public agencies indicates a potential savings of 22 percent.

According to the contract manager of Johnson County, the main reason for the higher initial unit price is its fixed value for the next 6 years. Because the contractor absorbs the risk of future price fluctuations and provides a quality of service (bus cleaning and regular maintenance) perceived by the county to be better than that provided by the previous service providers (a private contractor and Kansas City Transit), the county considers it a reasonable price. Moreover, the county believes that there are significant savings in comparison with the service cost of its regional transit system.

Approach 2

Under the second approach, the unit VM cost of the contractor's bid is compared with the estimated average VM cost of similar sized public properties located within the same state. The effect of the interstate wage differentiation is thus eliminated. Another important controlling variable, average fleet age, was dropped in this case because of the small sample size.

Under Approach 2, though the level of cost differences has declined for each case, they remain consistent with the findings of the previous approach. The range of average savings in the cases of Yolo County, Snohomish County, and Fairfax County is observed to be 13 to 33 percent, whereas in the case of Johnson County the contractor's proposed VM cost emerges 6.9 percent higher than the average unit cost of similar systems in the state of Kansas (Table 1). Because there is no public transit operation in the state of Texas comparable to DART II, no cost difference was estimated in this case. Comparison of average unit costs of four county operations with those of public agencies with similar fleet sizes in their respective states illustrates that private operations, on average, can be 17 percent lower than public operations.

Approach 3

Under the third approach, the economic performance of the private service provider was measured in comparison with the performance of the nearest regional transit agency that could have provided the same service. This notion is pertinent in light of the recent practice of "opting out" from regional transit systems adopted by many counties (e.g., Fairfax County, Johnson County, Snohomish County) to cut their transit-related expenditures. Therefore, under this approach, the VM costs of the contractor's bid and the regional public transit agency located in the vicinity of the case study site have been compared.

Under this approach, the cost savings in the cases of all four county-sponsored private services are between 44 and 70 percent (Table 1). Comparison of average unit cost of all four county operations with the average of regional systems suggests that, on average, the cost of private operation is 55 percent lower than that of the regional public systems.

EVALUATION OF CONTRACTING FOR BUS MAINTENANCE JOBS

The practice of contracting out maintenance jobs is prevalent among public transit operators. Major overhauls; rebuilding various components; and, in some cases, cleaning and servicing

of buses are considered good candidates for contracting. The frequently cited reasons for contracting these jobs have been economic in nature, for instance, cost saving, backlog of work, and nonavailability of special equipment and facilities or skilled manpower. However, contracting decisions are usually conditioned by a manager's or supervisor's perception of these factors instead of any ongoing procedure for conducting an in-house economic evaluation for all major maintenance jobs.

An attempt was made to estimate, in gross terms, the level of potential savings that may be attained by contracting out engine overhauls, bus cleaning and servicing, and certain component-rebuilding jobs. Six public transit operators, who have in the past contracted out these types of maintenance jobs, were contacted. The approach taken to the cost comparison analysis is briefly discussed next.

Approach to Cost Comparison Analysis

The principle underlying the approach taken to cost comparison analysis is based on the guidelines of fully allocated cost analysis prescribed by UMTA (4). According to these guidelines, the total cost, including the direct cost of undertaking a job or service and a portion of the shared cost of the management, administration, and underlying infrastructure supporting that particular job or service, should be attributed to that particular job or service. In addition, it was recognized that when calculating the cost savings for a job, it is important to consider the amount of future resources used or saved by contracting out that particular job. This is particularly relevant for capital-intensive jobs such as major overhauls, painting, and certain machining work. Moreover, under the internal resource constraint (e.g., manpower) situation, a transit system might have to hire one or more specialized mechanics to bring in a currently contracted-out job. On the completion of that particular job, if the newly recruited staff is suboptimally utilized, the potential cost of keeping them on the payroll is considered as a resource loss cost. Because the magnitude of these costs is directly linked to the scale of production and the efficiency of resource utilization, the average unit cost of capacity expansion and lost resources will depend heavily on specific internal factors of individual transit systems.

The in-house cost of producing a unit of currently contracted-out service or job can be expressed as follows:

In-house cost/Unit = Unit direct costs + Unit shared costs
+ Average incremental cost of capacity
expansion + Average cost of resource
loss

Direct costs include labor and material costs directly consumed in producing a unit of a particular job. They are calculated in the following manner:

Unit direct costs = Direct labor hours/Unit × Hourly wage × (1
+ Fringe benefits costs/$Labor) + Average
material costs/Unit

The shared costs per unit of production are calculated by allocating a portion of the maintenance overhead (OH) costs, maintenance administration (MADM) costs, and systemwide general administration (GA) costs to the job under consideration using the following expression:

Unit shared costs = Direct labor hours/Unit × 1/MAINTHR
{MADM/VEH No. VEH + GAM}
+ OH/$Labor × Unit direct labor cost

where

MAINTHR = total hours spent by mechanics and servicers for vehicle maintenance, inspection, and servicing during a year;

No. VEH = total number of revenue vehicles operated by a system;

GAM = amount of systemwide GA allocated to the vehicle maintenance function; in this case, total GA expenses were split among three functional areas: operation, vehicle maintenance, and nonvehicle maintenance, according to the operating budgets.

Other variables could also be used to allocate systemwide GA expenses. Many private industries, especially those with a high capital-to-labor input ratio, often allocate their GA expenses to various cost centers on the basis of the value of capital used by each cost center. However, because of the absence of such information and the labor-intensive nature of transit operations, no attempt was made to test the sensitivity of this allocation variable in the estimation of public in-house cost.

In cases in which the in-house production of a particular service necessitates additional capital outlay, for instance, for purchase of specialized equipment or plant expansion, the depreciation of this additional capital asset is taken into account. This is particularly relevant for systems that are currently contracting out certain jobs because of either the capacity constraint (e.g., backlog of work) or the absence of required equipment or facilities.

The average increment cost (AIC) of capacity expansion can be expressed as

$$\text{AIC} = \left[\sum_{i=0}^{t} I_i / (1-r)^i \right] \Bigg/ \left[\sum_{i=L}^{L+t} \Delta D_i / (1-r)^i \right]$$

where

I_i = the investment in year i;
r = the discount rate (e.g., the opportunity cost of capital used);
t = the planning horizon;
D = the change in work demand; and
L = the average time delay between investment and commission data of the new facility.

Sources of Data

Most of the information on the in-house direct costs of undertaking a contracted-out job was collected through interviews of maintenance staff at each site. Staff responsible for monitoring specific jobs were contacted. Using personal judgment, these

persons provided a reasonable estimate of average labor hours required to accomplish a specific job, the wage rates and the fringe benefits of the mechanics assigned, and the cost of material and supplies expected to be consumed in that job. No inherent bias in favor of contracting, and thus underreporting of direct labor hours, was noticed. In most cases the interviewee was not involved in contracting decision making and took pride in handling work in house.

At all case sites, severe difficulty was encountered in collecting information on maintenance overhead costs and administrative costs. Such information was usually not available in the desired form. Overhead costs representing the expenses associated with supporting maintenance personnel and facilities are particularly difficult to isolate in cases in which facility use is shared. On the other hand, maintenance administration–related expenses may generally be available in a well-defined manner in large properties but difficult to identify for small sized properties. This is because administrative personnel in small systems may perform multiple functions including those unrelated to fleet maintenance.

To overcome this constraint, a sample of transit systems that have reported data on their maintenance overhead and administration under Section 15 was drawn. Though few systems report in such detail, it was possible to get from this sample reasonable estimates of the average ratio of overhead to direct labor costs and the average maintenance administration cost per vehicle. Because system size typically influences these costs, they were estimated for different sized properties.

Information on the systemwide GA expenses of individual case study systems was also derived from the 1984 Section 15 report. Each system's GA expenses were first allocated to the maintenance function in proportion to the share of its total operating budget devoted to maintenance. The GA allocated to maintenance (GAM) was further attributed to direct labor hours using the reported annual labor hours of mechanics and servicers devoted to maintenance, inspection, and servicing of vehicles in that particular system.

For estimating the cost of private service providers at each case study site, the bid price for each chosen contracted-out job was collected. Staff members of the maintenance and, in some cases, procurement divisions were contacted.

Comparing Private and Public Costs

For the cost comparison analysis a sample of 16 contracted-out jobs from 7 public transit systems was selected. These can be broadly grouped into three categories: engine rebuilding, bus cleaning, and rebuilding various components. In the absence of any information on the current and future magnitude and pattern of individual job work load for each case study, an accurate needs assessment for the capital and manpower resources cannot be made. However, in recognition that among these three categories only engine rebuilding work necessitates the use of major capital equipment and shop facility, initially it was assumed that all jobs could be handled in house without any investment. Thus the average unit cost of each job comprised only unit direct costs and shared costs. For the engine rebuilding job, however, the effect of additional capital equipment, facility expansion, and manpower utilization on the average unit cost at each level of output (number of rebuildings per year) was evaluated separately. A range of potential savings was established for different scales of in-house production.

Results

The estimated cost differences between the contractors' bids and the calculated in-house costs are given in Table 2. A glance over the estimated savings suggests that, in 15 of the 16 cases of contracting considered, costs of private service are lower than public costs. In the following subsections, results are discussed for each of the three categories of maintenance jobs.

TABLE 2 ESTIMATED SAVINGS IN CONTRACTING OUT CERTAIN MAINTENANCE JOBS

System	Job Description	Private Bid Cost ($)	Estimated Public Cost ($)	Cost Savings (%)
	Engine rebuilding			
A	8V-71	5,834.00	6,675.60	12.61
B	8V-71	7,286.00	5,780.00	−26.06
C	6V-92TA	6,000.00	6,760.00	11.24
D	8V-71	7,100.00	9,076.00	21.77
F	8V-71	5,500.00	6,859.00	19.81
	Cleaning			
B	Clean graffitti	10.00	24.30	58.85
E	Nightly coach servicing	2.50	12.00	79.17
F	Cleaning of interior, windows, and doors	45.00	97.20	53.70
	Rebuilding various components			
D	A/C compressor	524.00	1,073.70	51.20
B	Bendix Tuflo 700	213.00	332.70	36.00
G	Air compressor	240.00	300.40	20.11
F	24V alternator	540.00	629.40	14.20
F	Marine pumps	102.00	153.00	33.33
F	A/C alternator	164.00	355.00	53.80
F	Starter motor	123.75	277.60	55.42
G	Injector	19.00	32.60	41.72

Engine Rebuilding

Engine rebuilding (or overhaul) is one of the major drivers of maintenance cost during the life span of a bus. It is long-periodicity preventive work and therefore can be planned and scheduled well in advance. A complete overhaul consists of dismantling, cleaning, washing, and replacing all defective parts and assemblies; reassembling; testing; and, on satisfactory completion, reinstalling the engine in the bus. This work demands an adequate shop facility and capital equipment such as dynamometer, valve and seat machine, line-boring bar, and injector tester.

The results of cost comparisons analysis, given in Table 2, clearly indicate that the decision to contract out rebuilding of engines can lead to savings for many public transit systems. In four of five cases, the estimated savings fall in the range of 13 to 22 percent. In only one case (i.e., B) the private bid was found significantly (26 percent) higher than the estimated in-house cost. Two major explanatory factors in this particular case could be (a) higher contractor's price, which may be due to the small size of the overall contract (only four engines), and (b) low value for average in-house shop hours reported by the

staff (only 45 hr compared with the normally observed standard of 55 to 60 hr).

As mentioned earlier, in individual cases of contracting, if account is taken of the host of internal factors that influence costs (e.g., magnitude and pattern of current and future engine rebuilding workload, existing plant capacity, availability of skilled manpower, inventory), the estimates of savings may be somewhat conservative. To illustrate this, a hypothetical case based on information on the five cases is presented.

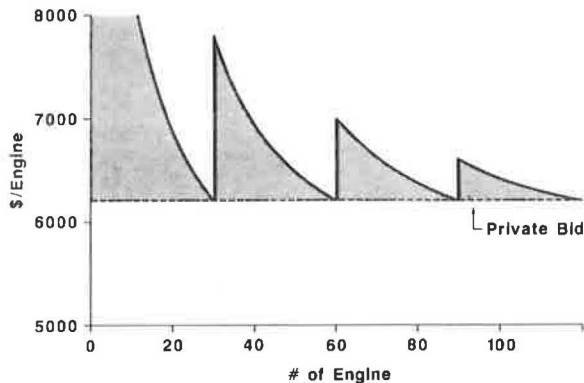The following assumptions were made to generate the illustrative average unit cost curve shown in Figure 1:

FIGURE 1   Average cost curve for engine overhaul.

• The capacity expansion plan will include addition of a dynamometer bay (1,719 ft^2) and an overhaul shop (2,324 ft^2) and purchase of a dynamometer, a line-boring bar, a valve and seat machine, and an injector tester.

• The expected life of garage facility and equipment will be 30 and 25 years, respectively. Straight line depreciation is assumed for the estimation of capital asset costs.

• The standard time for accomplishing each rebuilding job will be 55 hr, and the average cost of material and supplies consumed in each unit will be $4,500. The mechanic's wage rate and the overhead multiplier will be $12/hr and 2.5, respectively.

• A full-time mechanic will accomplish a maximum of 30 engine rebuilding jobs a year assuming 1,504 productive work hours in a year (27.7 percent unavailable time).

Although the private per unit bid price usually declines somewhat with increasing magnitude of a contract, it was assumed that it will remain fixed at $6,200 per unit. The shaded area in Figure 1 represents the potential savings that could be realized at various levels of output. The discrete jumps at 30, 60, and 90 overhauls per year are caused by the addition of a mechanic at these levels.

Figure 1 clearly shows that, in order to spread the costs of capital assets and to use manpower efficiently, a certain scale of production must be maintained. Most transit systems, particularly small and medium-sized ones, face lumpy and noncontinuous demand patterns for engine rebuilding, so it is difficult for them to attain an economy of scale. To establish a regular workload of 30 engines per year, a bus fleet of from 150 to 200 buses with an evenly distributed age appears to be necessary. Systems with erratic workload patterns will not find it economical to have overhaul facilities. Contracting out such

work will be cheaper even when high utilization of a facility can be achieved in the near term. Moreover, specialized work such as engine rebuilding requires considerable management attention, skilled mechanics, and separate training. For instance, according to Figure 1, on average, 21 percent savings can be achieved for 0 to 30 overhauls per year. Average savings for between 30 and 60 overhauls per year appear to be 16 percent and can vary between 0 and 21 percent.

In three of the five cases considered in the analysis, the number of units contracted out was less than 11. Therefore, these systems did benefit substantially by avoiding capacity expansion. Table 3 gives the level of savings these three

TABLE 3   ESTIMATED SAVINGS IN CONTRACTING OUT ENGINE AND POWERTRAIN REBUILDING

Sys- tem	Job Description	No. of Units Contracted Out	Savings (%)	
			Without Capacity Expansion	With Capacity Expansion
A	8V-71 engine	>50	12.61	12.61
B	8V-71 engine	4	−26.05	53.76
C	6V-92TA engine	10	11.24	32.61
D	Powertrain with 8V-71	11	21.77	39.23
F	8V-71 engine	>50	19.82	19.82

systems attained in their respective contracting decisions. Even System C, which handles such jobs at a significantly lower cost (26 percent below the contractor's price), realizes substantial savings (almost 54 percent) by deciding to send out its four engine-rebuilding jobs. No significant change in the level of savings of Systems A and F occurs because they contracted out more than 50 overhauls.

Bus Cleaning

Bus cleaning and servicing consume a significant portion of overall maintenance manpower (almost 20 to 25 percent). Thus economy in this area can substantially affect the maintenance budget. In the three cases of contract hiring considered, the estimated savings fall between 54 and 79 percent (Table 2). The factors that contribute to the lower cost of these contractors are lower wages and efficient utilization of labor. Because facility, equipment, and materials for cleaning were supplied by the transit systems, no effect of capital investment was considered.

Use of part-time nonunionized labor gives contractors great flexibility in deploying the labor force; lower wages are typically paid as well.

Rebuilding of Various Components

In all eight cases of rebuilding or exchange of remanufactured components, such as compressors, alternators, pumps, starter motors, and injectors, the in-house cost of undertaking the jobs is higher than the contractor's price. The estimated levels of savings range between 14 and 74 percent (Table 2). Rebuilding such components in-house is slowly becoming the exception rather than the rule, principally because firms that specialize in remanufacturing specific components are able to establish a scale of production that can be handled by an assembly line.

Both economies of scale and assembly line mode of production appear to lower the unit cost of production for private firms.

CONCLUSIONS

A cost comparison between the bid maintenance cost of five competitively awarded contracts and average maintenance costs for public systems operating under similar conditions demonstrates that, on average, the total bus fleet maintenance contracting option emerges 22 percent lower in cost than do similar public operations. Only in one of five cases is the maintenance cost slightly higher (in a range of 4 to 7 percent).

The average maintenance costs of four county-sponsored private services among the five cases considered are 44 to 70 percent lower than those of their respective regional transit systems.

In all 16 cost comparisons between the contractor's bid for maintenance jobs (or services) and the estimated cost of undertaking the same jobs in-house, the decision to contract out has proved economical. The calculated levels of savings for engine-rebuilding work, rebuilding various components (including compressors, alternators, pumps, injectors, and starter motors), and bus cleaning and servicing fall in ranges of from 13 to 54 percent, 14 to 55 percent, and 54 to 79 percent, respectively.

Differences between private and public costs are indicative of the level of potential savings that may be attained over a certain period of time by a public transit system. For the contracting of new services, a significant portion of the potential savings may be realized immediately after contracting only if new additional overhead expenses along with the direct costs associated with the contracted services are forgone. However, in cases in which a public agency is considering contracting out its existing in-house services, the difference between the real and potential savings will depend on the extent to which the contracting agency can eliminate, after contracting, both direct and shared costs linked to those particular services. In reality, because of the host of internal factors that impede actions such as layoffs and reductions in plant capacity, an agency may only partly realize overall benefit of contracting in the short run.

Although more data would be necessary to derive any statistically sound conclusions, these cost comparisons indicate that contract hire of bus maintenance can be a cost-saving option for many systems. For this purpose, an agency should maintain close links with private garages and regularly compare the costs of in-house jobs with those of private service providers. This is particularly essential before any service expansion or major capital outlay for facility or equipment is undertaken.

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DISCUSSION

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Contracting out on a competitive basis is an effective tool for public agency managers to use to control their costs, and its use is likely to increase rapidly in the future. Bus transit agencies devote approximately 22 percent of their total expenditures to maintenance (1), and thus maintenance is an important area in which to consider using this cost control strategy. This paper is important in shedding light on the potential for cost savings in this area. The main purpose of this discussion is to point out some significant conceptual and methodological issues related to cost savings from contracting and thereby place this paper's results in perspective. The discussion will also include a few specific questions about the numerical values and approach used.

The most important distinction in cost savings is that between monetary or dollar savings and real savings. Real savings refer to actual savings in physical resources, such as amount of labor or material used, and occur independent of the price paid for these items, whereas dollar savings can result from either a reduction in real resources or a reduction in the price paid. From an overall societal standpoint, of course, real resource savings are more significant. However, from the standpoint of a specific agency, the dollar savings are of interest because they release monies for alternative uses (e.g., reduce taxes, expand other services). Like most prior literature, this paper focuses on dollar savings, undoubtedly reflecting a transit industry perspective.

A second issue that must be addressed is the meaning of "saving." In this paper saving is implicitly defined by the equations or procedures used to estimate it, but it is not entirely clear what this saving is intended to represent. In the contracting context, the term "saving" is usually used for the incremental reduction in total cost of producing the same service

that results from contracting instead of in-house production. Conceptually this can be explained by reference to Figure 2 (2). The total cost of production of all service in-house is A + B. Under contracting, the public agency in-house cost will be reduced by an amount A. In order to have the service provided, the agency enters into one or more contracts for which the (bid) contract price is C. In addition, the agency may incur some additional management or monitoring costs, as a result of contracting out, as indicated by D. Furthermore, there may be some additional costs of producing the remaining service in-house as a result of contracting out; these are indicated by E. Thus the net cost saving would be as indicated in the figure (A − C − D − E).
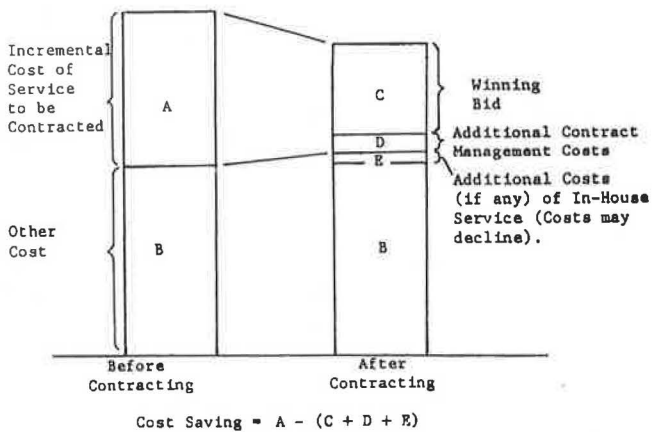

FIGURE 2 **Effect of competitive contracting on total costs of transit.**

In this paper, reference is made to Elements A, C, and D, but not to E. Whether or not E is properly taken to be zero in the case of maintenance contracting is unclear. In this case, the agency might add some backup capability to its maintenance facility in case the contractor cannot perform as intended, resulting in a positive value of E. Alternatively such in-house backup capability may be reduced, on the premise that the contractor's own backup can be used in a crisis at the agency's facility, so E might be negative.

Note that this saving could represent the incremental saving to the local transit agency alone or to the combination of all agencies that finance the service (local agency plus local, state, and federal governments). Transit agencies are basically responsible for operating and maintenance costs and receive grants for capital equipment from the federal government and other levels of government. Hence savings to the local transit agency would be different from those to government. Also, as noted in the paper, there are significant differences between private firms and public agencies with respect to taxation and user charges for public facilities (e.g., trash, sewers). Although "a leveling of the field" exercise with respect to these items is mentioned, it appears as though the end result is that no correction for taxes and user fees was applied. This biases the estimates in favor of a reduced level of cost savings. Another important distinction is between short-run and long-run costs and savings, and the author of the paper correctly distinguishes between these.

The private-public difference also relates to use of depreciation as a measure of value of capital expenditures. Depreciation itself is an arbitrary procedure for spreading expenditure over the depreciable life of the asset, and it has no real meaning as a true equivalent annual expenditure. This is well documented in engineering economics texts and need not be discussed in detail here [see, for example, Au and Au (3, p. 286 ff.)]. Instead of depreciation, the proper cost to use would be the annual equivalent cost based on use of the capital recovery factor (but of course considering the effect of depreciation allowances on taxes and after-tax income). Sufficient detail is not presented in the paper about how depreciation was used to adjust costs, so the impact on overall savings is unclear.

Turning to specific cost issues, the comparison of overall bus fleet maintenance using three different approaches bears comment. Under Approaches 1 and 2 maintenance costs under contracting are compared with the estimated average cost to public systems that are similar in a number of features including fleet size. This would appear to be appropriate only if the public agency that otherwise would have undertaken the maintenance was indeed the same size as the private firm. If, as is more likely, the public agency were larger and contracted only a portion of its vehicle maintenance, then the relevant comparison would be between private contractors and larger public agencies. This suggests that Approach 3 is really the most relevant comparison for purposes of estimating savings.

A second area of concern is certain parameter estimates and equations. Specifically, the estimates of 6 percent of other costs for insurance and 5 percent for monitoring bear discussion. Actual experience with monitoring costs of public services that are similar to public transit indicates that monitoring costs can be as high as 12 percent (4, p. 16). Also, the specific equation used for estimating depreciation costs for the "average incremental cost of capacity expansion" (in the section on Bus Maintenance Job Contracting) should be explained. Similarly, the "unit shared costs" in this section are also insufficiently defined. Finally, throughout the paper, when costs had to be estimated from aggregate data, as in the case of vehicle maintenance costs in public agencies, average costs were used on the assumption that costs are proportional to maintenance activity (e.g., vehicle miles). This is a strong assumption, and some discussion of its validity is certainly warranted.

Finally, a major issue in contracting is whether or not the products obtained through contracting and in-house production are indeed equivalent. In transportation it is generally possible to specify clearly and unambiguously what the product should be and to monitor the provision of the product so that deficiencies in quality should not be a problem. However, the discussant wonders whether or not in an area such as cleaning there might be quality differences, particularly when the contractors use lower-paid part-time labor.

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TABLE 4   VEHICLE INSURANCE PREMIUM DURING 1984

| Case Study Sites | Range of Observed Physical Damage Insurance Premium in 1984 | |
	$/RVM	Percentage of Contractor's VM Cost
Dallas (DART II)	0.017–0.040	2.58–5.87
Snohomish County	0.027–0.065	5.61–12.52
Fairfax County	0.009–0.022	2.66–6.06
Johnson County	0.014–0.034	2.37–5.43
Yolo County	0.012–0.028	3.48–7.82

AUTHOR'S CLOSURE

Morlok's discussion of the concept of savings resulting from competitive contracting is commendable. The discussion provides further insight to readers of the paper. The discussant does raise a few questions with regard to certain numerical values used in the cost comparison analysis. The intent of this closure is to provide answers to these questions.

Cost Element E, which represents additional costs of producing the remaining services in-house after contracting out, is likely to be experienced by a transit agency especially after contracting some of the existing services. In cases in which new services are contracted such effects may not occur. The value of E was assumed to be zero in the paper because all five cases represented turnkey service contracts for new services. Similarly, in the cases of maintenance job contracting no attempt was made to quantify such effects. This particular cost element is appealing but difficult to forecast accurately.

In the paper it is explicitly indicated that no correction was applied for taxes and user fees paid by private service providers because they are considered to be common costs of doing business in the private sector. This assumption is in compliance with the recommendations of the Competitive Services Board, which was created to develop cost comparison guidelines on competitive bidding (*1*).

In recognition that public operators have access to low-interest capital and, in most cases, receive federal grants to match up to 75 percent of their capital requirement, it was considered reasonable to isolate and subtract maintenance facility–related expenses from the contractor's bid before cost comparison. Because in three cases (DART II, Snohomish, and Yolobus) private bids were not explicit about such expense items, the annual cost of capital for maintenance facility and storage space was estimated for each case depending on the fleet size. For the purpose, first space requirements were calculated using general space standards for functions to be kept in house. Next, assuming a unit area cost of $52/ft^2, the capital requirement was estimated and then depreciated over a 30-year period using the straight line method.

The assumption of 5 percent of bid cost as monitoring expenses actually represents the average monitoring costs derived from a nationwide survey of transit contracting (*2*). In general, monitoring costs are observed to vary in a range of from 3 to 10 percent.

The premium for liability insurance paid by public transit agencies with fewer than 200 buses during 1984 was observed to vary within a range of from $340 to $800 per bus. Table 4 gives, for each of the five cases considered, the estimated range of insurance cost per revenue vehicle mile (RVM) and the share it represents of overall maintenance cost. The assumed value of 6 percent falls within the estimated ranges and coincides with the Wisconsin Municipal Insurance Commission rates of 1984 (i.e., $0.0324/RVM).

The quality of service provided by private contractors remains a major concern of public agencies considering contracting as an alternative mode of service delivery. However, in the area of bus cleaning, contrary to the discussant's perception, public agencies generally appear to be little concerned. In both cases of cleaning contracting mentioned in the paper, public agencies expressed satisfaction with the performance of their contractors. Bus cleaning should be considered a good candidate for contracting because it is labor intensive, demands few skills, and is generally a job least preferred by maintenance workers. As pointed out in the paper, substantial savings in this area are experienced by both public agencies.

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