USE OF SMALL BUSES FOR FIXED ROUTE SERVICE IN SMALL URBAN AREAS

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(The opinions, findings, and conclusions expressed in this report are those of the authors and not necessarily those of the sponsoring agencies.)

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SUMMARY

The deteriorating financial conditions and service levels of both public and private transit systems in Virginia's small urban areas have led the operators of these systems to question the desirability of continuing to operate them in their present forms. With many 40-50 passenger vehicles being operated at less than half capacity for extended periods of time, one of the more pressing questions before these transit operators is that of whether they should replace all or part of their fleets with smaller vehicles to achieve more efficient operations and services. Very little meaningful guidance in this regard existed in the transportation literature, therefore the research reported here was undertaken to determine the feasibility of using small buses for fixed route transit service in small urban areas.

The report identifies many characteristics of small vehicles and relates the experiences of several small bus operations. Also, the potential uses of small buses in fixed route service in small cities are presented. The report concludes that there is presently no single vehicle appropriate for all applications of bus transportation in small urban areas as the requirements vary from one city to another according to such factors as demand in service levels, economic conditions, management arrangement, geography, and weather. In view of the findings presented in the report, it has been recommended that the officials contemplating the establishment of a small bus system conduct detailed investigations to determine how well small vehicles will fulfill their needs.

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INTRODUCTION

With renewed interest in mass transit as a result of environmental concerns and, more recently, the energy crisis, many small cities in Virginia are examining their public transportation resources. In most cases, these examinations have revealed a common situation—public transportation in Virginia's small urban areas is either nonexistent or in such poor condition that a massive influx of capital, nearly equivalent to that required for new systems, would be necessary to restore their vitality. For all practical purposes, the small city desiring to provide public transportation must create a new system. Already facing serious budgetary difficulties, most small cities are deeply concerned with finding an economical and efficient means of meeting their public transportation requirements, and this concern has prompted a great deal of interest in all transit modes that have the potential to fulfill the public transportation needs of the small urban area.

Among the possibilities being considered is the use of small (approximately 20-passenger capacity) buses in a fixed route, fixed schedule type of service similar to that provided by large buses throughout the country. Because of strong sales efforts and the inability of large bus transit to survive in small urban areas, this is an attractive transportation mode to small cities.

Despite the fact that until recently there has been little demand for small vehicles, there are many more manufacturers of small buses than there are of full-size buses. While many of the small vehicles are similar, some have distinguishable characteristics. No single vehicle is appropriate for all applications and an operator must analyze a large number of variables before determining the type of vehicle most suitable for his particulare use. The officials in many small areas lack expertise in this area and they are seeking assistance in evaluating how well small buses can serve their needs.

PURPOSE AND SCOPE

The purpose of this study was to make a preliminary investigation into the feasibility of using small buses for fixed route transit service in small urban areas and to provide the findings of that investigation to cities desiring guidance in this area. Many characteristics of small buses have been delineated and, where applicable, operating experiences have been compiled. The reader should interpret these with care. Because of the recentness of the

introduction of the small bus concept, only a small amount of literature and data pertaining to the vehicles and operating expenses are available. Furthermore, the nature of this study was such that the adverse aspects of the service surfaced to a greater degree than did the satisfactory aspects, although efforts were made to obtain a balance between the two. Finally, as with any new product, the manufacturers are continually making modifications and improvements to their vehicles and all of these may not be cited in this report. Consequently, the findings merely illuminate some of the issues to be further investigated in the vehicle selection process and are not intended to be utilized as a basis for purchase decisions.

The information contained in this report was obtained from literature, bus operators, the American Public Transit Association, bus manufacturers, and officials in all levels of government.

CHARACTERISTICS OF SMALL BUSES

The small bus is commonly confused with the passenger van vehicle. The small buses referred to in this report usually have greater seating capacities than do passenger vans and, as shown in Figure 1, they resemble conventional buses in appearance. A review of their pertinent characteristics has been conducted and is presented in this section.

Figure 1. A typical small bus.

Body Design and Construction

Although there is a resemblance in the appearance, the design and construction of buses vary widely. Full-size transit vehicles are characterized by their unitized construc-

tion; that is, the body and chassis are designed as one unit. This type of construction provides a long life under stop and go transit operations, as well as a fairly smooth ride. A number of small buses are constructed in a similar manner; however, the majority are constructed by placing a body on a seperately constructed truck chassis. Manufacturers utilizing components have attempted to select those that can withstand the rather hard use transit vehicles undergo due to frequent stopping and large gross vehicle weights. To lower the weight, many bodies are made of aluminum, which also contributes to a longer body life.

One major concern noted by some users of small buses, was the high interior noise level. One manufacturer has provided better insulation for the engine compartment, while another obtained decibel readings that indicated the small vehicles were not noisier than regular buses. Apparently, public expectations of the small buses caused the vehicles to seem noisier.

Capacity

A small bus will accommodate from 13 to 30 passengers depending on the size, seating arrangement, and manufacture. The seating capacity appears to be very flexible. Many operators who purchased buses with the standard seating arrangement have increased the seating capacity by the installation of perimeter seating, while others, especially those offering dial-a-ride service, have removed seats to alleviate crowded conditions.

Most of the manufacturers offer a lift and/or ramp for wheel chairs as special equipment. Of course, the "handicapped vehicles" do not have as many seats as the conventional bus and the additional equipment may cost up to $7,000.

Size

One of the major advantages of the small bus is its size. The length ranges from about 20 to 27 feet and the wheel base varies from 133 to 159 inches, depending upon the make and model of the vehicles. These dimensions allow turning radii between 20 and 30 feet, which is the main source of the improved manueuverability which allows operation in areas that are not acceptable for full-size buses. These areas include shopping centers and apartment complex parking lots, and many residential streets. Furthermore, the small size makes them less objectionable for use within these areas as their appearance is important in attracting passengers who might have negative feelings toward the standard size buses.

One of the earlier models had an interior head room of only 68 inches. This was the source of many passenger complaints and now the majority of the small buses have interior heights within several inches of those provided by the standard size buses.

Weight

Small buses range in weight from approximately 4 to 6 tons, which is substantially lighter than standard size buses. The weight reduction can be of great importance when providing service over facilities such as parking lots and residential streets where the existing pavement design will not support heavier vehicles. Because of the lighter weights,

the small buses generally have good acceleration and deceleration. Although the weight has been kept to a minimum, there are reported cases where the chassis has not been capable of supporting the body of the vehicle.

As mentioned earlier, many manufacturers utilize truck chassis and many of the spring suspensions have been unsatisfactory. Recently, some manufacturers have begun using an air suspension system similar to those used in full-size buses, which should result in a smoother ride. Also, a number of axles have been bent because of the weight of the vehicle.

Power Plants

Internal Combustion Engines

The majority of small buses are powered by fossil fuels such as gasoline and diesel oil burned in internal combustion engines. Gasoline engines are standard on all small buses with the exception of one diesel powered foreign-made vehicle and two newly developed electric vehicles. On many models diesel engines are available as options. Some manufacturers will convert gasoline engines for propane or natural gas operation.

The many years of engine experience in the heavy truck industry reveals that the diesel engine is superior to the gasoline engine. Usually gasoline engines require extensive repairs or replacement before 100,000 miles of travel. Diesel engines tend to be less polluting, more economical, and are often preferred by transit operators who have had experience with full-size diesel power transit vehicles. Fuel mileage for gasoline engines has varied from 4 to 8 miles per gallon with 5 to 6 miles per gallon being most typical, whereas the fuel consumption for the diesel engine has varied from 7 to 15 miles per gallon.

The major disadvantages of the diesel engine are the added weight, high noise level, and exhaust odor. Also, serious difficulties have been encountered in starting the diesels during cold weather.

There are cases where a gasoline engine may be more desirable, the most notable being when the bus service is operated at a garage which maintains a substantial number of gasoline powered trucks and automobiles. If the truck fleet engines have been standardized and buses can be obtained with that type of engine or a similar one, the advantage of a shared spare parts inventory and the availability of mechanics familiar with the engine may outweigh the advantages of the diesel engine in service.

Electric

A recent development in the small bus field, and one which deserves an examination, is the emergence of electric powered small buses. While these power systems have had little in-service testing, operating experiences have confirmed many of the advantages which intuitively appeared characteristic of electric transportation.

Information obtained from the most significant electric small bus operation in this country indicates that the fuel cost of operating small electric buses are competitive with those for several of the conventional powered small buses in use. Records of the Long

Beach Transportation Authority, which operates three electric vehicles in a downtown service, shows a fuel consumption rate of approximately 2.24 kwh/mile. The price of electricity in Virginia is approximately three cents per kilowatt, therefore the fuel cost of a similar operation would be approximately 6.7 cents per mile. This figure would be comparable to that for a conventional small bus system utilizing gasoline engines and fuel, priced at fifty cents per gallon, and averaging 7.5 miles per gallon.

There are many favorable arguments for the electric powered small bus. It's quiet, pollution free operation does much to improve the perceived quality of transportation as well as the perceived quality of the environment in which the service is provided. The multiple sources for electric power give the electric bus a distinct advantage over petroleum-dependent, conventionally powered vehicles. In addition, most battery charging can be performed at night when electric utilities have excess capacity in power production.

The major disadvantages of the electric powered bus have not been effectively evaluated. The need to exchange the batteries as often as every four hours has been cited by traditional operators as a problem, however, the manufacturers claim that it is easily surmounted. Electric powered buses also appear to be somewhat inferior in performance characteristics when compared to other small buses, although this drawback may be insignificant in some applications where the acceleration, top speed, and maneuvering characteristics of the electric bus will be able to meet the demands of the service. To date there have been no operations of electric buses large enough to permit a valid evaluation of these and other possible disadvantages.

Image

The image of public transportation portrayed by a small bus can be of great value. While it will not attract riders by its mere presence, a small bus does have an image which can be effectively marketed to attract riders and maintain public support, especially if the small buses are used in a new, well designed transit system. Although increases in ridership are more dependent upon service improvements than upon the buses themselves, the buses become symbols of the improvements. The general public senses that a small bus should minimize the amount of subsidy, and the fact that small buses look fuller when they carry the same number of people also presents an image of efficiency. The small bus seems less out of place in a small city than does a large bus, and the fact that it is smaller tends to reduce the number of citizen complaints about buses rumbling through the neighborhoods.

Furthermore, the passengers find small buses to be a refreshing change from the large buses used in standard transit operations. Most of the vehicles are attractive and comfortable, which is not surprising since particular attention is given to these amenities by both the manufacturer and operator. The size of the vehicle stimulates interaction among the passengers and, more important, between the driver and passengers. Since the riders feel comfortable talking to the driver, they are more likely to request and receive assistance from him. Passengers such as heavy laden shoppers and children, with extraordinary needs, are also handled effectively. The user's easy access to the driver's attention reduces the fear of being stranded or misplaced by the system and thus increases confidence in it.

A high level of interaction also has disadvantages and may not be desirable in some instances. There is a question of safety if the driver's attention to the road is constantly diverted by a talkative passenger. Additionally, there is a chance of an obnoxious rider disrupting the entire bus, although this possibility is somewhat restrained by the driver's ability to confront the problem passenger in the closer environment.

Maintenance

Maintenance is usually the make or break item in a small bus operation and none of the vehicles reviewed in this study were totally free of problems. No single vehicle has proven to be clearly superior to the others.

Most of the maintenance problems experienced by operators of small vehicles relate to the fact that vehicles not designed specifically for transit operation have been placed into transit use. Foremost among the problems are braking difficulties. Often the brakes have not been large or powerful enough for stop-and-go transit operations. Also, many small buses use hydraulic rather than air brakes, which results in faster wear. Other common problems encountered include: (1) short transmission life; (2) air conditioning and heating failures; and (3) engine mounts and axles breaking or bending under heavy loads.

Only a small number of unconventional power plants, that is propane and natural gas engines and electric motors, have been used; therefore, no reliable maintenance data were available. Insufficient time has elasped since the introduction of these power plants to permit an evaluation of the useful life, maintenance costs and minor design defects. The manufacturers are continually improving these products and it appears that they will be competitive with conventional power plants in the future.

Regardless of the power plants used, the successful small bus operations are characterized by good preventive maintenance programs and drivers who are able to identify and alert mechanics to problems before they become serious. The maintaining of vehicles in top condition is not only an important factor in avoiding costly repairs, but is essential also from the standpoint of reliability. Gaps in service resulting from vehicle unavailability destroys the rider's confidence in a transportation system.

Cost

It is a popular misconception that the major reason for the use of small buses is economics; that is, that small vehicles are more economical to operate than full-size buses. Due to the limitations of the data, definite conclusion cannot be made relative to the cost of operating small bus fleets; however, the following general statements are offered for consideration.

Capital Costs

The lower capital cost of small vehicles is a strong incentive for their use. While the initial cost is dependent upon several factors such as the special equipment options selected and quantity of buses ordered, most small buses cost within the $15,000 to $30,000 range. The prices are especially attractive to the bus operator who is expanding or creating a system and desires to maximize the quality of service.

The cost of small vehicles should not be discussed without considering the durability of the vehicle; therefore, the cost per unit service life is the proper index in comparing the various sized buses.

Although it was originally estimated that the life of many small buses would be in the 15 to 20 year range, experience has shown that 5 to 10 years is generally regarded as the expected useful service life. For many models, the actual service life is closer to the 5 year estimate than it is to 10 years. In some city operations, the service life frequently falls to 4 years or less.

If the yearly capital cost, i.e., the depreciation and interest charges, is considered, the difference between the different size buses is not as great as one would expect. A full-size bus may cost $50,000, but is designed to last up to 20 years and 1,000,000 miles. A small bus can cost $25,000 and last 6 years and 300,000 miles. Assuming a straight-line depreciation and 8% financing, the annual capital costs would be approximately $6,500 and $6,200 for the full-size and small buses, respectively. Thus, the differences in the cost per unit of useful service are not as significant as the initial cost indicate. For this reason, serious consideration should be given to the service life or durability of the vehicle before making a selection of the type of bus to use in the transportation system.

Operating Costs

A considerable part of the expense of operating a bus is not a function of the vehicle itself. In most operations, 50% to 70% of the operating cost consists of the drivers' wages and benefits. Frequently, it has been argued that this fact makes any savings obtainable by using a small bus insignificant since "the driver costs the same." While this notion has widespread acceptance, it is not based on factual data. The operation of a small vehicle is less demanding upon the driver than is the operation of the full-size bus, therefore, the wages could possibly be different. Although the effect of unionization must be considered, it was noted in a Washington, D. C. suburb where both small buses and standard transit buses are operated by different agencies that the driver wage rate for the small vehicle was lower than that for the full-size buses.

The majority of the remaining operating expenses can be contributed to fuel and maintenance costs, which are directly dependent upon the vehicle being used. While some of the small buses have obtained better fuel milage than have standard transit vehicles, others have not. In addition, the maintenance problems encountered by many of the small vehicles have resulted, in general, in high maintenance costs. Thus, some small buses may in fact be as costly to operate as a full-size transit vehicle. Operating costs data of several bus operations are shown in Table 1, where small bus cost information from cities throughout the country are compared with that for standard transit bus operations in similar cities in Virginia. This information should be considered approximate as accounting practices, particularly the depreciation and administrative salaries, make exact comparisons impossible. It does appear that the operation of small buses in small urban areas is slightly cheaper than the operation of a standard transit bus system.

Table 1

Operating Cost Figures

Bus Size / City Size	Small Bus	Standard Transit Bus
Small	Evansville, Indiana,[a] $.49/mi. Lafayette, Indiana, $.405-.435/mi. Westport, Conn., approx. $.60/mi.	Charlottesville, Va., $.83/mi Danville, Va., $.63/mi. Staunton, Va., $.77/mi.
Medium	Rochester, N.Y., $.78/mi. Orange County, Calif., $1.10/mi.	Richmond, Va., $1.08/mi. Norfolk, Va., $1.16/mi.
Large	Washington, D.C., $2.33/mi.	APTA #1[b] $1.33/mi. APTA #2[b] $1.22/mi.

SOURCES: Individual operators and reports filed with the Virginia Department of Highways and Transportation and the American Public Transportation Association.

(a) Evansville, Lafayette, Westport, Rochester and Orange County figures are current as of 1975. All others are 1974.

(b) From operating information of two large East Coast cities near Virginia furnished to APTA.

Availability

The availability of small buses is more important in analyzing why small cities have purchased them than in analyzing how they have performed. Frequently, small cities have been required to provide public transportation because private operators have discontinued service, and the fact that small buses could be obtained quickly was the decisive factor in purchasing them. One of the major selling points used by small bus manufacturers is that the vehicle can be delivered for service within a few months. If a city is heavily subsidizing an operating private concern until new buses arrive, the delay required to obtain full-size buses could be very costly. The subsidy payments could possibly be enough to justify the purchase of small buses to provide service over an interim period while plans for a final system are formulated.

PRIOR USES OF SMALL BUSES IN FIXED ROUTE SERVICE

In assessing the proper uses for small buses in public transportation, it was important to review their past performances in transit systems. This examination was not only valuable in reaching conclusions about small buses, it was helpful to an understanding of the opinions of the people in the transit industry relative to small buses and how those opinions were formulated.

Downtown Shuttle Experiences

In the early 1970's small bus advocates urged their use in special downtown services in large cities, services catering to the needs of shoppers and businessmen in the downtown area. Many of the experiments of that time generated negative attitudes toward small buses, especially among transit system managers and management firms. While the operations were not examples of small bus functions in small city environments, they did serve as a basis of opinion for many bus system operators whose advice was requested by small cities considering the purchase of small buses for use in their communities.

For a shuttle service, the small bus possesses a few characteristics which make it superior to a standard bus but many of its characteristics are inferior. The package laden shopper enjoys the comfort and convenience of the peripheral seating arrangement available on many small buses and the interaction with other passengers; however, there is little difference in the travel times of the various size buses. Although the small bus is easier to maneuver in heavy urban traffic than the standard transit bus, the total advantage of this characteristic cannot be obtained because route speed and vehicular flow are governed by the adjacent traffic and traffic control devices.

The major problems encountered with small buses in shuttle service are with the vehicles. The stop and go travel is demanding and, as mentioned earlier, the small vehicle has been plagued with transmission, suspension, brake, engine mount, and air conditioning failures. Many of the mechanical problems have involved weeks for repairs and thus the vehicles were out of service. Unfortunately, the service became unreliable and the public lost confidence in the system.

The above is not to imply that small buses should not be considered for shuttle service. The transportation needs vary among localities and all parameters should be reviewed when selecting the type of vehicle to fulfill the demands of a community. It is important to remember that most transit system managers and officials of transit management firms are relying upon experiences from large cities for their information on small buses, not upon experiences where the small bus was used in a small city. It is these small city experiences which are of great relevance to cities in Virginia.

Small City Demonstration Projects

Small buses began to appear in the transportation systems of small cities in the late 1960's. Generally, their appearance coincided with the disappearance of privately operated transit systems, and they were financed by the municipalities involved. The idea of using

small buses appeared to have merit when considering the low ridership encountered by the private firms.

Two of the first demonstration projects that analyzed the potential for using small buses for public transportation in small urban areas were conducted in Rome, New York, and New Castle, Pennsylvania. The final report covering the project in Rome revealed that revenues never reached 50% of those projected before the project began, and despite vigorous promotional campaigns it was concluded that the system was utilized only by persons who were not able to use another mode.

The New Castle project consisted of little more than substituting one large bus with a small vehicle while maintaining the same headways. With this type service, it was not surprising that the findings of the study revealed that the exclusive use of compact buses would not satisfy ridership demands and increase patronage. Since few efforts were made to increase the quality of service by operating at shorter headways, there was a greater possibility of the buses being overcrowded during peak periods. Under these conditions it was concluded that it would be advantageous to solve the capacity problem by going back to the standard transit buses.

The results of both of these demonstration projects strengthened the objections of bus operators and transportation consultants to small buses. This was indeed unfortunate because much of the disparagement can be attributed to the early timing of the projects. Being forerunners of the small bus movement, they were equipped with some of the earlier small bus designs and at a time when the demand for bus transportation was low. In the New Castle project there was little need for bus transportation as an automobile could be operated anywhere in the city without stress and parked easily at a cost which was not prohibitive.

During the past three years the popularity of the small buses has increased, however, most of the increase can be traced directly to the sales organizations of various small bus manufacturers. Many buses have been placed in demand responsive systems that do not operate on a fixed route and therefore were not included in this study. Of those being utilized in fixed route service, many have been plagued with mechanical problems and have thus provided a low level of service. Several systems are currently being evaluated and the findings should be forthcoming in the near future.

Factors of time and distance precluded observations of small city-small bus operations, but information on these experiences was obtained by telephone and personal conversations. Many manufacturers provided announcements that certain cities had purchased buses, but rarely did this information deal with the experiences of the small buses in service. The telephone interviews and manufacturer literature must be considered of limited value, however, they do indicate many significant characteristics of small buses used in small urban areas. A comparison of the reported characteristics revealed many similarities relative to the performance of the vehicle. The major differences among the small city operations were due mainly to differences in management attitudes and policies.

The successful small bus operations appeared to be the ones in which the operational characteristics were well suited to the service being offered. Many of the unsuccessful operations resulted from a failure either to realize the limitations of small buses or to take advantage of the useful characteristics.

POTENTIAL USES OF SMALL BUSES

It has been noted that no single vehicle is appropriate for all applications, and in fact several different sizes of transit buses may be required to fulfill the needs in the small city. Matching a vehicle fleet to the specific requirements of the service area is a choice of major importance, especially in view of the characteristics previously described. In the following sections, potential applications of the small buses in small urban areas are reviewed.

Minimal Service With Low Demands

In many small cities, the public transportation demands are usually low as the private modes accommodate the majority of the needs. In this situation the small bus should be considered by the cities desiring to provide a minimal level of public transit service for the persons without transportation. The capacity of the small vehicle should be such as to satisfy demands and the operating cost of the service should be lower than that of standard size transit buses. The perceived quality of service should be higher due to faster speeds, improved image, and the personalized service provided by a small bus.

Maximum Service Through Growth

If a city desires to continually expand its transit system to meet and further stimulate demand, the small bus is well suited to its needs. Starting with a skeleton service, such as hourly headways, additional buses can be added to expand service as the demand dictates. In this manner, the system would be continually improved in quality until further improvements would be of questionable value; for example, headways less than 10 minutes would probably be considered unnecessary. Since the small bus is the cheapest way of providing bus transportation on a per bus basis, it is the best vehicle for the type of system where service quality improvements have a high priority. The advantage of developing a transportation system in this manner is that service can be maximized while the capital cost required to support the service is minimized. The objective is to get people out of their cars rather than simply to accommodate the present public transit demand at minimal cost.

New Transportation System

In the case of a small city initiating a public transportation system, the small bus offers the cheapest means of providing a given level of service. Since demand estimates for public transportation are expensive to secure and often inaccurate, the demand can rarely be measured until a system is initiated. Should the demand in one or more areas of the city exceed the capabilities of the small buses, additional buses may be added or larger buses can be substituted. On the other hand, if the new system fails, then the capital expenditures for small buses are much less than those for standard size buses. Whether the system succeeds or fails, the officials have attempted to conserve funds, an effort that usually minimizes adverse public reaction.

When the Standard Bus is Unsatisfactory

In some small cities, the maneuverability and small, unobtrusive nature of the small bus have permitted fixed route transit service that would have been impossible with a standard transit bus. In these cities, the small bus has been routed through residential areas and other parts of the city where either physical obstacles or public opinion would not allow the operation of a large bus. These systems have competed with the automobile by providing the residents of the city easy access to public transportation. This service, successfully designed, has provided an alternate mode for many of the trips and thus has eliminated a family's need for a second car.

In this type of service the bus stops for hailers, and also lets people off anywhere along the fixed route. It has been successful in many small cities. Although these type systems have not required extensive subsidies, many cities appear skeptical about the possibilities of their being successful in their particular communities. The lack of evidence that this type of service would work in a particular city is probably the main reason that other small cities have been reluctant to establish public transportation along these lines.

CONCLUSIONS

It was found in this study that there is no ideal vehicle for all applications in fixed route bus transportation in small cities. Because vehicle requirements vary from one city to another according to such factors as demands in service levels, economic conditions, management arrangements, geography, and weather; vehicle selection is not a straightforward process. Even after a determination that small buses are the proper size vehicles for specific requirements, the selection of the make and model of the vehicles is a choice of great importance, especially in view of the fact that all vehicles have inherent problems of some sort.

The small size transit buses have been in use for only a few years and, unfortunately, mechanical difficulties have contributed to the failure of many small bus demonstration projects. It wasn't until the recent increase in the demand for small vehicles that there was an incentive for small bus manufacturers to develop a superior vehicle. The manufacturers are now responding in terms of both an increase in the number and type of small vehicles available and in improvements to the existing vehicles. If this response continues, much improved small transit vehicles should be on the market in the near future.

The officials of a city contemplating the establishment of a small bus system and the purchase of small vehicles should thoroughly review the experiences of other agencies operating a fleet of small buses. A partial list of small vehicle operators is in the Appendix. The majority of the information contained in the listing was provided by the vehicle manufacturers or distributors.

RECOMMENDATIONS FOR FURTHER RESEARCH

Small buses appear to be a feasible means of public transportation in small urban areas under some circumstances. Because many questions about their effectiveness remain

unanswered, additional study is necessary. A final evaluation of the potential uses of small buses in Virginia should be based on the results of a demonstration project. Recommendations for further research are given below.

1. Research should be conducted relative to the specification and design of small transit vehicles in an effort to alleviate maintainance problems and extend vehicle service life.

2. Aspects such as economics, levels of service, and travel times should be evaluated as each is dependent upon the other and each contributes much to the success or failure of small bus transit systems. These aspects of small buses should be compared to those of standard size buses.

3. Techniques and methodologies for improvements of small bus transit such as incentive ridership programs, marketing management, and system monitoring and evaluation procedures should be designed and evaluated.

4. Community benefits such as reduced congestion through increased use of mass transit and the smaller size transit vehicles, reduced parking space demand in the central business district and residential areas, conservation of fuel, and reductions in air and noise pollution warrant further evaluation and study.

1934

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1936

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APPENDIX

VEHICLE USER LIST

Vehicle	City or Operator
Flxible Flxette	Racine Flash Transit, Racine, Wisconsin
	City of Aurora, Aurora, Illinois
	Bloomington Bus Company, Bloomington, Minnesota
	City of Elgin, Elgin, Illinois
	City of Amarillo, Amarillo, Texas
	City Bus Lines, Washington, Pennsylvania
	Twin Cities Area Metropolitan Transit, Commission St. Paul, Minnesota
	City of Evansville, Evansville, Indiana
	Batavia Bus Service, Batavia, New York
	Columbia Association, Columbia, Maryland
	J & J Transportation, Fairmont, West Virginia
	Continental Air Transport, Chicago, Illinois
	United Transportation, Inc., Columbus, Ohio
	Greater Pittsburgh Airport, Pittsburgh, Pennsylvania
	Blue Line Sightseeing Co., Inc., Washington, D.C.
	Texas Medical Center, Houston, Texas
	Crystal City Marriott Hotel, Alexandria, Virginia
Grumman	Grand Rapids Transportation Authority, Grand Rapids, Michigan
	Chemung County Transit Authority, Elmira, New York
	William Bus Line, Buffalo, New York
Mercedes	Morgantown, West Virginia
	Town of Bramalea, Ontario
	Haddonfield, New Jersey
	New Orleans, Louisiana
	Miami, Florida
	Fairmont, West Virginia
	Bloomington, Indiana
	Hertz Corporation, Chicago, Illinois, and Alexandria, Virginia
	Airport Shuttle, Inc., Wilmington, Delaware
Minibus MBS	Southern California Rapid Transit District, Los Angeles, California
	City of Menlo Park, California
	City of Burlingame, California
	City of Lincoln, Nebraska
	Economy Jitney Service, Bahamas
	Yellow Cab, Edmonton, Canada
	Rowe, New York
	Kansas City International Airport, Kansas

2000

Twin Coach TS-25	State of New Jersey, DOT, Trenton, New Jersey City of Richmond, Indiana Denver Metro Transit, Denver, Colorado City of Helena, Montana D. C. Transit, Washington, D.C. City of Worcester, Massachusetts Valley Transit District, Ansonia, Connecticut Massachusetts Bay Transportation Authority, Boston, Massachusetts City of Lansing, Michigan City of Lafayette, Indiana Tri State Transit Authority, Huntington, West Virginia Town of Chapel Hill, North Carolina City of Ashtabula, Ohio City of San Mateo, California