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Cost and Productivity of Transportation for the Elderly and Handicapped: A Comparison of Alternative Provision Systems

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This paper reports on one part of a comprehensive study of 56 specialized transportation providers throughout the United States. Cost and productivity data for three different classes of providers (social service agencies, private contractors, and transit authorities) are presented. Such data were examined for their policy implications for systems currently in operation and proposed coordination and brokerage efforts. A distinction was made between "perceived" costs (items in the budget that require a monetary outlay) and "actual" costs (a more comprehensive account of the required resources for service provision). Such distinction helped explain seemingly irrational choices made by the providers studied and assisted in the determination of an "average" transportation budget for specialized services by major cost items. A comparison of the unit costs experienced by different providers revealed some uniformities: (a) the systems that have the highest productivities operate in dense areas and achieve a mix of group subscription and individual demand-responsive trips, (b) the separation of ambulatory from nonambulatory clients can lead to substantial economies, (c) it is not as clear that contractual agreements offer lower costs when hidden costs are accounted for, and (d) social service agencies are becoming increasingly more expert in the provision of transportation and in many cases have lowered their costs over time to a competitive level. On the basis of these findings, present and planned systems should stress the integration of group and individual trips and the separation of clients by level of service required in order to maximize efficiency.

It is difficult to analyze and evaluate the cost and productivity of transportation systems for the elderly and the handicapped (E&H) because the figures made available by the providers themselves are often incomplete, inaccurate, and scarcely reliable. Existing project reports, each referring to a specific geographic area and period of time, and each employing its own methodology in the definition of costs, do not allow for very meaningful comparisons of alternative provision systems from an economic viewpoint.

At the same time several policy hypotheses have been formulated on the basis of the results of local experiences. Among them are the alleged economic advantage of provision through contractual agreement over direct social service agency (SSA) provision, the opportunity for the heavier involvement of transit authorities in E&H transportation, and the desirability of mixing different client and trip types. Although supported by individual studies (and sometimes contradicted by others), many of these hypotheses have not been tested against comparable or consistent data sets.

In 1978-1979 the University of Texas at Austin undertook a national study of the cost and effectiveness of alternative E&H transportation systems sponsored by the U.S. Department of Transportation. The study attempted to provide a detailed nationwide data base whose cost and productivity measures were developed by using a consistent methodology and comparable terminology. [All data presented here appear in more detailed form in that project's final report (1).]

STUDY BACKGROUND

The purposes of the University of Texas study were manifold; they included

1. To look at the cost and productivity of different alternatives in order to isolate the characteristics of the most productive and more economic systems,
2. To examine the impact of different forms of assistance (for example, capital grants for purchase of equipment as opposed to operating subsidies) on the behavior of the recipients at the local level,
3. To develop a data base that would provide reference figures for a manual (2) addressed to the planning and evaluation needs of local E&H transportation providers, and
4. To formulate policy suggestions based on the observed uniformities and the relative advantages of particular provision alternatives.

Fifty-six providers were surveyed and were grouped into three major classes and further divided as shown below:

1. Social service agencies (17): 7 national and regional, 5 in urban setting, and 5 in rural setting;
2. Contract providers (28): 10 urban, not lift-equipped; 6 urban, lift-equipped; and 12 rural, lift-equipped; and
3. Transit-managed systems (11): urban, at least partly lift-equipped.

Two different definitions of cost were elaborated

(3): "perceived" costs, which represent disbursements made by the providers, and "actual" costs, which also include the costs not sustained by the provider but nevertheless essential for the execution of the service.

The distinction is relevant because the perspective of the observer will determine which of the two definitions will be used. An SSA or a direct provider will base its decisions on its perceived costs, since they are the ones that affect the resources it has available. Conversely, policymakers at an upper level will be interested in the total amount of resources used in a given project, and this perspective will bring them to look at actual cost figures. As a classic example, the use of a vehicle purchased on a grant and driven for a few hours a day by existing staff may be the most economical way for an SSA to provide transportation for its clients. The agency that funds the vehicle grant may wish to include the prorated cost of the vehicle (and the driver's wage). If that is done it may be evident that a direct subsidy given to the clients to use existing providers in the community (such as a taxi company) is on the whole a more cost-effective approach. Both views of the same system are rational, once the underlying assumptions and objectives are clear. Both definitions are therefore relevant for a meaningful analysis of any E&H system. In addition, however, the use of actual cost patterns allows the comparison of different types of providers from across the country.

This paper presents some of the most relevant study findings on the structure of the budget of E&H transportation providers, cost and productivity ranges and averages, and policy observations that were suggested by the experiences of the systems surveyed.

In the first section of this paper, the methodology followed in the reconstruction of cost items is briefly explained. The incidence of different cost items (equipment depreciation, overhead, fuel, maintenance, insurance, and operating salaries) in the budgets of E&H transportation providers is analyzed and compared. The second section of the paper maintains the distinction between perceived and actual figures, and identifies range and average costs per indices of operation (vehicle miles, passenger trips, and vehicle hours) for different categories of providers. The third section focuses on a comparison between SSA and contract provision.

The policy implications for both existing E&H transportation systems and the future of the recently introduced concepts of brokerage and coordination are summarized in the conclusions.

COMPOSITION OF THE E&H TRANSPORTATION BUDGET

Because available project data are usually vague or unreliable, it was important to accurately reconstruct the amount (and the cost) of the resources involved in alternative forms of provision of E&H transportation. Data were obtained from published research reports, unpublished materials and records, on-site visits, telephone interviews, or combinations of the above. These project-reported or supplied data were then "reconstructed" for all three classes of providers.

Reconstruction Methodology for SSAs and Transit Systems

A similar approach was followed for SSAs and transit systems; it was necessary to handle contract providers somewhat differently. For SSAs and transit systems, expenses were grouped into six major cost items: equipment depreciation, overhead, fuel, maintenance, insurance, and operating salaries. Perceived costs were those reported by the providers in their budgets. In order to reconstruct actual costs, an extensive checklist to evaluate the acquired data was developed, and the information available in written reports was supplemented by follow-up correspondence or telephone calls.

When cost data were not available for SSAs or transit system providers, information was gathered on the resources employed (e.g., number and type of vehicles or hours of volunteer work), and estimates were made on the basis of reasonable cost figures from comparable providers. Full equipment cost was depreciated over a four-year period (a reasonable lifetime for lift-equipped paratransit vehicles); volunteer labor was calculated at either going wages for the same type of work or at minimum wage rates. When existing staff members were dedicating part of their time to the project, a comparable part of their salaries and indirect costs (benefits, insurance, etc.) was imputed to the E&H transportation budget. If a specific cost item was clearly not reported at all, its value was estimated on the basis of that item's average incidence in the budgets of the same type of E&H transportation providers.

Reconstruction Methodology for Contract Providers

When E&H transportation was provided through contractual agreements (the third class of provider), the price charged by the contractor was considered to be the perceived cost since it represents the monetary outlay necessary if this option is chosen. Detailed breakdowns by cost items are not normally available from private contract providers, so that it was not possible to follow the format used for SSAs and transit systems. Three additional cost items had to be added to the price of contract service in order to reconstruct the actual cost: in-kind contributions, SSA equipment depreciation, and administrative costs. These items are often omitted by those evaluating contract provision, but their magnitude is sizable. Omitting such costs leads to an average 17 percent underestimation in the actual cost of service.

Each of these three items can be significant. First, private contracts for service often contemplate a discount on the total cost. If the agreement is with a taxi company and the price is based on meter reading, it is not unusual for a 5 or 10 percent discount to be granted at the time of payment. Such a discount can be viewed as in-kind contribution or subsidy given by the contractor, and was accounted for, just as in-kind contributions such as volunteer labor were quantified in dollar terms in the analysis of SSA budgets.

Second, some contractors manage and operate systems that use vehicles belonging to the public agency in whose name the service is provided. Typically, such vehicles are leased to the contractor for a nominal sum, and their depreciation is not accounted for by either party. In such cases this item has been reconstructed and included to determine the actual cost.

Finally, even when the system's operation is delegated to an outside contractor, an agency will still incur administrative costs that will vary according to the functions that have been retained by the agency. On the basis of information from the providers whose detailed data have been examined, administrative expenses range from 6 to 25 percent of total actual cost per trip; the average is 13 percent (1).

Table 1. Range and average distribution of cost items expressed as percentage of total system cost.

Cost Item	SSA						Transit-Managed System					
	Perceived			Actual			Perceived			Actual		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Equipment depreciation	0	19	5	5	16	12	1	21	9	5	23	14
Overhead	0	18	10	17	42	25	12	18	17	6	21	12
Fuel	6	16	12	6	14	10	5	12	8	2	11	6
Maintenance	3	17	10	3	13	8	2	13	9	2	22	8
Insurance	0	3	2	1	7	4	4	7	6	2	9	5
Operating salaries	49	72	61	33	48	41	47	62	51	42	72	55
Total			100			100			100			100

Note: Min = minimum percentage reported; Max = maximum percentage reported; Avg = average.

Missing Cost Items in Direct SSA and Transit System Provision

Social service agencies' data usually required adjustments in three cost items:

1. Equipment depreciation (vehicles, wheelchair lifts, and radiocommunications equipment): Very often such equipment is purchased entirely or nearly entirely through federal and/or state funds or else is donated by organizations or private citizens. As a result, most of the SSAs do not include a prorated cost of such equipment in their figures or at the most only depreciate the local share of such costs.
2. Overhead (general administrative functions such as certification of clients and eligibility screening, reservations intake, billing and accounting, elaboration of operating statistics, and program advertising and monitoring): Many SSAs do not carry transportation as a line item in their budgets since such programs have often developed over a period of time and no specific full-time positions have been created for the purpose. As a consequence, one or more agency staff members devote part of their time to the administration of the program, but the share of their salaries and other costs (such as utilities, supplies, and office space) is not isolated or clearly defined.
3. Maintenance and operating salaries (drivers and dispatchers): In-kind contributions of volunteer labor for any of these functions (especially driving) is the most common cause of the difference between the perceived and actual costs for this item.

In transit-managed systems, equipment depreciation is the most frequent cause of discrepancies. Besides simply considering the local share, some transit authorities depreciate the equipment cost over 15 years, which is considered the average life span for a transit bus but is too long for paratransit vehicles.

Comparison Between Transit Systems and SSAs

Table 1 gives the incidence, in percentages, of the six main cost items of the transportation budget of SSAs and transit systems derived from the 56 U.S. providers of E&H transportation previously mentioned. It allows a direct comparison between the two classes of providers by using either perceived or actual cost figures. [For a more extensive treatment of the data, see Hickman, Pio, and Rosenbloom (1, Chapter 2 and Tables 1.5 and 1.7).]

As mentioned previously, the average figures in this report have been obtained from a variety of sources throughout the United States. The range figures that accompany them show that variations caused by local factors and system characteristics are fairly large. These range figures, however, indicate the extreme values encountered; under normal conditions the spectrum would be narrower.

The data from Table 1 can also be used for a comparison between SSA and transit-managed systems. First, SSAs seem to have higher actual overhead costs than transit systems in the provision of E&H transportation (25 percent versus 12 percent). This can be explained both by their limited expertise in the field and by the mixture of agency-specific activities with the provision of transportation. Conversely, the incidence of perceived expenditure is lower for SSAs because they often use part of the time of agency staff members as well as other resources (such as office space and telephone) without attributing such costs to the transportation program.

Second, when actual costs are compared, operating salaries are a more relevant cost component for transit authorities (55 percent versus 41 percent for SSAs), mainly because of higher unit cost due to the unionization of the drivers. [Perceived cost figures are not significant because so many other cost items (equipment, overhead) are on the average underestimated by SSAs that labor automatically becomes the major perceived component.]

Finally, systems managed by transit authorities seem to be allocating less of their budget to fuel and oil consumption (6 percent versus 10 percent for SSAs). Although there is no clear evidence, it seems reasonable that such savings may be generated through mass purchase at a discount or through the use of more fuel-efficient and better-maintained vehicles.

Magnitude of the Differential Between Actual and Perceived Cost

The distinction between perceived and actual costs and the use of the reconstruction methodology described earlier have made it possible to identify the items most often neglected in the available E&H transportation budgets. When SSAs or transit authorities directly manage a system, the items usually underestimated are equipment depreciation, overhead, and operating salaries (because volunteer contributions or expenses paid for by higher levels of government are not accounted for). In the case of provision under contractual agreement, the omission of in-kind contributions from the contractor in the form of price discounts, SSA equipment depreciation, and overhead expenses normally explains the discrepancy between actual and perceived cost.

The magnitude of discrepancy between perceived and actual cost for the three major alternatives is shown below. These averages are derived from the average values of Table 2. The unit of measurement

Table 2. Unit cost data for classes of E&H transportation providers.

Type of Provider	Cost per Vehicle Mile ($)			Cost per Passenger Trip ($)			Cost per Vehicle Hour ($)		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
SSA area averages									
Actual	0.73	0.94	0.80	1.79	4.42	2.81	4.82	13.18	10.34
Perceived	0.46	0.79	0.67	1.50	4.19	2.54	4.05	12.49	8.91
SSA urban									
Actual	0.59	1.61	1.10	2.37	5.72	3.94	–	–	13.87[a]
Perceived	0.27	1.43	0.69	1.09	5.08	2.78	–	–	11.23[a]
SSA rural									
Actual	0.66	1.49	1.11	1.62	5.48	4.44	10.15	12.77	11.46
Perceived	0.57	1.19	0.74	1.29	4.77	2.91	5.27	11.11	8.19
Contract, urban non-lift-equipped									
Actual	0.53	1.55	1.08	1.48	10.80	3.70	–	–	–
Perceived	0.46	1.35	0.89	1.16	8.62	2.83	–	–	–
Contract, urban lift-equipped									
Actual	0.58	2.36	1.15	3.75	19.57	7.97	–	–	–
Perceived	0.38	2.10	0.96	3.75	17.39	6.68	–	–	–
Contract, rural lift-equipped									
Actual	–	–	–	–	–	–	–	–	–
Perceived	0.10	3.21	0.84	2.90	19.76	9.24	–	–	–
Transit system, urban lift-equipped									
Actual	0.65	2.76	1.64	1.12	10.84	6.16	9.84	27.54	17.86
Perceived	0.54	2.54	1.48	1.02	9.06	5.12	9.84	25.97	16.61

[a]Only figures available for this category.

does influence the absolute size of the discrepancy but not the relative standing of the three provision systems.

	Percentage of Actual Cost		
Unit Cost	Direct SSA Provision	Contractual Agreement	Transit Authority
Per mile	28	17	10
Per trip	24	17	17
Per hour	18	Not available	7

SSAs' perception of the cost of direct provision is the one farthest away from the actual cost. This misperception results from both a low degree of accuracy in record keeping and the fact that a significant amount of the resources used is provided by other entities (e.g., volunteers) or levels of government (e.g., grants for equipment purchase). As a consequence, SSAs that use their perceived costs as a reference figure will find direct provision preferable to other alternatives whose perceived costs are higher. This is in spite of the fact that comparison of actual costs would show other alternatives to be more economical.

This finding has often been used to prove that subsidized SSAs are unfairly competing against private contract providers. However, the above text table clearly shows that even contractual provision displays a significant difference between perceived and actual costs. Since at the local level the comparison takes place between the perceived cost of both alternatives and since in both cases the underestimation is significant, we should conclude that the argument has limited validity. In fact, as will be shown, in many cases direct SSA provision is an economically rational decision even when actual service costs are compared.

Finally, systems managed by transit authorities show the least discrepancy between actual and perceived costs not only because of their expertise in the field of transportation but also because of the more stringent reporting requirements imposed on them.

COST AND PRODUCTIVITY RANGES AND AVERAGES

Cost and productivity data for the three major classes of providers further subdivided into seven classes are presented next. In order to make them comparable, cost figures are presented in terms of unit costs (respectively per vehicle mile, per passenger trip, and per vehicle hour). All three measures have been computed to provide the reader with data in a variety of formats. In the following sections the analysis will be based mainly on cost per passenger trip.

The productivity data are presented per vehicle hour (total passenger trips divided by total vehicle hours), the indicator most commonly used in paratransit operations. Two additional measures are presented: passengers per vehicle mile (total passenger trips divided by total vehicle miles) and average operating speed (obtained by dividing the first indicator by the second).

Cost: Reported Values and Preliminary Observation

Table 2 presents the range of unit cost data for seven different classes of providers derived from the 56 U.S. providers mentioned above. Both actual and perceived costs are reported for each class. Minimum and maximum unit costs are, respectively, the lowest and highest costs reported by any provider within the class. Variations around the average and within the range are caused by the diversity of the local situations surveyed. They are reported here to underline the uniqueness of each system and to provide general reference points. [For more extensive treatment of the data, see Hickman, Pio, and Rosenbloom (1, Chapter 2 and Figures 2.1, 2.2, and 2.3).]

The difference between perceived and actual costs (in both ranges and averages) is clearly apparent. The effects of this difference are also easy to detect. If, for example, we look at the provision in urban areas, SSAs have no incentive to delegate transportation of their clients to lift- or to non-lift-equipped contractors, since the average perceived cost of direct provision ($2.78/trip) is lower than both alternatives ($6.68 and $2.83, respectively). This happens in spite of the fact that the actual cost of non-lift-equipped contract service ($3.70) would on the average be lower than the actual cost of SSA service ($3.94). SSAs' actual costs are lower than those of other lift-equipped providers, and we shall see later that this is achieved through a mix of demand-responsive and group subscription transportation.

Table 3. Productivity measures for E&H transportation.

Type of Provider	Passengers per Vehicle Hour			Passengers per Vehicle Mile			Average Operating Speed (miles/h)		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Social service agency	0.72	4.50	3.05	0.10	0.52	0.27	2.88	23.00	13.36
Contract provider	2.50	6.40	4.44	0.10	0.36	0.23	17.74	24.00	20.87
Transit authority	2.68	13.60	5.82	0.17	1.28	0.49	4.50	22.21	11.51

Transit provision appears to be the most costly alternative, both in terms of cost per mile and cost per hour, although not necessarily so in terms of cost per trip. Providers in rural areas experience a wide fluctuation in unit costs coupled with higher costs per trip. These can be explained in terms of the peculiarity of some contractual agreements and the generally higher average trip length.

Both urban lift-equipped contractors and transit systems have a higher average actual cost per trip than do non-lift-equipped contractors ($7.97 and $6.16, respectively, versus $3.70) because of differences in equipment costs, boarding time, etc. The perceived cost for rural lift-equipped contractors is also higher ($9.24).

If we were to choose reference figures to indicate the unit cost of operating an E&H transportation system, Table 2 can provide some general indications according to the system's characteristics. An attempt to further generalize across classes (with all the risks and limitations involved in such a generalization process) would produce the following approximate value ranges: (a) cost per vehicle mile = $1.10-1.50, (b) cost per passenger trip = $4.50-8.00, and (c) cost per vehicle hour = $11.00-18.00.

Productivity and Characteristics of Most Efficient Providers

Table 3 presents three productivity indicators (passengers per hour, passengers per mile, and average operating speed) for the three major classes of providers. This classification by type of provider is not necessarily the most analytically useful, but it is the only one possible with the data available. [The source of the data, which I have elaborated, derives from 11 SSAs, 2 contract providers, and 9 transit-managed systems. More extensive treatment may be found in Hickman, Pio, and Rosenbloom (1, Chapter 2 and Table 2.4).]

Average system productivity as expressed by the number of passengers per hour fluctuates between 3 and 6 across the whole sample. It seems to be higher, both in average and maximum values, for contract providers and even more so for transit-managed systems. The higher productivity of the latter offsets at least in part the greater average cost of operation ($17.86/h as opposed to the average of $10.98/h for the 11 SSAs that were examined).

A closer look at the distribution of values within each class shows that there are relatively few providers that have rather high productivity; they tend to raise the average for the class to which they belong. The common characteristics that these exceptions share can be summarized as follows:

1. Operation in urban areas or in settlements characterized by fairly high density (which allows for better routing and less deadheading),
2. Relatively few mobility-impaired riders who require special assistance (which shortens the time required for boarding and leaving the vehicles), and
3. Provision, among others, of a considerable amount of group subscription rides or route-deviation trips (thereby approaching the operational characteristics of a chartered vehicle or a transit system).

If these systems were excluded from the computation of the average productivity, the value for the remaining ones would be closer to 2.5-3 passengers/h, and no significant difference between providers could be detected.

Figures for passengers per vehicle mile are a traditional measure of productivity used by fixed-route bus operators. A more precise indicator could be constructed if passenger miles, rather than vehicle miles, were available but, because of the difficulty of collecting such data, very few systems offer this information. The range of values observed varies between 0.10 and 1.28. Systems with the highest values are normally characterized by the provision of group or subscription trips and/or the fairly high density of the areas in which they operate (such is the case, for example, of transit-managed systems). The rural providers considered in this study averaged only 0.04 passengers/mile, which is the equivalent of a considerable average trip length of 22.2 miles. If we exclude the relatively few providers that have a fairly high value, the most common range in urban areas seems to be around 0.15-0.30, and the average is close to 0.20.

Finally, it is possible to obtain average operating speed simply by dividing the first item (passengers per hour) by the second (passengers per vehicle mile). The data show that contract providers seem to operate at a considerably higher speed (though the figures should be taken with some caution, since they represent the average of the only two contractors for which data on the hours of operation were available). Other providers average about 12 miles/h, but the variations are significant among them, as the width of the range of values demonstrates.

PROGRAM AND POLICY IMPLICATIONS OF SYSTEM EXPERIENCE

An examination of the data presented in the previous section shows that on the average both unit costs and system productivity tend to become higher as we move from SSAs to contract provision to transit-managed systems. Average actual cost per trip grows from $3.75 to $5.80 and $6.16, respectively, and a similar pattern can be found in cost per mile ($1.00 to $1.10 to $1.65, respectively). Average passengers per vehicle hour increase from 3.05 to 4.44 to 5.82.

A closer look at the characteristics of the systems studied makes it possible to explain the reasons for such differences and to draw some significant policy inferences. Transit-managed systems will be considered first, and attention will be then concentrated on the difference between SSAs and contract providers.

Higher Cost of Transit Provision

Systems managed by transit authorities have the highest cost per mile and per hour. The higher wage rates paid by transit operations seem the primary cause of this phenomenon. At the same time, transit systems are generally available to the whole population of a locality and not just to a restricted client group. As a consequence, they tend to have longer operating hours and to maintain an excess capacity at times of day when demand is fairly low. Both factors tend to increase unit costs. The fact that they achieve a cost per trip lower than that of lift-equipped contract providers can be explained in part by the fact that transit systems exist only in urban areas where densities are higher and average trip lengths shorter than those encountered by the rural providers considered in the sample. As for the comparison with urban contractors, the transit systems that have significantly lowered their cost per trip seem to be those that have been able to provide both group rides and demand-responsive service. This aspect will be explored further when direct SSA provision and the use of contracted service are compared.

SSAs and Contract Provision

Incidence of Hidden Costs

It has been claimed that the apparently lower cost of direct SSA provision of E&H transportation can be explained by the omission of several cost items from the budget. In fact, this understatement is significant--between 18 and 28 percent of the actual cost (see text table above).

However, this study found that a similar phenomenon takes place when E&H transportation is managed by contract providers: Underestimation of cost, as the text table shows, is approximately 17 percent. Although approximately 3.5 percent represents in-kind contributions (discounts) from the contractors, the remaining 13.5 percent comes from the sponsoring agency's overhead expenditures and equipment depreciation.

When the omitted items are included, the actual cost of contract provision is increased to a more realistic level, and the argument for SSA inferiority in terms of cost-effectiveness loses some of its strength. Local providers engaged in comparing alternatives need to be aware of the necessity to include these considerations in their decision process.

Separation by Client Needs

The comparison between SSAs and contract providers becomes more meaningful if we break down the latter according to the type of vehicles used and if we limit ourselves to an urban setting.

The average actual cost per trip for urban contractors that use lift-equipped vehicles ($7.97) is significantly higher than for those that do not ($3.70); SSAs average $3.94 per trip. Table 2 also shows that, in general, cost per trip can reach considerably higher values for individual lift-equipped providers. The upper limit of the actual cost range observed was $19.57 per passenger trip, as opposed to $10.80 for trips on non-lift-equipped vehicles.

Several reasons can be given to account for the greater cost of providing demand-responsive trips to severely impaired passengers. Larger vehicles equipped with wheelchair lifts and tiedowns are needed; however, nonimpaired persons can be transported in normal cars, like those most taxi fleets use for their regular service. The higher cost of equipment (prorated through its depreciation) is therefore a first component. Such vehicles also require more fuel and, in many cases, are charged higher insurance premiums. Handicapped passengers also require more time and assistance in boarding the vehicles, and this causes the system's productivity (passenger trips per hour) to decrease.

A clear policy implication derives from this finding: Whenever possible it is highly advisable to separate mobility-impaired passengers from fully mobile clients and to adopt different modes of provision for the two. Even SSAs that use predominantly lift-equipped vehicles could achieve economies by tailoring their services to the special equipment and assistance needs of the clients.

Directly transporting the severely impaired traveler and allocating the overflow of mobile clients to a taxi company under a contractual agreement is a method already used with success in many localities. In Austin, Texas, the cost of direct provision in Special Transit Service vans ($10.84/trip) is significantly higher than the fare charged under agreement by a local taxi company ($5.00). A similar difference in cost ($9.75 versus $4.10/trip) can be found in the operation of San Antonio (Texas) Handi Lift. This situation shows the potential for a complementary, rather than competitive, use of alternative providers.

Mix of Trip Types

Range and average cost figures reported in earlier sections of this paper have shown that some SSAs have been able to bring their costs to a level that is quite competitive with that of other providers. The mixing of trip types has played an important role in this process.

The contract providers (both lift- and non-lift-equipped) considered in this study are typically involved in individual, demand-responsive trips from many origins to many destinations. A close examination of the service characteristics of the SSAs shows a mix of demand-responsive trips with other group trips of the one-origin-to-one-destination or many-origins-to-one-destination type.

Handicapped persons who go to work or rehabilitation courses typically need transportation in the early morning and late afternoon; senior citizens' meals normally take place at lunchtime. Individual demand-responsive trips (which are in greater demand during the middle hours of the morning and the afternoon) can be scheduled around this skeleton of subscription group transportation. Such an arrangement allows for the utilization of a system at levels close to full capacity. In reality, the integration of different kinds of trips does not always proceed as smoothly, since scheduling conflicts often develop and the resources available to a system may not be adequate to cope with utilization at full capacity. Vehicles may be idle but there may not be anybody available to drive them, or intense use of a vehicle can cause serious maintenance problems, just to mention a few recurring problems.

Across all types of providers the cost per group trip is much lower (from one-half to less than one-fourth) than the cost of demand-responsive service, as Table 4 [an elaboration of survey data (1)] clearly points out. The reasons for such differences are intuitive, since group trips concentrate the time-consuming boarding process, allow for reduction in miles traveled due to easier routing, and better utilize the capacity of the vehicles. The policy followed by SSAs of integrating group and demand-responsive trips that

Table 4. Cost comparison between demand-responsive and group subscription trips.

Type of Provider	System	Cost per Mile ($)		Cost per Trip ($)	
		Group	Demand-Responsive	Group	Demand-Responsive
SSA	Allied Services (Jackson, Mississippi)	1.33	1.29	0.89	3.91
Contractor	Variety Care Van (Dallas, Texas)	Not available	Not available	3.70	4.95-6.20
Contractor	Goodwill Rehabilitation Service (San Antonio, Texas)	0.67	0.78	3.75	5.39
Transit authority	Dial-A-Bat (Brockton, Massachusetts)	1.44	1.53	1.12	5.99

have different peak demand hours can be generalized to other providers; the policy seems particularly useful for systems that are attempting coordination or brokerage efforts.

In addition, the operation by private for-profit contractors of lift-equipped systems that employ dedicated vehicles and drivers does not present economic advantages over direct SSA provision. The two systems for which data are available (Dade County, Florida, and Fort Worth, Texas) show costs of $19.57 and $9.16/trip and $2.36 and $1.11/mile, respectively. Such costs are not any lower than those incurred by SSAs and are in fact higher than the average for lift-equipped contractors ($7.97/trip).

From an economic viewpoint, therefore, it seems that the role of contract provision should be in the complementary service to non-mobility-impaired clients rather than in the parallel development of systems that have dedicated vehicles and drivers.

CONCLUSIONS

In the course of this study, an extensive data base on the cost and productivity of E&H transportation has been reconstructed and analyzed. Both the perceived (direct outlay of the provider) and the actual cost (monetary equivalent of all the resources necessary) for the provision of the service under different arrangements have been determined.

The average budget for different types of providers has been compared, showing the significantly higher incidence of overhead expenditures for SSAs and of labor costs for transit-managed systems. All three classes of providers considered (SSA, contractor, and transit) show sizable discrepancies between their perceived and actual costs, although the reporting accuracy seems to increase as we go from the first to the last. The use of perceived cost as a decisive criterion at the local level explains some choices that would otherwise seem irrational from a broader policymaking perspective. One such choice is the direct SSA provision of transportation to clients who are not severely impaired and could be more efficiently and economically served by contract providers such as taxi carriers.

Both cost and productivity ranges and averages have been presented, maintaining as detailed a distinction between the alternative provision systems as the existing data allowed. These data, and the percentage budget composition illustrated earlier, can be cautiously used as reference figures in assessing a system's performance against that of the fairly large number of providers in the nation whose operating statistics have been organized by means of a uniform methodology.

Finally, a direct comparison of the different provision alternatives produced some interesting results in terms of policy implications. Transit-operated systems are consistently found to be the most costly, because of the higher incidence of excess capacity at some times of the day. If cost items such as equipment depreciation, overhead, and in-kind contributions that are normally omitted when contract provision is considered are allowed for, the often-proclaimed competitive edge over direct SSA provision is eroded.

Furthermore, it appears that, by providing a mix of demand-responsive and group trips that have different peak-demand times, SSAs have been able to lower their unit costs. Although such integration does reduce unit costs for the system on the average, the inevitable higher cost of providing individualized, demand-responsive, many-origins-to-many-destinations transportation must be acknowledged. It is, therefore, especially important to identify the actual needs of the client group served in terms of special assistance and equipment and, whenever possible, to differentiate between those clients who can use more conventional transportation modes and those who cannot. By providing the former with a less specialized, but still adequate, transportation service (typically a taxicab or non-lift-equipped provider), considerable money can be saved and can be used to improve service for the remaining segment of the client population.

The application of these concepts can be extended to the whole field of E&H transportation, regardless of the nature of the provider, and should be of special interest for the coordination projects now being implemented. Such projects are faced with a wide client population characterized by different needs, peak-demand times, and trip characteristics and have the possibility of using different modes of transportation in a creative combination that better exploits their characteristics and complementarity.

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Impacts of Allegheny County's Access Program

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Access is a countywide door-to-door transportation system for the elderly and handicapped in the Pittsburgh, Pennsylvania, area that is conducted under the Service and Methods Demonstrations Program of the Urban Mass Transportation Administration (UMTA). Access is managed for UMTA and the Port Authority of Allegheny County (PAT) by Multisystems, Inc., a private company that acts as central broker of transportation for human service agencies and for individual elderly and handicapped persons. The service is provided under contract through the use of vehicles operated by a mixture of existing private for-profit carriers and nonprofit agencies. Each provider is assigned a specific service area, and all requests for service in that area are normally handled by that provider. The broker can also arrange backup service whenever necessary. The Access program, including a description of the service, the delivery network, and implementation issues, is discussed. The fare system is described, including the zone structure, the use of scrip coupons to pay for service, the agency billing system, and the user-side subsidy program sponsored by PAT for those who cannot use the fixed-route transit system. The broker's role in managing funds to pay for service on a vehicle-hour basis is also described. Impacts on agencies, individuals, carriers, and the quality and cost of service are discussed. Service statistics for the first eight months of service are presented.

Access is a countywide transportation program in the Pittsburgh area that has been established to improve mobility for the elderly and handicapped and to provide benefits to social service agencies through coordination. It is funded as a two-year demonstration program under the Service and Methods Demonstration (SMD) program and is currently entering its second year.

Access is a door-to-door, advance-reservation, shared-ride service for persons 60 years of age or over and for persons who are handicapped regardless of age. The service is provided through the use of vehicles operated by existing private for-profit carriers and nonprofit agencies. Service costs are borne by social service agencies, by individual riders, and by the Port Authority of Allegheny County. Access services are managed by a "broker," Access Transportation Systems, Inc., a wholly owned subsidiary of Multisystems, Inc., which is charged with the responsibilities of organizing and managing service delivery and of coordinating the demands of individuals and agencies for this service.

Access offers a uniform system of fares that can be predetermined, a comprehensive countywide delivery network of lift-equipped and other paratransit vehicles, and a convenient, easily monitored scrip system that facilitates the application of user-side subsidies.

Access officially began offering service on March 14, 1979. By October 1979, monthly ridership exceeded 6000 passenger trips.

PROGRAM DESCRIPTION

This section provides brief descriptions of the key design and operating components of the Access system.

Coordination

In its original conception, Access was primarily geared toward coordination of human social service agencies. Because of the multiplicity of agencies that provide services directly or through contracts with for-profit carriers (mostly cab companies), a principal design feature of the Access system was a coordinated, nonduplicative delivery network. This had to be accomplished in an environment in which for-profit carriers had "turf" rights, firmly established by tradition and often (but not always) confirmed by regulatory approval.

Also, nonprofit agencies provided services directly to their clients in many portions of the county. Needless to say, this often met with a degree of resistance from the cab companies. To confuse matters, the authority to regulate service and similar issues was disputed between the state Public Utilities Commission (PUC) and the regional Port Authority of Allegheny County (PAT).

Delivery Network

In this environment, we decided to establish a comprehensive delivery network that produced the benefits of the competitive marketplace through a contract bidding process. At the same time, we decided that contract awards would give each of nine sections of the county [total area 1866 km^2 (729 $miles^2$)] exclusively to one carrier. This was intended to maximize the capability for ridesharing in any location despite potentially low demand densities.

The service is currently provided by a network of eight carriers, including four taxicab companies, one nonprofit chair carrier, and three nonprofit human service agencies. Despite the original intent to give exclusive responsibility for each area to only one carrier, cooperative arrangements were eventually negotiated in several areas to allow better distribution of resources.

Communication

Because of the unique correspondence of a single carrier to any given geographic area, there was no necessity for central dispatching. Each carrier could handle all calls for its area. Access installed a Centrex system that linked all contracted carriers with each other and with the central Access office. Thus, if consumers called the wrong number or needed to be referred to a different carrier or to the central office for any reason, they could be transferred without redialing. The Centrex system was part of a systematic effort to make the service as simple as possible to the user.