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## Effect of Size and Type of Organization on Quality of Special Transportation Services

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### ABSTRACT

An index of quality of service for special transportation services for elderly and handicapped persons was developed and used to analyze the relationships of quality to the size of the provider and to the type of organization of the provider. For a sample of 42 special services it was found that quality increases with size of ridership and that private organizations provide greater quality of service than do public organizations.

To efficiently deliver special transportation for the elderly and handicapped it is necessary to choose an appropriate method of providing service. This involves an analysis of a variety of issues including the size of the provider and whether the provider should be public or private. Researchers have studied these questions from the point of view of cost efficiency (1); however, the quality of the service that is provided should also be considered. The relationships between type of provider (i.e., its size and public or private nature) and the quality of transportation service are analyzed. To depict these relationships, a measure of quality was developed. The measure was applied to a sample of special transportation services for the elderly and handicapped, and the relationships between the quality of service and other characteristics (primarily size and type) were statistically analyzed.

In the first two sections of this paper the development and application of the index are discussed. The third and fourth sections cover the relationship between quality and size and type of organization. In the next two sections the interrelation of size and type of organization is discussed

and the relation of quality to productivity and to the provision of wheelchair service is introduced. A summary of the conclusions of the analysis is presented in the final section.

### INDEX OF QUALITY

The measure of quality of service that was developed is a hierarchic index. It is composed of eight general aspects of a special transportation service:

1. Reliability and on-time performance,
2. Comfort,
3. Convenience of making reservations,
4. Extent of service,
5. Vehicle access,
6. Safety,
7. Driver characteristics, and
8. Responsiveness to user.

Each aspect is composed of specific attributes or general measurable characteristics. For instance, under the general aspect reliability is the attribute, "delays while on the vehicle." This attribute can be measured in expected minutes of delay per year.

The different aspects are of different relative importance to quality of service. Thus each aspect was assigned a weight that is proportional to its relative importance. The weights are designed so that they sum to 10. Similarly, each attribute has a different importance to its relevant aspect. Therefore, the attributes also were assigned weights. The weights of all the attributes that contribute to one aspect also add to 10.

The weights were developed from a survey of elderly and handicapped users and potential users of special transportation services. A questionnaire was sent to a sample of 659 elderly or handicapped people. In the questionnaire, the respondents ranked the attributes according to their importance to the

relevant aspect and ranked the aspects according to their importance to quality. One hundred fifty-seven usable questionnaires were returned. The rankings were turned into a set of weights using psychometric scaling techniques. The final index, including all the attributes and the weights, is given in Table 1. The development of the index is discussed in greater detail elsewhere (2,3).

#### APPLICATION OF THE INDEX

Data on 42 providers of special transportation for the elderly and handicapped in the Chicago metropolitan area were collected by personal interview and observation. Of the 42 providers, 26 are run by governmental or public bodies, 10 are run by private, nonprofit organizations (PNPs) and 6 are run by private, for-profit firms (PFPs). Three of the provider organizations have the primary purpose of providing special transportation, and the rest of the providers are parts of larger organizations. For 13 providers, the larger organization's primary purpose is to govern or provide government services. These are generally townships, park districts, or local municipalities. Five of the services are provided by firms specializing in transportation; three of these are taxi companies and two are bus oper-

ators. Thirteen providers are social service agencies and three are sheltered workshops.

Table 2 gives some typical characteristics of the providers. The service areas range from small, urban, densely populated areas to large, countywide or multicounty areas encompassing suburban and rural regions. Population densities range from 380 people per square mile to 14,200, with an average of 4,450 people per square mile. Ridership follows the same pattern. Half the services have riderships of fewer than 20,000 trips per year, but there are a few with very large riderships (more than 100,000). For the average provider, 7 percent of the trips are made by wheelchair users. However, 13 of the services provide no wheelchair service, and wheelchair users make more than 10 percent of the trips of 10 providers.

On the average, two-thirds of the service is demand responsive (door-to-door service with each trip individually scheduled). However, the largest services are less likely to provide demand-responsive service. When the size of the providers is taken into account, only 39 percent of all the trips in the sample are demand responsive. The average service provides 19 percent subscription service (door-to-door service with trips permanently scheduled), but 46 percent of the total trips are subscription.

TABLE 1 Index of Quality of Service

Aspects <sup>a</sup>	Attribute <sup>b</sup>
1.75 Reliability	3.9 Arriving at destination on time 2.9 Notification of delays or cancellation of service 1.3 Wait time for pick-up at home 1.2 Wait time for pick-up away from home 0.7 Few delays while on the vehicle
1.61 SAFETY	4.4 Low probability of a traffic accident 2.7 Low probability of falling 2.5 Low probability of personal assault 0.2 Type of tie down 0.2 Position of the wheelchair in the vehicle
1.36 VEHICLE ACCESS	1.9 Height of first step 1.8 Short distance from house or destination to vehicle 1.4 Number of steps 1.4 Assistance in getting from vehicle to destination 1.2 Assistance in carrying packages 1.2 Width of the aisle 1.1 Presence of a wheelchair lift or ramp
1.31 DRIVER CHARACTERISTICS	2.9 Knowledge of general needs 2.6 Courtesy and friendliness 2.0 Ability to handle medical emergencies 1.6 Neatness and professionalism 0.9 Familiarity with habits and needs of individual user
1.29 CONVENIENCE OF MAKING RESERVATIONS	2.9 Being picked up at time selected by traveller 2.6 Shortness of reservation time 2.3 Convenience of return reservation procedure 2.1 Accommodation to changes in reservations
1.07 EXTENT OF SERVICE	2.7 No or few restrictions on where vehicle will go 2.6 Total number of hours of service 1.8 Low rate of turning down reservations 1.6 Service on weekends 1.3 Service on evening
0.87 RESPONSIVENESS	3.9 Courtesy and friendliness of telephone operators 3.7 Ease of getting clear information on service 1.9 Receptiveness to complaints and user suggestions 0.5 Procedures for follow-up on complaints
0.74 COMFORT	2.5 Guaranteed seat or location for wheelchair 1.9 Sheltered waiting areas for pick-ups away from home 1.4 Condition and cleanliness of vehicle 1.4 Smoothness of the ride 1.4 Air conditioning and good ventilation 1.4 Seats at waiting areas for pick-ups away from home

<sup>a</sup>The number in front of the aspect is the weight of that aspect or its relative contribution to quality of service.

<sup>b</sup>The number in front of each attribute is the weight of that attribute.

TABLE 2 Characteristics of Providers (n = 42)

	Mean	Range
Years in operation	9	1-35
Service area (square miles)	240	1-2030
Population density of service area	4450	380-14,200
Fleet size	14.6	1-35
Annual ridership (one way trips/year)	45,030	525-650,000
Percent of trips by wheelchair users	7	0-55
Percent of service provided as: <sup>a</sup>		
Demand responsive	67	0-100
Subscription	19	0-95
Route deviation	5	0-100
Fixed route	8	0-100
Charter	1	0-40
Vehicle productivity (trips/vehicle hour)	4.3	.7-15
Sources of revenue (%) <sup>a</sup>		
Fares	14	0-100
Federal subsidy	18	0-100
Other government subsidy	51	0-100
Private subsidy	6	0-100
Other sources	12	0-100

<sup>a</sup>These figures are averages for providers and do not take the differences in size of the providers into account.

Five percent of the average provider's service is route deviation, and 8 percent of all trips are route deviation. The average system provides 8 percent of its service as fixed route, and 6 percent of all trips are fixed route.

The average productivity is 4.3 trips per hour. The services that have very low productivities generally are those that dedicate a vehicle to a particular round trip, leaving the vehicle and driver idle while the passengers are at their destination. The services with very high productivities provide a large proportion of their service as fixed route.

Government subsidy is the major source of operating revenue with the federal government providing about 18 percent and state and local governments providing about 51 percent of operating revenue. Fares (and suggested donations from riders) provide about 14 percent of revenue. Fourteen of the 42 providers collect no fares or donations from passengers. Private subsidies from groups such as United Way, Catholic Charities, or other charitable organizations as well as donations from individuals account for about 6 percent of revenue. Other sources include cross subsidies within organizations and purchases of service by other agencies and account for about 12 percent of revenue.

To apply the index to the providers, a performance measure for each attribute and a method of relating the measure to the level of satisfaction for the attribute were developed. The relation between the level of satisfaction and the performance measure is called a scoring function. The scoring functions are designed so that the score or level of satisfaction for complete satisfaction is one and the score for no satisfaction is zero. Returning to the example of "delays while on the vehicle," the measure is expected minutes of delay per year, which is based on actual delays in the past year. The scoring function assigned a value of 1 to no delays and a value of 0.1 to the expected delay for the worst (i.e., most delay) case in the sample. Perform-

mance measures and scoring functions were developed for all the attributes in the index (2).

Using the scoring functions, each provider was given a score for each attribute. Then each provider was given a score for each aspect by summing the weighted attribute scores. (The weights are those given in Table 1.) Finally the provider was given a score for quality by summing the weighted aspect scores. Thus, the quality score for each provider is

$$Q_k = \sum_j \sum_i W_j W_{ij} S_{ijk}$$

where

$Q_k$  = quality score for provider k,  
 $W_j$  = weight for aspect j,  
 $W_{ij}$  = weight for attribute i of aspect j, and  
 $S_{ijk}$  = score for attribute i of aspect j for provider k.

The averages and ranges of scores for the aspects and for overall quality of the sample of special service providers are shown in Table 3. The values of the scores for different aspects cannot be compared (e.g., 6.7 for reliability compared with 8.3 for comfort) because the scoring functions are not necessarily on the same scale. However, the amount of variation in scores for a particular aspect is meaningful. The standard deviations indicate that providers vary the most in the extent of service they provide, in the ease of vehicle access, and in driver characteristics. They vary the least in safety, which probably indicates that all providers recognize the importance of safety. The overall score for quality varies relatively little for its size; this may indicate that providers that are poor in some aspects compensate by doing better in others.

TABLE 3 Scores for Quality and the Aspects of Quality

	Mean	Range	Standard Deviation
Quality	68.2	45.8 - 82.9	7.25
Reliability	6.7	3.3 - 8.7	1.29
Safety	7.7	4.9 - 8.7	0.86
Vehicle access	6.6	1.2 - 9.5	2.02
Driver characteristics	5.8	1.3 - 8.7	1.96
Convenience	7.5	5.0 - 9.5	1.12
Extent of service	5.3	1.9 - 10.0	2.04
Responsiveness	7.1	3.4 - 10.0	1.63
Comfort	8.3	3.9 - 9.7	1.36

#### EFFECT OF SIZE

The 42 providers in the sample were divided into three categories based on annual ridership. The boundaries of the size categories were chosen at natural break points in the sample. Table 4 gives the means of the scores for each aspect and for overall quality for each of the three groups.

It can be seen from the table that overall quality tends to increase as the size of the provider increases. Three aspects, extent of service, vehicle access, and safety, also show increased scores with increases in size. The other aspects generally do not show any tendency to vary with respect to the size of the provider.

The data in Table 4 indicate that size of service area does not have a consistent relationship with size of ridership. The data also show that larger organizations tend to have a greater percentage of

TABLE 4 Effect of Size of Provider

	Small (ridership under 15,000)	Medium (ridership between 15,000 and 50,000)	Large (ridership over 50,000)
Sample size	16	17	9
Scores			
Quality	65.9	68.5	71.9
Reliability	6.6	6.9	6.7
Safety	7.3	7.7	8.1
Vehicle access	6.2	6.6	7.3
Driver characteristics	5.7	5.5	6.4
Convenience	7.5	7.5	7.4
Extent of service	4.4	5.6	6.2
Responsiveness	7.1	6.8	7.8
Comfort	8.4	8.2	8.1
Type of organization (number of organizations)			
Public	11	11	4
Private-non-profit	4	4	2
Private-for-profit	1	2	3
Service area	560	213	558
Percent of trips by wheelchair users	3	7	13
Percent of trips provided by:			
Demand responsive	77	71	42
Subscription	13	15	37
Fixed route	6	9	9

trips by wheelchair users. Finally, larger organizations provide a smaller percentage of their service as demand responsive and a greater percentage as subscription than do the medium and small services.

Table 5 gives correlations between overall quality and individual aspects and several other characteristics of the providers. The correlation coefficients that are underlined are significant at the 10 percent level or better. The majority of the coefficients for size of ridership are positive, which corresponds with the data in Table 4. However, none of the coefficients for ridership are significantly different from zero at the 10 percent level. (The

other correlations indicated in the table will be discussed in later sections.)

Regression analysis was also used to investigate the relation of quality and size. A number of models involving various measures of size were tested. The best model was

$$\text{QUALITY} = 39.1 + 1.67 \ln (\text{RIDER}) + 13.8 \text{ DR} + 17.7 \text{ SUB} \\ (5.59) \quad (2.59) \quad (4.93) \quad (4.83)$$

$$R^2 = 0.508$$

$$F = 13.09$$

TABLE 5 Correlation of Quality Scores with Other Characteristics

Scores	Correlation Coefficients for				
	Rider <sup>a</sup>	Profit <sup>b</sup>	Public <sup>c</sup>	Productivity <sup>d</sup>	WC <sup>e</sup>
Quality of service	0.15	<u>0.28</u>	-0.25	<u>-0.38</u>	<u>0.54</u>
Reliability	-0.00	0.07	-0.13	-0.10	<u>0.43</u>
Safety	0.15	0.03	0.03	0.01	<u>0.45</u>
Vehicle access	0.05	<u>0.34</u>	<u>-0.30</u>	<u>-0.68</u>	0.17
Driver characteristics	0.11	-0.21	-0.06	-0.04	<u>0.43</u>
Convenience	-0.05	0.25	<u>-0.34</u>	0.04	0.01
Extent of service	0.23	<u>0.57</u>	-0.03	<u>-0.36</u>	0.09
Responsiveness	0.11	-0.22	0.16	0.09	<u>0.34</u>
Comfort	-0.14	0.13	-0.25	<u>-0.51</u>	0.06

Note: The correlation coefficients that are underlined are significant at 10 percent level or better.

<sup>a</sup>Rider is the annual ridership of the provider.

<sup>b</sup>Profit is a dummy variable which equals one if provider is for-profit and zero otherwise.

<sup>c</sup>Public is a dummy variable which equals one if provider is a government agency and zero otherwise.

<sup>d</sup>Productivity is average riders per vehicle hour.

<sup>e</sup>WC is a dummy variable which equals one if provider serves people in wheelchairs and zero otherwise.

where

QUALITY = overall quality score (range from 0 to 100),

RIDER = annual one-way trips,

DR = proportion of service that is demand-responsive (range from 0.00 to 1.00), and

SUB = proportion of service that is subscription (range from 0.00 to 1.00).

The numbers in parenthesis are t-values. The model and all the coefficients are highly significant (at the 2 percent level or better) and the model explains about 50 percent of the variation in quality. Although the correlation between quality and ridership was not significant (see Table 5), the natural logarithm of ridership is significant in this model at the 1 percent level. This is due partly to the effect of the mode on quality in the model and partly to the intercorrelation between size of provider and mode of service (see last rows of Table 4). The model gives a better indication of the effect of size on quality than the averages in Table 4.

The model indicates that quality increases continuously with size--rapidly at smaller riderships (under about 50,000) and more slowly at larger riderships. In addition, providers of demand-responsive service will tend to have significantly higher quality scores than route deviation or fixed-route services, and providers of subscription service will tend to have even higher scores.

The effect of demand-responsive and subscription service in the model is interesting. Demand-responsive service is defined, for this study, as door-to-door service where each trip is individually reserved. The reservation period may vary from 15 min to 2 weeks. (Separation of demand-responsive services into those with same-day reservations and those with 24-hr or longer reservations did not improve the model.) Subscription service is defined as door-to-door service with a permanent reservation. Demand-responsive service is generally considered of higher quality than fixed-route service, everything else (e.g., extent of service) being equal; therefore its role in the model is as expected. However, subscription service had been expected, because it is less flexible than demand-responsive service, to have a slightly lower coefficient than demand-responsive service. One explanation for its higher coefficient is that it generally is more efficient than demand-responsive service; savings attributable to greater efficiency may be used to increase quality in other ways.

#### EFFECT OF TYPE OF ORGANIZATION

The 42 providers were separated into public (i.e., government operated), private nonprofit (PNP), and private for-profit (PFP). Table 6 gives the means of the scores for each of the three types of organization. Overall quality tends to increase as the type of organization moves from public to private nonprofit to private for-profit, which agrees with the correlations given in Table 5. For all aspects except driver characteristics and responsiveness, the private for-profit organizations have the highest score or are tied for the highest score. For four of these, however, the differences are not great.

With regard to extent of service, there are quite large differences between the three types of organization, with the PNP organizations having the lowest scores. This is probably because many of the PNP organizations are social service agencies that pro-

TABLE 6 Effect of Type of Provider

	Public 26	PNP 10	PFP 6
<b>Sample size</b>			
<b>Scores</b>			
Quality	66.8	69.0	73.1
Reliability	6.6	7.0	7.0
Safety	7.7	7.6	7.7
Vehicle access	6.1	6.8	8.2
Driver characteristics	5.7	6.6	4.7
Convenience	7.2	7.8	8.1
Extent of service	5.2	3.7	8.1
Responsiveness	7.4	7.1	6.3
Comfort	8.0	8.7	8.7
Annual ridership	26,500	28,000	153,600
Service area (square miles)	62	468	635
Percent of trips by by wheelchair users	5	4	21
Percent of trips provided by:			
Demand responsive	78	44	59
Subscription	9	33	41
Fixed route	13	0	0

vide transportation for limited purposes, frequently to serve one program.

PFP organizations have the highest score for extent of service, which is confirmed by the strong correlation in Table 5. However, in some cases, actual extent of service for PFP providers may be limited by contractual arrangement. The PFP organizations operate by a contract or purchase of service agreement with a public or PNP agency or, sometimes, with several different agencies. The contract specifies the extent of service (e.g., geographic boundaries, hours of service) that is to be provided, which frequently is less than the extent that the PFP operator is capable of providing. When the PFP operators were scored, they were given the score for the greatest extent that they were able or willing to provide, because any limitation of that extent of service was due to the contract negotiated with the purchasing agency rather than the limitations of the operating agency. However, a user would only experience the extent of service specified in the contract. This will be discussed further in the next section.

There are also large differences in ease of vehicle access among the three types of organization. The PFP organizations apparently have the vehicles that are the easiest to access. On the other hand, the PNP organizations score lowest for driver characteristics and responsiveness to the user. Examination of the attributes grouped under these two aspects implies that PFP providers are less personal than the nonprofit providers. However, Table 5 shows that these relationships are not significant.

The for-profit organizations tend to provide many more trips per year than do the nonprofit organizations, and a greater percentage of the trips are made by wheelchair users. A large portion of the service provided by the PFP organizations is subscription. The public organizations provide mostly demand-responsive service, but they also provide a significant amount (13 percent) of fixed-route service. The private organizations provide no fixed-route service.

#### RELATION OF SIZE AND TYPE OF ORGANIZATION

As the data in Table 6 indicate, public and PNP providers tend on the average to be small, and for-



profit providers tend to be large. Table 7 is an attempt to isolate the effects of size and type of organization on quality of service by dividing the sample into nine groups, cross tabulated by size and type of organization. Because of the effect of contractual arrangements on extent of service for PFP providers mentioned previously, overall quality excluding the extent of service aspect is also included below the overall quality of service scores. The number of cases in many of the cells is too small for the results to be significant, but the table does suggest tendencies that could be checked through further research. The table indicates, as does the previous analysis, that overall quality of service increases with size and that quality is lowest for public providers and highest for private for-profit providers. However, the scores for quality of service excluding extent of service do not follow the same pattern. In this case the PNP services have the highest quality, although quality still tends to increase with size. This seems to indicate that potential extent of service is the major advantage of PFP providers over PNP providers. The public providers still tend to have lower quality of service than do private providers when extent of service is excluded.

TABLE 7 Effect of Size and Type of Provider

	All Sizes	Small	Medium	Large
All types	68.2 <sup>a</sup>	65.9	68.5	71.9
	62.6 <sup>b</sup>	61.2	62.5	65.4
	(42) <sup>c</sup>	(16)	(17)	(9)
Public	66.8	64.9	67.8	69.4
	61.3	60.0	62.0	62.9
	(26)	(11)	(11)	(4)
PNP	69.0	67.3	69.3	71.5
	65.1	64.0	65.0	67.4
	(10)	(4)	(4)	(2)
PFP	73.1	71.9	70.1	75.5
	64.5	64.0	60.8	67.2
	(6)	(1)	(2)	(3)

<sup>a</sup>Average score for quality of service.

<sup>b</sup>Average score for quality of service excluding extent of service.

<sup>c</sup>Number of cases.

#### OTHER RELATIONSHIPS

The correlations of productivity and wheelchair service to quality and its aspects were given in Table 5. There is a significant negative correlation between productivity and quality, which is primarily the result of the negative correlation of productivity with comfort, extent of service, and vehicle access. This indicates that the special services with the highest productivity (i.e., riders per vehicle-hour), have the lowest quality of service. Although data were not collected on costs for this sample, other studies (4) have indicated that services with high productivity tend to have low unit costs. The not very surprising implication is that services with high quality also have high unit costs (i.e., cost per passenger trip). The effect of demand-responsive service in the regression model also indicates that costs go up with quality because unit

cost tends to be higher for demand-responsive services (1,4).

The data in table 5 also indicate a highly significant positive correlation between wheelchair service and quality. Providers that serve wheelchair users tend to have higher levels of quality, particularly for reliability, safety, driver characteristics, and responsiveness to the users. These relationships suggest that providers of these services place a greater emphasis on quality of service than does the typical service in the sample. This confirms indications from earlier studies that operators that provide wheelchair service are often more professional (4).

#### CONCLUSIONS

This study has provided evidence that large special service agencies tend to provide higher quality of service than small agencies, particularly very small agencies, and private agencies tend to have higher quality of service than public agencies. These findings support the policies of encouraging agencies to coordinate or consolidate their services and encouraging public agencies to contract with private operators rather than operate their own services. However, the differences in quality between types of agencies, while significant, were not large, and several agencies were exceptions to these trends. It should not be expected that quality will automatically be improved by increasing size or changing the sector of provision. The quality of service of any provider should be evaluated just as total cost and productivity are evaluated.

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