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16. Abstract

This report is a step towards improving elderly and handicapped transportation service in Texas. It is organized into four sections: mobility requirements, alternatives evaluation, case studies, and conclusions and recommendations. The section on mobility classifications recommends a four category classification scheme. The alternatives evaluation section evaluates two alternatives--accessible fixed-route buses and separate specialized service--from three perspectives. Attributes of the two alternatives are evaluated from a user, provider and public point of view. Two Texas cities--Lubbock and El Paso--are studied in detail concerning operating statistics and cost.

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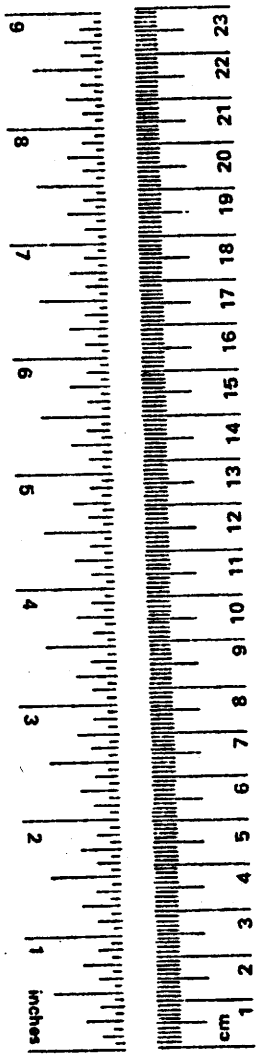
METRIC CONVERSION FACTORS

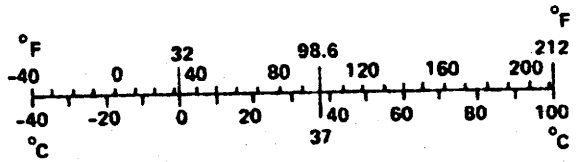
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

TRANSPORTATION OF THE ELDERLY AND HANDICAPPED IN TEXAS: A Case Study

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Study Number 2-10-78-1056

Transportation of the Elderly and Handicapped

Sponsored by the

State Department of Highways and Public Transportation in cooperation with the Urban Mass Transportation Administration

Texas Transportation Institute
Texas A&M University
College Station, Texas 77843

September 1979

DISCLAIMER

This report was prepared by the Texas Transportation Institute for the Texas State Department of Highways and Public Transportation in cooperation with the U.S. Department of Transportation, Urban Mass Transportation Administration.

The contents of the report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views of policies of the sponsors. The report does not constitute a standard, specification, or regulation.

SUMMARY

One of the needs in transit planning today is the development of cost-effective systems to meet the needs of the elderly and the handicapped. Given that 114 federal programs exist, the task is by no means trivial. This report is a step towards improving elderly and handicapped transportation service in Texas.

The report is organized into four sections: mobility requirements, alternatives evaluation, case studies, and conclusions and recommendations. The section on mobility classifications recommends a four category classification scheme. The alternatives evaluation section evaluates two alternatives--accessible fixed-route buses and separate specialized service--from three perspectives. Attributes of the two alternatives are evaluated from a user, provider and public point of view. Two Texas cities--Lubbock and El Paso--are studied in detail concerning operating statistics and cost.

Several conclusions were documented in the report. Cost savings of 10 to 30 percent appear to be possible through coordination and/or private operation. Coordination is not a natural tendency because agencies do not know costs and may not be willing to relinquish control. An incremental approach to coordination may be self-defeating because the coordinated provider is inefficient during initial startup. The study recommended development of a data monitoring system to provide uniform financial and operating information.

IMPLEMENTATION STATEMENT

The study recommended development of a data monitoring system as the basis of analyzing the effectiveness of individual providers of transportation service. Development of the data monitoring system is feasible within the content of a technical study. However, implementation of a uniform financial and operating data system will require action beyond provision of the necessary means for implementing such a system.

The ultimate implementation goal is provision of more cost-effective service. Similar to implementation of the data monitoring system, implementation of more cost-effective human services transportation appears not to be a natural phenomenon. An overall coordination function appears necessary to assure improvements. Several state agencies are attempting to improve the status quo cooperatively through the Resources Advisory Group.

The magnitude of the problem (dozens of programs, hundreds of agencies and thousands of vehicles) may require a more structured approach. At least one state, Iowa, has established regional and state clearing houses to improve cost-effectiveness. This approach does not control local programs, but does require individual agencies to show their use of resources is efficient.

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TRANSPORTATION OF THE ELDERLY AND HANDICAPPED

A CASE STUDY

I. INTRODUCTION

BACKGROUND
OBJECTIVES
ORGANIZATION

Background

One of the needs in transit planning today is the development of transportation services for the elderly and the handicapped that will maximize the effectiveness of available resources and avoid the duplication of services that has resulted in many areas because of the lack of coordination among providers. It is, therefore, necessary to better define the various transportation requirements. From this need perspective, one can then evaluate alternatives.

The magnitude of the problem is indicated in a report of the Comptroller General of the United States in which the General Accounting Office (1977) identified 114 federal programs that provide financial assistance for the transportation of people. The report stated:

> GAO did not identify any express statuatory authority or regulatory restrictions that specifically prohibit coordination of transportation resources of these programs but did identify a number of hindrances to coordination.
>
> The most significant hindrance appears to be confusion at all government levels about the extent of transportation coordination federally funded projects may engage in. The Congress should reduce this confusion by endorsing transportation coordination when feasible, providing there is appropriate cost-sharing and cost and service accountability.

Before a solution to the problem can be properly addressed, it is necessary to more explicitly define the target population. This leads to the basic questions of who are the elderly and the handicapped and what are their transportation needs. Definition of the elderly is generally straightforward with the selection of an appropriate age to use. A more difficult question is what is a handicapped person.

The U.S. Department of Transportation (1979) has provided a comprehensive definition in their final rule implementing Section 504 of the Rehabilitation Act of 1974. The definition is:

> "Handicapped person" means (1) any person who (a) has a physical or mental impairment that substantially limits one or more major life activities, (b) has a record of such an impairment, or (c) is regarded as having such an impairment. (2) As used in this definition, the phrase: (a) "Physical or mental impairment" means (i) any physiological disorder or condition, cosmetic disfigurement, or anatomical loss affecting one or more of the following body systems: neurological; musculoskeletal; special sense organs; cardiovascular; reproductive; digestive; genito-urinary; hemic and lymphatic; skin; and endocrine; or (ii) any mental or psychological disorder, such as

mental retardation, organic brain syndrome, emotional or mental illness, and specific learning disabilities. The term "physical or mental impairment" includes, but is not limited to, such diseases and conditions as orthopedic, visual, speech, and hearing impairments; cerebral palsy; epilepsy; muscular dystrophy; multiple sclerosis; cancer; heart disease; mental retardation; emotional illness; drug addiction; and alcoholism.

(b) "Major life activities" means functions such as caring for one's self, performing manual tasks, walking, seeing, hearing, speaking, breathing, learning, and working.

(c) "Has a record of such an impairment" means has a history of, or has been classified, or misclassified, as having a mental or physical impairment that substantially limits one or more major life activities.

(d) "Is regarded as having an impairment" means:

(1). Has a physical or mental impairment that does not substantially limit major life activities but that is treated by a recipient as constituting such a limitation;

(2). Has a physical or mental impairment that substantially limits major life activity only as a result of the attitudes of others toward such an impairment; or

(3). Has none of the impairments set forth in paragraph (1) of this definition, but is treated by a recipient as having such an impairment.

The definition, while extensive, is not particularly helpful in estimating the potential market for transportation services. It does not explicitly recognize the implications in terms of types of facilities the transportation agencies must provide to meet the requirements of the handicapped.

Although the U.S. Department of Transportation (1979) has recently mandated (in response to their interpretation of Section 504) that all facilities be totally accessible, it has been the position of some that an alternative specialized service better meets the needs of the handicapped. The issue is still unresolved as the American Public Transit Association (1979) has recently (June 29, 1979) filed suit in U.S. District Court to stop implementation of the U.S. Department of Transportation's final rules implementating Section 504.

Objectives of Report

The preceding discussion summarized the major issues concerning transportation of the elderly and the handicapped. The following objectives represent the specific study areas identified to meet the overall goal of providing a

cost-effective elderly and handicapped transportation system.

The specific objectives of this study are:

- Establish guidelines for use in categorizing various classes of mobility;
- Determine the specific mobility requirements for each category of mobility limitation;
- Survey at least two cities in Texas to document the needs and special requirements of each mobility class, to document the extent to which these needs and special requirements are being met, and to suggest how the various programs for special transportation can be coordinated;
- Evaluate the advantages and disadvantages of total accessibility versus equivalent mobility;
- Determine how the various state, local, federal, and private programs for the elderly and the handicapped can best be coordinated;
- Evaluate the alternative equipment presently available for elderly and handicapped transportation; and
- Provide assistance as requested by SDHPT on matters concerning transportation of the elderly and the handicapped.

A separate report (Urbanik et al., 1978) has been published, addressing the objective concerning alternative equipment. The other objectives are addressed in this final report.

Organization of Report

The report is presented in the following four sections:

- Mobility Requirements
- Alternatives Evaluation
- Case Studies, and
- Conclusions and Recommendations

The section on mobility requirements puts the needs of elderly and the handicapped into a transportation handicapped perspective. The next section concerns the two major alternatives that have been widely debated--accessible fixed-route buses and separate specialized service. In order to place the problem into practical perspective, several case studies in Texas cities are discussed. Finally, conclusions and recommendations are set forth.

II. MOBILITY CLASSIFICATION

NEED FOR CLASSIFICATION
PROPOSED CLASSIFICATION

Need for Classification

The transportation handicapped are diverse in types of mobility limitations. It is, therefore, logical that their transportation service requirements vary. Furthermore, it may be more cost-effective to provide more than one type of service to meet the needs of the transportation handicapped. Even if a single service is provided, knowledge of the number and types of limitations is essential to good planning. From the definition of functional requirements it is possible to define performance requirements of the service to be provided.

Figure 1 summarizes the procedure developed (Urbanik and Soegaard 1979) to estimate the market for transportation services for the transportation handicapped. The procedure is complicated by the need to use existing data sources. There is, however, a need for a simple classification for everyday use.

Proposed Classification

For data collection it is desirable to have a classification scheme that can be used by observation alone, yet reflects the performance requirements of an effective transportation system. Table 1 is a four-category classification that meets the proposed criteria. The classification is patterned after the one developed by the North Central Texas Council of Governments (1976).

It was found by Michaels and Weiler (1974) that 43 percent of the mobility limited population in Chicago had no limitation in the use of public transportation. A national study by Grey Advertising (U.S. Department of Transportation 1978) similarily found that 51 percent of the transportation handicapped population had little difficulty in using public transportation. It, therefore, seems appropriate to include an ambulatory as well as a semiambulatory and nonambulatory category in any classification scheme. The housebound category would implicitly not be used in categorizing transit system users.

Figure 1: Market Estimation Procedure for Transportation Handicapped by Mobility

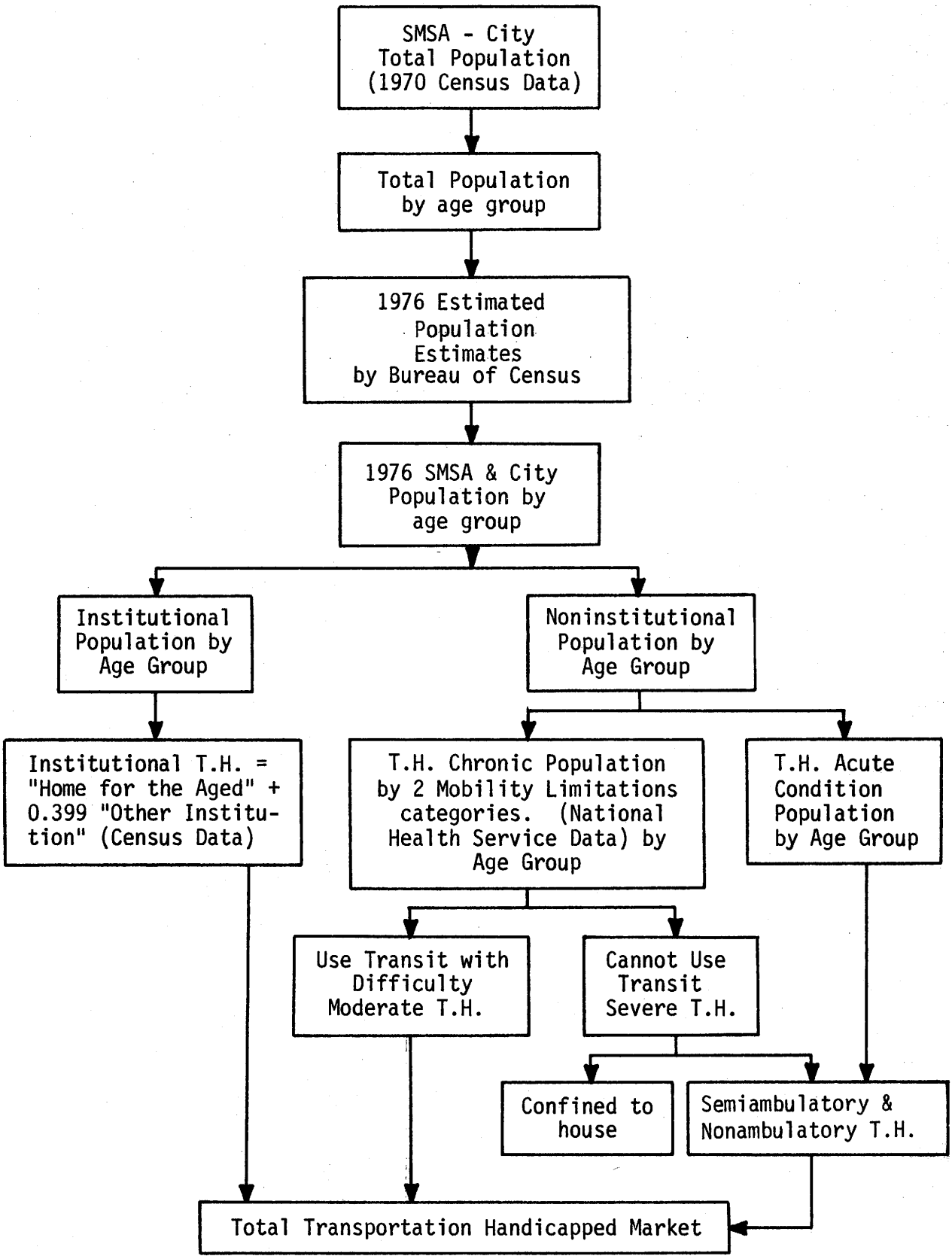


TABLE 1

Mobility Limitation Categories

Category	Description	Major Travel Disfunction
Ambulatory	Able to use existing transit facilities	No major difficulties
Semi-Ambulatory	Able to use transit if minor modifications made to vehicles, service and driver training.	Walking and climbing limitations. Communication and emotional disorders.
Non-Ambulatory	Able to use transit only with major vehicle modifications and/or personal supervision	Non-independent ambulatory and wheelchair bound. Severe retardation and emotional disorders.
Housebound	Unable to use transit	Housebound or bedridden.

Source: North Central Texas Council of Governments (1976).

III. ALTERNATIVES EVALUATION

ALTERNATIVES CONSIDERED
METHODOLOGY USED
USER ATTRIBUTES
OPERATOR ATTRIBUTES
SOCIETAL ATTRIBUTES

Alternatives Considered

This study is limited to two principal operational concepts for meeting the needs of the elderly and the handicapped. The accessible fixed-route bus alternative is the concept whereby existing fixed-route systems are made accessible by removing the barrier to entry by utilizing a device such as a lift. The second alternative is the provision of a separate specialized service. The specialized service is provided on a door-to-door basis. The analysis presented in this section of the report is aimed at assessing the equivalency of the two alternatives.

Methodology Used

Each type of public transportation service has different characteristics. The nature of these characteristics differ when viewed from various perspectives. This report will examine the two alternatives from the following perspectives:

- user or service characteristics
- provider or operating characteristics
- nonuser or community values.

The method of evaluating the characteristics that will be used in this study will be to compare the mobility provided by the alternatives.

In order to place the evaluation in proper perspective, it is desirable to explicitly specify the public policy objectives, service goals, standards and criteria to be used. Public policy has been determined by the Congress in Section 16 of the Urban Mass Transportation Act of 1964 and the Rehabilitation Act of 1973. The U.S. Department of Transportation (1979) is implementing these laws through its rulemaking authority. This analysis differs from the rulemaking in that it presumes an alternative exists to accessible fixed-route buses in meeting national policy. The final rule mandates accessible transportation. This analysis assumes a broad interpretation of the law since to do otherwise negates consideration of alternatives that exclude fixed-route accessibility. Nevertheless, the overall public policy objective is to maximize user benefits subject to minimum levels of satisfaction for providers and society in general. This goal recognizes better movement of the handicapped as the goal of transportation investments.

User Attributes

Service standards are a way to evaluate transit systems in a quantitative way. The evaluation method used in this study consists of a list of user attributes along with a corresponding performance measure. The following user (service) attributes or characteristics that will be evaluated are:

- Travel Time,
- Travel Costs,
- Safety and Security,
- Convenience, and
- Comfort.

Travel Time

Travel time is the total time between origin and destination which would be available for other purposes if the trip had not been made. For a demand-responsive system, time would start at the point in time at which a passenger had to be ready to be picked up; it would not start at the time a call was placed for service. In a fixed-route system, time would start when the passenger left for the bus stop. Time would end when the passenger reached his final destination.

Travel time is defined as access time plus running time. Access time is the time necessary to get to the transit vehicle from the trip origin and from the transit vehicle to the destination. For a demand-responsive type of specialized service, this time would be measured from the point in time at which a passenger was told to be ready until the time at which the vehicle arrives and the passenger boards. Fixed-route access time includes walking time to the bus stop plus waiting time at the stop.

Table 2 represents the values for fixed-route and specialized service access times. The table reflects different equivalencies for indoor and outdoor access time.

A ratio of transit running time to automobile running time is used to measure the running time portion of travel time. Table 3 presents the values to be assigned to the running time ratios.

TABLE 2

Rating of Transit Access Time

Value	Performance Measure
5	less than 5 min. outside, or less than 10 min inside
4	5 to 9 min. outside, or 10 to 14 min. inside
3	10 - 14 min. outside, or 15 - 19 min. inside
2	15 - 19 outside, or 20 - 24 min. inside
1	20 - 24 min. outside, or 25 - 29 min. inside
0	25 min. or more outside, or 30 min. or more inside

TABLE 3

Rating of Transit Running Time

Value	Performance Measure*
5	less than 1.0
4	1.00 to 1.10
3	1.11 to 1.33
2	1.34 to 1.50
1	1.51 to 2.00
0	more than 2.00

*Ratio of Transit to Automobile Running Time

Cost

User cost is the total anticipated expenditure for the entire trip between origin and destination and which would have been available for other purposes if the trip were not made. This is not the same cost as seen by the providers. The cost for both types of services is assumed to be the same.

Safety and Security

User safety and security is the anxiety perceived by the passenger, both as far as the mechanical hazards of the system are concerned and as far as actions by other people are concerned. Inadequate data exists to evaluate the mechanical hazards of the two alternatives. User security, however, can be estimated based on the relative exposure to other people. That is, the percentage of total travel time the user is exposed to others (e.g. walking to bus stop and waiting at bus stop). Table 4 rates the relative exposure as a percent of total trip time. It is assumed that little exposure exists while actually on the vehicle (i.e. regular bus or specialized service).

TABLE 4

Rating of Safety Factor

(Percentage of Exposure)

Value	Performance Measure
5	less than 10 percent
4	10 - 20 percent
3	21 - 25 percent
2	26 - 30 percent
1	31 - 40 percent
0	greater than 40 percent

Convenience

User convenience deals with those processes in which the user is required to perform some action on his own initiative and is responsible for its accomplishment at the proper time. This attribute includes activities such as studying the time schedule, time spent looking for the bus stop, and any other time spent familiarizing oneself with the system. Although this attribute is rated high (Haynes et al. 1977, p. 42), no performance measure has been developed to measure this characteristic.

Comfort

This attribute is the anticipated comfort or discomfort of the trip. One indication of comfort is the passenger density in the vehicle and the types of seats available. A low comfort level at a point in the trip causes a rider to judge the service as completely unsatisfactory (Botzow 1974, pp. 73-84). Table 5 presents the performance measure used to describe comfort and the corresponding value rating.

TABLE 5

Rating of Comfort

Value	Performance Measure
5	Each passenger has individual, separated seat; or each passenger has minimum of suburban-type (high-back) seat
4	One seat per passenger; parallel rows of upholstered seats, with a minimum of five sq. ft. per person
3	One seat per passenger; parallel rows of molded seats, with a minimum of five sq. ft. per person
2	Perimeter seating; or from 3 to 5 sq. ft. per person; or from 100% to 110% of seated load
1	From 111% to 125% of seated load; or two to three sq. ft. per person
0	More than 125% of seated load; or two sq. ft. or less per person

Weighting

Each indicator needs to be weighted to indicate its relative importance. Each city can have different rankings for the indicator based on the priorities and goals of the community. This study uses a set of weights developed in the Dallas-Ft. Worth area (Haynes et al. 1977) using an attitudinal survey. The weight values for each attribute used in this study are shown below:

Attribute	Weight Value
Comfort	4.246
Security	4.092
Travel time (Running time & Access time)	3.851

Results

The evaluation of the two alternatives was performed using average operating conditions of Texas transit systems whenever possible. The results are summarized in Table 6. The weighted average value for accessible fixed-route buses is 1.27; the weighted average for the specialized service is 2.77. The specialized service has a rating that is considerably better on the four attributes used. One attribute (user cost) was considered equal for both alternatives and not included. One other attribute (convenience) was not evaluated due to lack of a performance measure.

It is desirable to list the assumptions regarding the attributes that were used in the analysis above. The assumptions follow.

- Average transit operating speed is 12.8 mph (20.5 kph) (Urbanik and Soegaard 1979)
- Average specialized service operating speed is 15.0 mph (24 kph) (Crain 1978, and Ann Arbor Transportation Authority 1973)
- Average automobile running speed is 25 mph (40 kph) (Institute of Transportation Engineers 1976)
- Average walking distance is 2.25 blocks or approximately 900 feet (274 meters) (Haynes et al. 1977)
- Average walking speed (handicapped) 2.5 feet per second (0.76 meters per second)
- Average trip length 5 miles (8 km.)
- Average wait time is 15 minutes (Crain 1978 and Ann Arbor Transportation

Authority 1973)

- Fixed-route seating is forward facing in a 40 foot vehicle
- Specialized service seating is perimeter seating in a van

TABLE 6

Evaluation of Attributes

Attribute		Fixed-Route			Specialized Service		
Name	Wt.	Measure	Value	Wt. x Value	Measure	Value	Wt. x Value
Running Speed	3.851	$\frac{25}{12.8}$	1	3.851	$\frac{25}{15}$	1	3.851
Access Time	3.851	24	1	3.851	15	3	11.553
Security	4.092	$\frac{24}{44}$	0	0	0	5	20.460
Comfort (sq. feet)	4.246	5-7	3	12.738	10-12	2	8.492
TOTAL				20.440			44.356

Note: The higher the value, the better the rating.

Operator Attributes

The operating characteristics are of concern to those firms and government agencies which provide the transportation. The attributes relevant to this evaluation are:

- Revenue,
- Capital Cost,
- Operating Cost,
- Subsidy, and
- Cost-effectiveness.

These attributes have been evaluated in another study (Urbanik and Soegaard 1979) and only the results are summarized in Table 7. The results indicate that accessible buses have a lower total cost requirement, but specialized service is more cost-effective.

Evaluation of Societal Attributes

This section deals with the evaluation of those attributes of alternative transportation systems which affect individuals other than users and suppliers of transportation services. The state of the art has not advanced far enough to attempt to fit empirical data to a set of proposed measures. Only a few measures have been developed to evaluate the effects of alternative transportation systems. The following parameters were identified as relevant to the alternatives under evaluation: air pollution, noise pollution and energy consumption. These parameters will not be significantly affected in the fixed-route system since the system is already in operation and the marginal increase in transportation handicapped ridership is not enough to create a change in service requirements (Urbanik and Soegaard 1979).

The special service, however, is a new service which will generate an increase in noise and air pollution, and fuel consumption. The estimated (Urbanik and Soegaard 1979) requirements for a statewide specialized service is 480,000 vehicle hours which translates to 0.9 million gallons (3.4 million liters) of gasoline (assuming an operating speed of 15 mph [24 kph] and 8 mpg [3.36 kpl]). This is less than 0.025 percent of the 1978 consumption of 3.9 billion gallons (14.8 billion liters) (SDHPT 1978) in the study cities. It is concluded that the impact of all societal attributes is insignificant.

TABLE 7

Summary of Operator Attributes

for Texas Transit Systems (1979-1993)

Attribute	Accessible Fixed-Route Buses ($)	Separate Specialized Service ($)
Capital Cost	24,725,000	7,602,000
Operating Cost	73,545,000	155,775,000
Revenue	994,000	2,936,000
Subsidization	72,551,000	152,839,000
Net Total Cost	97,276,000	160,441,000
Unmet Demand (pass.)	5,761,000	17,140,000
Capital Cost/Pass.	4.29	0.44
Operating Cost/Pass.	12.77	9.09
Revenue/Pass.	0.17	0.17
Subsidization/Pass.	12.59	8.92
Net Total Cost/Pass.	16.89	9.36

Source: (Urbanik and Soegaard 1979)

IV. CASE STUDIES

INTRODUCTION
EL PASO
LUBBOCK
EVALUATION

Introduction

This section of the report presents some preliminary findings of a case study of specialized service for the elderly and the handicapped in two Texas cities. The two cities were selected after an extensive search of systems throughout the state. The two cities selected were El Paso and Lubbock. Lubbock was selected because an agency existed that was formed to act as a single coordinated provider of service. El Paso was selected because there appeared to be a potential for coordination of several providers.

El Paso

The population of the El Paso Standard Metropolitan Statistical Area (SMSA) is approximately 425,000 (U.S. Department of Commerce 1978). The population of the city is approximately 381,000, making it the 33rd largest city (U.S. Department of Commerce 1977) in the United States. The city covers an area of 159.5 square miles (414.7 sq km) (U.S. Department of Commerce 1975).

The City has a relatively low percentage (5.7) of residents age 65 or older and a relatively low percentage (4.0) of residents age 18 to 64 with a work disability (U.S. Department of Commerce 1971). The 1970 median family income of $7,983 is also relatively low (U.S. Department of Commerce 1971). Approximately 57 percent of the city residents have a Spanish surname (U.S. Department of Commerce 1971).

Public transportation in El Paso is principally provided by the City through the Sun City Area Transit system (SCAT). In 1978, SCAT carried 8.7 million passengers (SDHPT 1979). In 1978 SCAT instituted a demand-responsive system called HandySCAT, for handicapped persons unable to use convential public transportation.

Two other systems studied in El Paso were the City-County Nutritional Project and Project Bravo. The City-County Nutritional Project is a federally funded program of the Department of Health Education and Welfare under Title VII of the Older Americans Act of 1965, as amended. Project Bravo provides transportation in support of its Community Services Administration programs and as a contractor for medicaid transportation for

the Department of Human Resources. Each of the three services programs is described in the following subsections.

HandySCAT

HandySCAT is a special transportation service for the physically disabled citizens of El Paso offered jointly by the City of El Paso's Sun City Area Transit System and the El Paso Area Chapter of the American Red Cross. The system uses seven 10-passenger buses equipped with hydraulic lifts and wheelchair tie-downs in a 24-hour advanced call-in type of demand-responsive service. The service uses volunteer drivers supervised by a paid Red Cross staff. No fare is charged as required by Red Cross policy. The service operates Monday through Friday between the hours of 7:00 a.m. and 6:00 p.m. within the city limits of El Paso.

In order to qualify for the service a person must be certified by a personal physician or qualified social service agency using eligibility guidelines determined with the assistance of the HandySCAT Advisory Committee. No limitations with regard to income or institutional requirements are placed on the program. However, in the event of excessive demand, the following trip purpose priorities are observed.

1. Non-emergency medical and work trips.
2. Education and rehabilitation trips.
3. Personal business trips.
4. Shopping, recreation and other trips.

The overall organization is shown in Figure 1. Practically all daily operation, except maintenance, is performed by Red Cross. Maintenance is provided by SCAT. The Red Cross drivers and part-time driver coordinator are volunteers, while the rest of the staff are paid employees.

A request for service by a certified user begins with a call at least 24 hours in advance (and before 2 p.m.) to the dispatch center. Driver assignments for the following day are made in the late afternoon. The information provided to the driver includes name, address, destination, appointment time, disability, and type of trip. The driver records actual times and mileage. Information is summarized monthly.

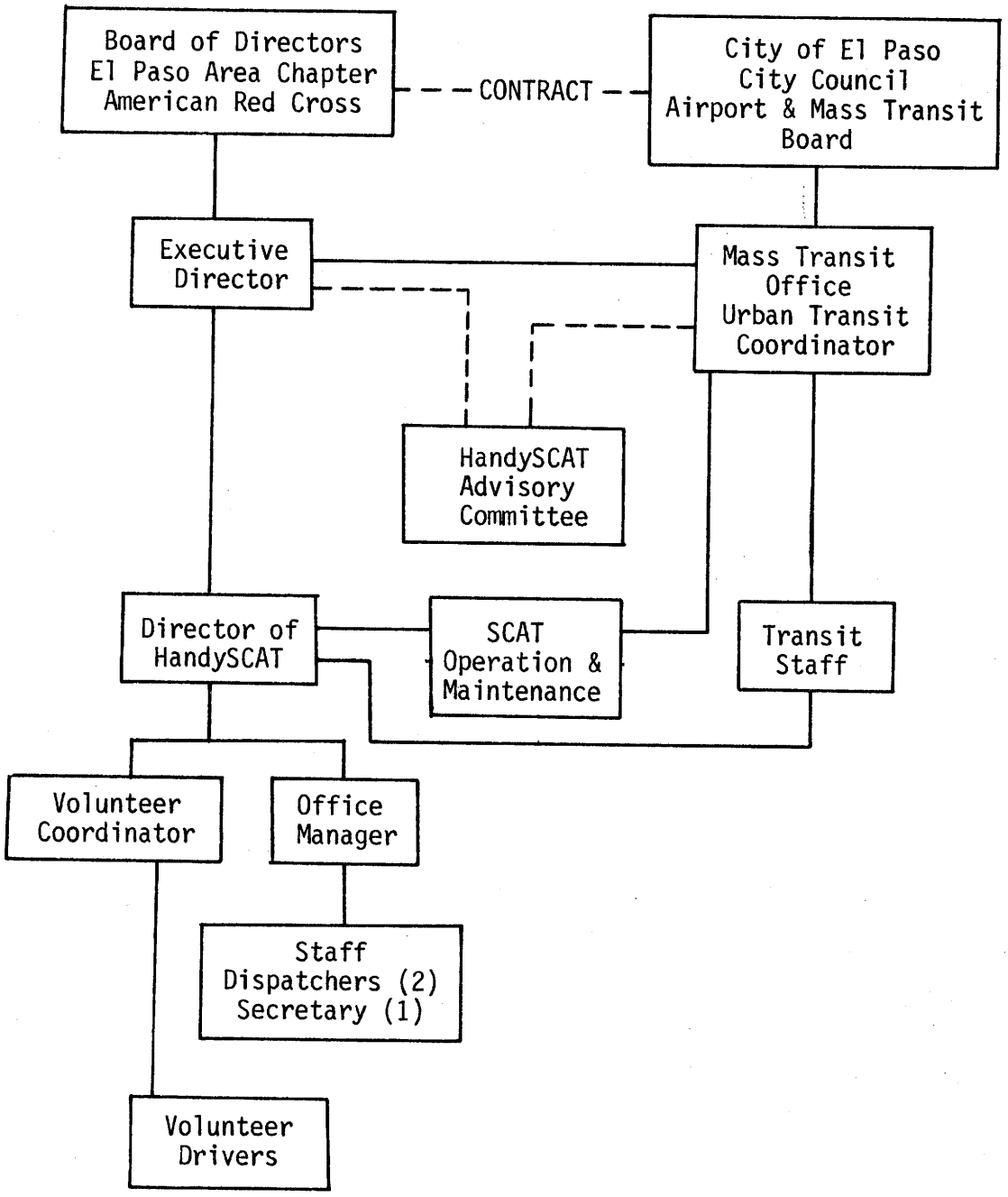


Figure 1

HandySCAT Organizational Chart

Table 8 summarizes the HandySCAT ridership statistics for the first 16 months of operation. Table 9 estimates the average total cost for the 15 months from February 1978 to April 1979. The estimate includes costs for the value of contributed services and straight line depreciation of the vehicles over their estimated 4 year life. Table 10 presents the 15 month operating statistics. The average cost per passenger is $10.14. If contributed services are deducted from total costs, the cost per passenger is $5.78 (See Table 9).

TABLE 8

HandySCAT Ridership Statistics

	1978												1979				
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	Total
Elderly – Handicapped Passengers	49	369	545	538	471	417	388	520	511	410	516	504	697	639	812	741	8,127
Non-Elderly Handicapped Passengers	281	506	725	704	749	822	825	991	1.029	1,000	871	782	925	1,098	1,126	927	13,361
Total Passengers	330	875	1,270	1,242	1,220	1,239	1,213	1,511	1,540	1,410	1,387	1,286	1,622	1,737	1,938	1,668	21,488
Nonambulatory Passengers	88	272	394	325	219	317	283	436	481	402	359	274	278	393	367	340	5,228
% of Total Passengers	27%	31%	31%	26%	18%	26%	23%	29%	31%	29%	26%	21%	17%	23%	19%	20%	24%

Source: City of El Paso, Texas (1979).

In order to compare costs with taxi fares, it is necessary to compute some additional statistics. Taxi fares are based on mileage with passengers aboard. Therefore, the term loaded vehicle-miles is used to indicate mileage with passengers aboard. Taxi fares are typically mileage based for the first passenger only. Additional passengers are generally charged an extra person charge only. It is therefore necessary to compute the number of passengers per trip.

Data necessary for computing the equivalent taxi cost are based on a one day (May 15, 1978) sample of origin and destination data. Below are the statistics for the one day.

Number of Vehicles	6
Vehicle-Miles	808
Load Vehicle-Miles	483
Number of Passengers	87
Number of Vehicle Trips	53

TABLE 9

Cost Estimate For HandySCAT

For An Average Operating Month

Transportation Costs			
* 5 Bus Drivers @ $752 per month each		$3,760.00	
* Salary Benefits 14% of $3,760.00		526.40	
Depreciation of Vehicles (7 Vehicles @ $216.67 each)		1,516.69	
Operating and Maintenance Costs			
Maintenance & Repairs	$1,093.78		
Fuel & Oil	1,202.20		
SCAT-Other Operations	351.72		
Advertising & Printing	584.97		
* Vehicle Storage (SCAT)	96.15		
Other	302.55		
		3,631.37	
* Red Cross Insurance for Vehicles and Drivers		923.00	
Radio Lease for 2 years @ $3,675/2 yrs.		153.13	
Radio Antenna Rental @ $1,210.80/yr.		100.90	
Sub Total			$ 10,611.49
Adminiatrative Costs			
Personnel:			
Salary for Transportation Director @ $11,760/yr.		$ 980.00	
Salary Benefits - 18% of $980.00		176.40	
Salary for Office Manager @ $8,350.00/yr.		695.50	
Salary Benefits - 18% of $695.50		125.19	
Volunteer Coordinator 1/2 Time @ $4,400/yr.		366.66	
Salary Benefits - 14% of $366.67		51.33	
* Bookkeeper @ $1,200/yr.		100.00	
* Fringe Benefits - 14% of $100.00		14.00	
Salary for Dispatcher @ $7,800.00/yr.		650.00	
* Fringe Benefits - 14% of $650.00		91.00	
Sub Total			$ 3,250.08
Office Operation Expenses			
Telephone and Utilities		$ 241.66	
Postage		41.66	
Supplies		33.33	
Travel and Training		54.17	
Office Space		50.00	
Sub Total			$ 420.82
Total With Contributed Services			$14,292.39
Total Without Contributed Services			$ 8,131.84

* Estimated Cost for Contributed Services

Sources:
1) "HandySCAT-The First Year-1978" publication by City of El Paso, April 1979
2) Monthly Reporting Form for Private Non-Profit Organization Receiving 16(b)(2) UMTA Funds
3) HandySCAT Budgets for 1977-1979 provided by El Paso American Red Cross

TABLE 10

HandySCAT Operating Statistics

Month and Year	Actual Maintanance Costs, $	Total Costs, $	Vehicle-Miles Traveled VMT's	Passengers	Maintenance Cost Per Vehicle-Mile (¢/Mile)	Total Cost Per Vehicle Mile ($/Mile)	Total Cost Per Passenger ($/pass.)	Vehicle-Miles Per Passenger (Mile/pass.)
February '78	1057.82	14,379.36	10,400	875	10.2	1.38	16.43	11.9
March	1637.79	13,605.00	14,828	1270	11.0	0.92	10.71	11.7
April	2031.19	13,606.25	12,927	1242	15.7	1.05	10.95	10.4
May	3015.72	14,966.98	14,168	1230	21.3	1.06	12.17	11.5
June	1507.86	13,137.64	12,268	1239	12.3	1.07	10.83	9.9
July	2213.05	13,623.95	13,552	1213	16.3	1.00	11.23	11.2
August	2200.50	14,669.32	16,644	1511	13.2	0.88	9.71	11.0
September	1998.07	13,393.01	15,122	1540	13.2	0.89	8.70	9.8
October	2863.95	14,087.89	13,484	1410	21.2	1.04	9.99	9.6
November	2266.49	14,256.51	14,531	1387	15.6	0.98	10.28	10.5
December	1730.30	12,954.24	13,264	1286	13.0	0.98	10.07	10.3
January '79	2329.05	14,496.91	16,638	1622	14.0	0.87	8.94	10.3
February	3138.26	15,068.99	16,750	1737	18.7	0.90	8.67	9.6
March	3627.98	16,484.40	18,548	1938	19.6	0.89	8.51	9.6
April	2821.60	15,655.22	15,831	1668	17.8	0.99	9.39	9.5
Average	2229.98	14,292.38	14,557	1409	15.3*	0.98*	10.14*	10.3*

Note: * Weighted Averages.

Source: City of El Paso, Texas (1979)

Miles per Trip	9.11
Passengers per Trip	1.64

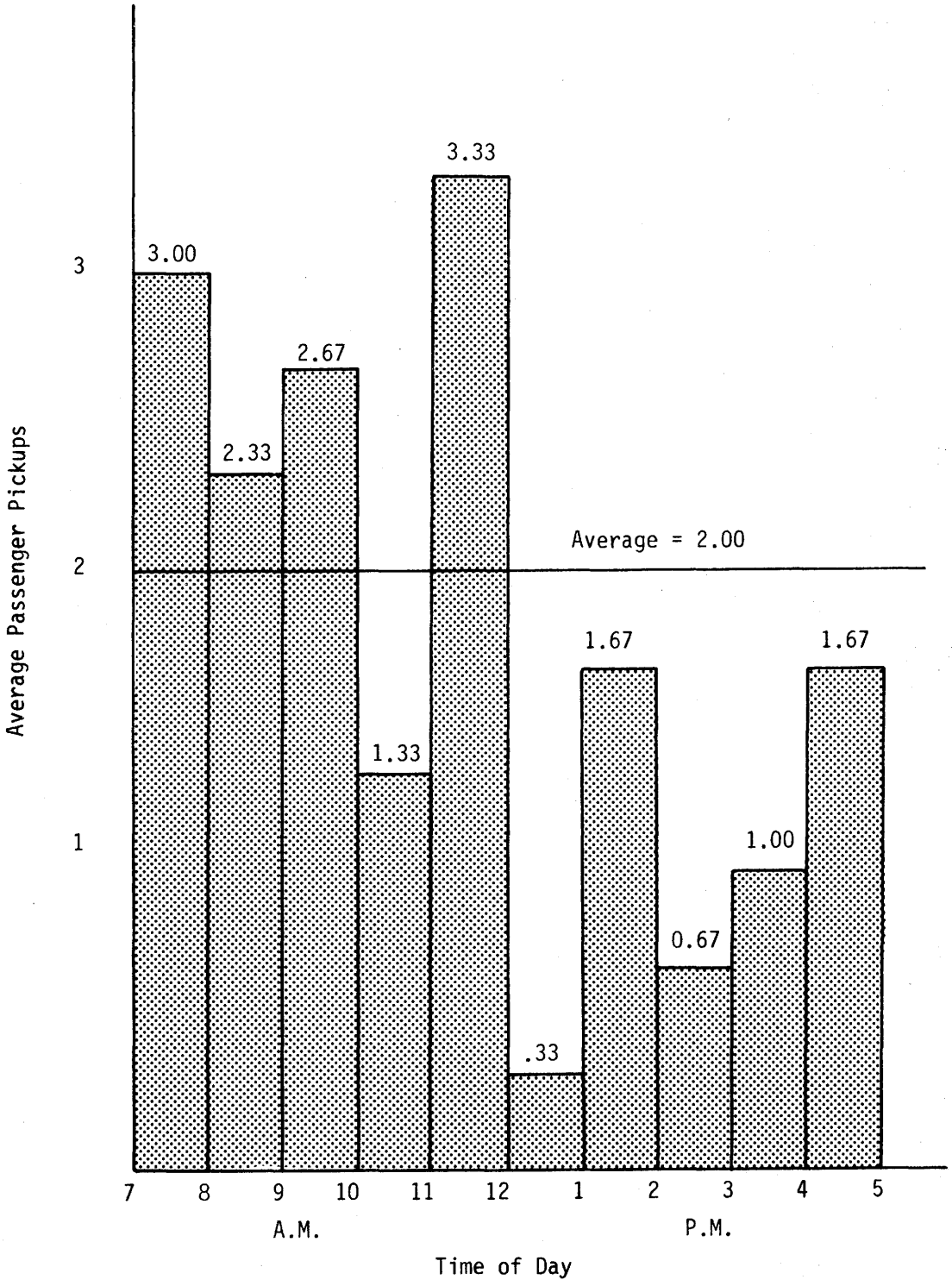
From the above data it is possible to compute the equivalent taxi cost per passenger. Taxi fares are $0.80 plus $0.10 for each one-sixth of a mile. Additional passengers are charged $0.15 per trip. Assuming 9.11 miles (14.58 Km) per trip yields an average taxi fare of approximately $6.36. This translates into an average cost of approximately $3.88 per passenger, compared with a total HandySCAT cost of $10.14 per passenger. However, the cost per passenger WITHOUT the cost of contributed services is approximately $5.78.

A definite conclusion should NOT be drawn from the above analysis. First, costs must be considered preliminary in nature due to the need to estimate some contributed services. Second, and most important, taxi service CANNOT be considered a direct substitute for the type of service being provided by HandySCAT. Third, the productivity of the system can possibly be improved. This issue will be discussed in the next paragraph. The point to be made in this preliminary analysis is that further analysis into alternative configurations including taxi operation is warranted, as is means of improving the efficiency of the present operation.

The last area to be addressed in this case study of HandySCAT is productivity. Productivity is the basic performance measure defined in this analysis as the number of passenger trips (one-way trips with each individual, even if part of a group, counted as one passenger trip) per vehicle-hour of operation. HandySCAT's productivity varies as shown in Figure 3 from nearly zero to more than 3 on one day of observation. The average for the 3 vehicles surveyed was 2 passengers per hour. The overall system productivity is estimated to be 1.6, assuming 5 vehicles operating 8 hours per day and 22 days per month. Further examination of the scheduling procedures appears warranted to determine if afternoon productivity can be improved. If afternoon productivity was increased to the morning average, the daily average would be increased 25 percent to 2.5 passengers per vehicle-hour.

FIGURE 2

HandySCAT Productivity



Project Bravo

Project Bravo is the City of El Paso's Community Action Agency. It is a public agency funded by the Community Services Administration. It is also the department of Human Resources contractor for Medicaid transportation which has priority for transportation.

The service is a 24-hour advance call-in type of demand-responsive service. The system utilizes seven 11-passenger vans, none of which are wheelchair lift equipped. Disabled clients are referred to HandySCAT. The service is available Monday through Friday from 7:00 a.m. until 5:00 p.m. No appointments are allowed after 2:30 p.m. in order to assure that all vehicles are finished by 5:00 p.m.

The operation consists of a supervisor, a clerk, a van driver/clerk and 6 drivers. The supervisor is responsible for overall operation and maintenance. The clerk handles dispatching and record keeping and the van driver/clerk assists the clerk and is also a back-up driver. All vehicles are radio equipped.

Table 11 estimates the cost for providing service in an average month to be approximately $8400.00. Table 12 summarizes the operating statistics which estimates the cost per passenger at $6.00 per passenger trip based on an average of 1396 one-way passenger trips. Total vehicle-miles (loaded and unloaded) per trip averages 6.93 (11.09 km). This is significantly less than the 10.3 total vehicle miles (16.48 km) for HandySCAT. Average productivity is estimated at 1.3 passengers per vehicle-hour (assuming 6 vehicles operating 8 hours per day and 22 days per month). Insufficient data exist to make a comparison with taxi costs. However, based on similar per mile cost ($0.87 for Bravo and $0.98 for HandySCAT) and a similar productivity (1.3 for Bravo and 1.6 for HandySCAT), it appears that Project Bravo would warrant further examination of alternatives as indicated for HandySCAT.

City-County Nutrition

The El Paso City-County Nutrition Project is a federally funded program under Title VII of the Older Americans Act of 1965, as amended. The project was established in 1973 for persons age 60 or older.

The project provides transportation to 11 senior citizen centers with the county. Lunch is provided at the centers and some lunches are delivered to homes. This report does not consider the homebound meal program.

TABLE 11

Cost Estimate For Project Bravo Specialized Transportation Services For An Average Operating Month

Transportation Costs			
4 Bus Drivers @ $540 per month each		$2,160.00	
Salary Fringe Benefits @ 18.5% of $2,160		399.60	
2 Bus Drivers @ $519 per month each		1,038.00	
Salary Fringe Benefits @ 18.5% of $1,038		192.00	
Radio Lease & Maintenance		235.00	
Depreciation of Vehicles*		835.00	
Operating and Maintenance Costs			
Maintenance and Repairs		78.82	
Fuel & Oil		538.71	
Insurance for Vehicles & Drivers**		750.00	
	Sub Total		$6,227.13
Administrative Costs			
Personnel:			
Salary for Transportation Supervisor @ $567 per month		$ 567.00	
Salary Fringe Benefits @ 18.5% of $567		104.90	
Salary for Clerk @ $470 per month		470.00	
Salary Fringe Benefits @ 18.5 % of $470		87.95	
Salary for Driver/Clerk @ $562 per month		562.00	
Salary Fringe Benefits @ 18.5% of $562		104.00	
	Sub Total		$1,895.85
Office Operation Expenses:			
Telephone & Utilities		111.67	
Postage			
Supplies		58.33	
Office Space		100.00	
Travel & Training			
	Sub Total		$ 270.00
	TOTAL		$8,392.98

Notes:

* - Estimated Value of Vehicles - $7,100 per Vehicle with an Estimated Life Expectancy of 4 years, Straight Line Depreciation
** - The Insurance Rate per Vehicle per Year is $750
*** - The Office Operation Expenses are Estimated to be About 15% of the Personnel (Administrative Costs) Costs

Source: Project Bravo data.

TABLE 12

Operating Cost Statistics for Project Bravo
for the Period Between January '79-April '79

Month	Operating Cost,($)	Total Clients	Total Pass-Trips	Total Veh-Miles	Cost Per Client ($)	Cost Per Pass. Trip ($)	Cost Per Veh-Mile ($)	Veh-Mile / Trip
Jan.	8392.98	845	1534	10,235	9.93	5.47	0.82	6.67
Feb.	8392.98	826	1427	9,717	10.16	5.88	0.86	6.81
Mar.	8392.98	838	1419	10,223	10.02	5.91	0.82	7.20
Apr.	8392.98	660	1204	8,498	12.72	6.97	0.99	7.05
Avg.	8392.98	792	1396	9,668.3	10.59	6.01	0.87	6.93

Note: Operating Cost includes vehicle depreciation

Transportation service is provided using four 55-passenger buses and nineteen 12-passenger buses (including spares).

The county is divided into areas based on the location of senior centers. The centers provide the drivers with a list of pickups for the entire week. The driver selects the route to follow in picking up passengers. Several vehicle trips are necessary to meet the demand in some cases. The many origins and a single destination make this operation inherently more efficient than the many-to-many type operation more typical of the other two El Paso systems. However, the use of a weekly schedule appears to result in an abnormally high number of no shows.

Only a limited amount of data was collected from the project. Overall, there appears to be little compatibility with the other two operations. Operating statistics collected are summarized in Table 13. Productivity is in excess of 8 passengers per vehicle-hour which is largely the result of the many-to-one operation. It should be noted, however, that based on a limited amount of observation, that some slack time exists during the middle of the day while seniors are at the centers.

TABLE 13

El Paso City-County Nutrition Project Operating Statistics for the Months March and April of 1979

(Includes 16 Vans and 2 Large Buses)

Month	Passenger	Vehicle Miles	Vehicle Hours	Gallons of Gasoline	Pass. Per Veh.-Mile	Pass. Per Veh.-Hour	Veh.-Miles Per Veh.-Hour	Veh.-Miles Per Gals.-Gas
March	23,429	24,644	2,684	3,227	0.95	8.73	9.18	7.64
April	19,841	23,081	2,440	2,410	0.85	8.13	9.46	9.56
Average	21,635	23,863	2,562	2,818.5	0.91	8.44	9.31	8.46

Lubbock

Lubbock's Standard Metropolitan Statistical Area had a 1976 population of approximately 200,000 persons according to the Census Bureau (U.S. Department of Commerce 1978). The corresponding population of the city would be approximately 166,000 persons. The city area in 1976 was 83.8 square miles (217 sq km) according to the Census Bureau (U.S. Department of Commerce 1977). The percentage of persons age 65 and older(6.0) and of persons with a work related disability(4.1) are relatively low compared to other U.S. cities (U.S. Department of Commerce 1971). The 1970 median family income was $8464 and more than 13 percent of the families had an income below the poverty level (U.S. Department of Commerce 1971).

Citibus, Lubbock's Transit System, transported approximately 2.3 million passengers in 1978 and operated 960,000 vehicle-miles of service (SDHPT 1979). The average number of buses on regular routes is 26 (SDHPT 1979), although the city owns 25 twenty-one passenger vehicles and 17 large (40 or more passenger) transit buses (Urbanik and Soegaard 1979). The bus system is operated by Lubbock Transit, a subsidiary of American Transit Corporation under the administration of the Lubbock Transit Department of the City of Lubbock. The 1978 operating expense was approximately $993,000 (SDHPT 1979). It is estimated (Urbanik and Soegaard 1979) that 3 percent of the city residents are transportation handicapped with 21 percent of the transportation handicapped being semiambulatory or nonambulatory.

Citizens for Improved Transportation

Citizens for Improved Transportation (CFIT) was organized in April 1976 with the goal of providing coordinated transportation for the elderly and the handicapped. The organization was chartered in May 1977, making interagency coordination possible. The existence of CFIT makes it possible to delineate the problems involved in implementing and operating a coordinated human services transportation system.

CFIT's vehicles include 2 buses (24 and 28 passengers), 3 regular vans and one lift-equipped van. In addition, CFIT provides scheduling and dispatching of Citybus' lift-equipped bus. Both lift-equipped vehicles operate a 24 hour advance call-in requirement. The two buses and three vans operate in a prescheduled semifixed-route service principally for the City's Title VII nuitrition program. CFIT also provides a limited number of trips. to several other agencies including LAERS, and Easter Seals.

The CFIT staff consists of an executive director, a dispatcher, a part-time bookkeeper; and 5 to 7 drivers. The demand-responsive service is scheduled at the end of the previous day and given to the driver in the morning. The semifixed-route service is scheduled by the various centers the previous day and given to the driver.

The cost estimate for CFIT is shown in Table 14. Using the cost data and operating statistics, it is possible to compute the unit costs as shown in Table 15. In the month of April, CFIT carried 1800 one-way passenger trips in the semifixed-route service and 290 passenger trips in the demand-responsive service (including Citibus' lift-equipped vehicle). These 2090 riders translate into a cost per passenger of $4.06. However, the cost for the lift service is $11.04 per passenger while the semifixed-route service costs $2.94 per passenger.

The estimated productivity, assuming 6 vehicles operating 8 hours per day and 22 days a month, is 2.0 passengers per vehicle-hour. The productivity of the two lift-equipped vehicles is 0.8 passenger per vehicle-hour while the semifixed-route service productivity is 2.5 passengers per vehicle-hour.

The CFIT records for the demand-responsive portion of the service allows direct computation of loaded vehicle-miles, which numbered 756 in April 1979. Loaded vehicle-miles per trip were 4.0. Furthermore, the number of passengers per loaded trip was 1.5. From this data it is possible to compute an equivalent

TABLE 14

Cost Estimates for Citizens for Improved Transportation, Inc. (CFIT)

for an Average Operating Month

Item	Maintenance	Total Operation	Fixed Route	Specialized Service
TRANSPORTATION COSTS				
6 Bus Drivers @ $616 per month each (1)		$3,696.00	$2,464.00	$1,232.00
FICA @ 6.13 of $3,690		226.50	151.04	75.52
Depreciation of Vehicles (6 @ $114.85 + 1 @ $260.42(2))		949.52	574.24	375.28
Operating and Maintenance Costs				
Maintenance & Repairs	$218.42		140.36	78.06
Fuel and Oil	525.00		315.00	210.00
Vehicle Equipment & Registration	24.27		16.17	8.10
		767.69		
Bodily injury insurance on 6 vehicles @ $5,000 per year		486.12	324.12	162.00
Sub Total		$6,125.89	$3,984.93	$2,140.96
ADMINISTRATIVE COSTS				
Personnel:				
Salary for CFIT Director @ $9,600 per year		$ 800.00	$ 533.33	$ 266.67
Salary Benefits 20% of $800		160.00	106.67	53.33
Salary for Dispatcher @ $8,100 per year		675.00	225.00	450.00
Salary Benefits 20% of $675		135.00	45.00	90.00
Bookkeeper @ $2.90 per hour, 4 hrs per day		255.20	170.13	85.07
FICA @ 6.13% of $255.20		15.64	10.43	5.21
Sub Total		$2,040.84	$1,090.56	$ 950.28
Office Operation Expenses:				
Office Rent @ $200 per month		$ 200.00	$ 133.33	$ 66.67
Telephone		51.02	34.00	17.02
Office Supplies & Postage		56.23	37.49	18.74
Travel & Training		27.75	18.50	9.25
Sub Total		$ 335.00	$ 223.32	$ 111.68
Total		$8,501.73	$5,298.81	$3,202.92

Notes:

1) Includes cost of Handibus driver which is paid by Lubbock Transit
2) Depreciation cost of Handibus owned by Lubbock Transit

taxi fare. Effective May 1, 1979, the Lubbock taxi fare was $1.00 plus $0.70 per mile plus $0.25 for each additional passenger. Cost per trip would be $3.92, and cost per passenger would be $2.61. Again it must be noted that taxi service is not a direct substitute for handicapped service.

Department of Human Resources

For comparison purposes, it is interesting to look at the cost data from the Department of Human Resources which uses Yellow Taxi to provide medicaid transportation in Lubbock. The following costs are for the period October

TABLE 15

Summary of CFITS' Operating Statistics for

the Month of April 1979

Type of Operation	Total Cost ($)	Vehicle Miles	Passenger Trips	Cost per Veh-Mile ($/Mi.)	Cost per Pass-Trip ($/pass)	Veh-Mile/ Pass-Trip (Mi/pass)
Centers and Special Trips	5299	3889	1800	1.36	2.94	2.16
Handibus and Lift Van	3203	2164	290	1.48	11.04	7.46
Total System	8502	6053	2090	1.40	4.06	2.90

1978 through April 1979. During that period the taxi fare was $0.90 plus $0.60 per mile plus $0.25 per trip for each extra person. Effective May 1, 1979, the taxi fare is the one previously mentioned.

The total cost of medicaid transportation during the period was $28,556 for 9,527 one-way passengers using 34,258 loaded vehicle-miles. Cost per passenger trip was $3.00. Based on a one-month sample of the data, the average number of passengers per vehicle trip was 1.17. The average loaded vehicle trip was 4.2 miles.

Evaluation

Although the scope of the case studies is limited in both number of agencies and locations surveyed, it is possible to estimate the potential benefits from coordination. Several scenarios are suggested as possible means of improving operations. First, it is suggested that HandySCAT and Project Bravo could be combined into a single operation. For the purposes of this analysis, the fact that Red Cross uses volunteers is ignored since this is not typical of most operations.

Both Project Bravo and HandySCAT operate similar services in terms of type of operation. Their scheduling and dispatching are generally the same, yet each operation has a director, dispatcher, bookkeeper and a clerk. If it is assumed that only one set of administrative and office personnel are required (i.e., economies of size exist), the cost of the operation would be reduced 10 percent. It is likely that economies of size would be less as the operation was further increased in size. That is, the percentage reduction would be smaller as the operation was increased in size. Another potential efficiency exists. With twice as many vehicles operating in the same area, some efficiency is possible through an increase in productivity. It is not possible with available data to estimate that potential.

As indicated earlier in the data for HandySCAT, the number (18 percent) of nonambulatory persons is a relatively small percentage of the total users. According to the National Survey of the Transportation Handicapped by Grey Advertising (U.S. Department of Transportation 1978) only 5.5 percent of the transportation handicapped use wheelchairs. It is, therefore, reasonable to conclude that only a small percentage of persons cannot use taxicabs as a means of transportation. The potential savings in cost is dependent on how the nonambulatory clients are handled.

The available data to analyze the potential savings using taxicabs is limited by the lack of separate operating statistics for nonambulatory clients. It is, however, possible to estimate the maximum potential savings. The present total monthly HandySCAT cost averages $14,300. If all trips could be handled by taxi, the cost would be approximately $5,500. The difference, $8,800, is the amount available to cover excess costs of nomambulatory service above normal costs. This is approximately $50 per hour.

One alternative would be to pay the taxicab company a flat rate, for example $15 per hour, to have a driver to handle wheelchair clients. To this cost would have to be added the cost of the vehicle. At 20¢ a mile and 15 mph the hourly cost for the vehicle would be $3.00 resulting in an $18 per hour total cost. A potential savings of perhaps 33 percent exists under the assumptions given. However, given that HandySCAT presently uses volunteers, no savings is possible under the above assumptions.

Data for Lubbock's CFIT allowed computation of an $11.04 cost per passenger for the two lift-equipped buses as contrasted to a $2.61 taxi fare. The difference in cost per month is approximately $3200 per month. Using the assumption

as before of an $18 per hour total flat rate, taxi service would result in no savings over the present operation.

The preceding analysis indicates a limited amount of cost saving that might accrue under the above scenarios. The conclusions are limited by both the data base and the necessary assumptions. Nevertheless, some potential does exist. Whether or not the potential can be realized is also a difficult question. As costs, especially for fuel, increase, the need to consider cost saving approaches may increase. The actual potential of alternatives identified would depend on local conditions.

V. CONCLUSIONS AND RECOMMENDATIONS

It is not startling to conclude that the financial and operational data available for evaluation are extremely limited. The principal function of most agencies is other than transportation. Transportation is considered as a subcomponent of their principal programs and therefore is molded around the adminstrative structure developed for their principal programs.

Given the nature of the data used (due to rudimentary accounting systems, varying definitions, and limited operating data), conclusions concerning coordination must be considered tentative. It appears that some amount of savings, perhaps 10 to 30 percent, might be realized by consolidating providers and/or using private providers such as the taxi industry. This conclusion must be further qualified in that the comparison is based on existing levels of efficiency. Similar savings might be possible through improved efficiency.

Coordination is not a natural tendency among providers, even when a separate agency for the express purpose of providing coordinated service exists. There are at least two reasons that could be given to possibly explain this failure to coordinate. The noncoordinated agency does not, as previously indicated, know its true cost so it is unlikely to be willing to pay the true cost. The second supposition is the agencies would not want to give up control even if they could reduce real costs.

Another conclusion concerning coordination is that an incremental approach may be self-defeating. The coordinated provider, during the initial startup phases is also an inefficient provider. If the coordinated provider has to charge full cost, there is no incentive for others to coordinate. It should be noted that this was not the case with CFIT. CFIT has other funding that allowed it to charge only marginal costs. This was not sufficient to overcome resistance of some other agencies to coordinate.

From the above conclusions it is recommended that development of a data monitoring system for use by the various providers be undertaken. The system would provide uniform financial and operating information. The system would provide standard financial and operational definitions. It would resolve the problem of accounting for vehicle depreciation. In essence, it would provide a means to analyze the alternatives for which only tentative conclusions could be reached. Further recommendations cannot be strongly supported without this basic data.

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