REPORT NO. UMTA-MA-06-0049-78-6

Service and Methods Demonstration Program

ANNUAL REPORT

July 1978

U.S. DEPARTMENT OF TRANSPORTATION
Urban Mass Transportation Administration
Office of Transportation Management and Demonstrations
Washington, D.C. 20590

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UMTA-MA-06-0049-78-6		

4. Title and Subtitle	5. Report Date
SERVICE AND METHODS DEMONSTRATION PROGRAM ANNUAL REPORT	July 1978
	6. Performing Organization Code
7. Author(s): Don Kendall et al.*	8. Performing Organization Report No.: DOT-TSC-UMTA-78-33
9. Performing Organization Name and Address: U.S. Department of Transportation Research and Special Programs Administration Transportation Systems Center Cambridge MA 02142	10. Work Unit No. (TRAIS): UM827/R8712 11. Contract or Grant No. 13. Type of Report and Period Covered: FINAL REPORT Oct. 1976 - Sept. 1977
12. Sponsoring Agency Name and Address: U.S. Department of Transportation Urban Mass Transportation Administration Office of Transportation Planning Management and Demonstrations Washington DC 20590	14. Sponsoring Agency Code

15. Supplementary Notes

*Mark Abkowitz, Robert Casey, Carla Heaton, Marian Ott, Elizabeth Page, Grant Paul, James Poage, Simon Prensky, Howard Simkowitz, Howard Slavin, Robert Waksman

16. Abstract

This report contains a description of the Service and Methods Demonstration Program for Fiscal Year 1977. Program activities and accomplishments are reviewed, including current and future demonstration project descriptions, project findings, and other support activities.

Results of demonstration projects and studies leading to or in support of demonstrations are summarized. Areas where there are gaps in the understanding of innovative concepts are mentioned, together with future projects aimed at obtaining necessary experience to arrive at more conclusive understanding of the applicability and potential of these concepts. Other activities carried out in support of the demonstrations are reviewed, such as the development of structured approach to project evaluations, studies of independently initiated local innovations, and the information dissemination program.

17. Key Words	18. Distribution Statement
Urban Transportation, Transportation for Handicapped and Elderly, Demand Responsive Transportation, Bus Priority, Innovative Transportation Projects, Transit Demonstration Projects	DOCUMENT IS AVAILABLE TO THE U.S. PUBLIC THROUGH THE NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VIRGINIA 22161

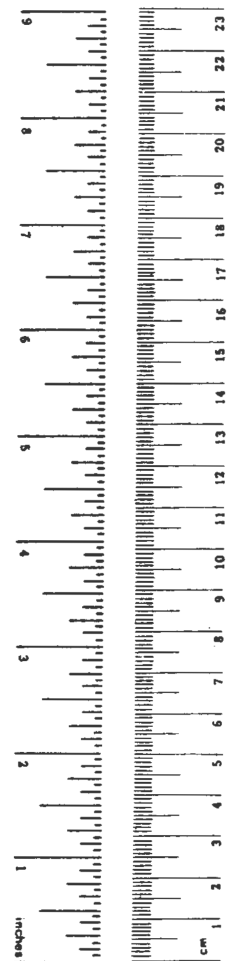
19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	342	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

METRIC CONVERSION FACTORS

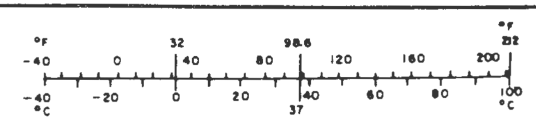
Approximate Conversions to Metric Measures

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



PREFACE

Information exchange on a timely basis is of crucial importance to the Service and Methods Demonstration Program activities. One element in that effort is an annual accounting of the results of the previous years' activities in both sponsoring local innovations in public transportation and monitoring related local initiatives. It is hoped that bringing this together in one annual source document will aid transportation policy formulation at local, State, and Federal levels. This is the third year that an annual report of program activities has been published.

This annual report is developed for the Service and Methods Demonstration (SMD) Program by the Office of Systems Research and Analysis at the Transportation Systems Center. It is prepared in close collaboration with SMD Program staff, various private contractors retained to carry out specific research and evaluation tasks, and local staff directly involved with the innovations being reported. It is important to note that operational demonstration projects represent a cooperative effort in policy research among State, local, and Federal levels of government. At the State and local levels, there are usually several different public agencies involved with the implementation and operation of a demonstration under the leadership of a lead local agency. It is clearly not a unilateral Federal effort, but an effort that depends heavily on State and local initiative. The SMD Program is very appreciative of the many partnerships it has formed with State and local innovators and the courage and competence they are exhibiting in the testing of the many project concepts under consideration in the program. Often there is controversy and political risk associated with these tests until the fears as to what might be an outcome are replaced by actual positive results. Our hope is that these vanguard efforts will benefit all those interested in urban public transportation improvements.

Ronald J. Fisher
Director, Office of Service
and Methods Demonstrations

ACKNOWLEDGMENTS

The authors wish to acknowledge the contributions of the organizations acting as evaluation contractors - Applied Resource Integration, Inc.; CACI, Inc.; Cambridge Systematics; Charles River Associates; Crain and Associates; Deleuw, Cather and Co., Inc., Multisystems, Inc.; and SYSTAN, Inc., for their assistance in providing project status information and photos used in this Annual Report. Special credit is due Larry Englisher of Multisystems, Inc., and Richard Kuzmyak of Charles River Associates, Inc., for their contribution to Chapters 4 and 5, respectively.

In addition, the authors wish to thank Ronald Fisher, Director of the UMTA Office of Service and Methods Demonstrations, and the following members of his staff for their guidance during the preparation and review of this report: Bert Arrillaga, James Bautz, Larry Bruno, Mary Martha Churchman, Paul Fish, Marvin Futrell, Joseph Goodman, Vicenzo Milione, and Lynn Sahaj.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

The UMTA Service and Methods Demonstration (SMD) Program addresses the national need to improve the quality, quantity, and efficiency of public transportation services by sponsoring the development, demonstration, and evaluation of innovative transit operating techniques and services which utilize existing technology. The SMD Program also has the goals of reducing institutional and regulatory obstacles to transit innovations and improving transportation for the transit dependent.

The basic premise of the Service and Methods Demonstration activity is that much better performance of existing urban transportation systems can be attained through the imaginative use of traffic management, pricing and marketing techniques, transit service variations and state-of-the-art technology. The demonstrations are intended primarily to develop public transportation improvement models, and then to bring about their widespread adoption in conjunction with other UMTA efforts and DOT programs. The program has very high payoff potential with respect to efficient improvements in the quality of transit service and is directly supportive of the Transportation Systems Management Element (TSME) of the joint planning and programming regulations issued by UMTA and FHWA. Further, the program supports the major National goals of improved air quality and energy conservation.

The SMD program was established in 1974 to provide a consistent and comprehensive framework within which to formulate, implement, and evaluate demonstration projects. In years prior to the SMD Program, UMTA demonstration projects were hampered by a lack of a coordinated set of program goals and a procedure for disseminating project findings. Consequently, prime consideration has been given to increasing the effectiveness of demonstration projects, resulting in the development of a structured approach to the evaluation and dissemination of demonstration findings. This is expected to improve greatly the utility and impact of SMD Program activities. The following objectives were established to guide the SMD program and provide a focus on those areas where transit improvements are most urgently needed. They are attainable by virtue of actions taken as part of demonstration projects, and support the overall goals cited above.

a) Reduce travel time by transit.

This is an important factor in increasing transit ridership and improving vehicle productivity.

b) Increase the area coverage of transit service.

This is important for increasing transit ridership, yet responding with cost-effective approaches to public pressure for new transit service in our lower density suburban and non-urbanized areas.

c) Improve the reliability of transit service.

This is one of the most important factors in maintaining and increasing ridership.

c) Increase the productivity of transit vehicles. This is most important in the continuing struggle to reduce operating deficits while maintaining or improving service.

e) Improve the mobility of the transit dependent.

The development of promising techniques to achieve this is necessary to respond to increased pressure to provide mobility to people without automobiles.

Demonstrations of innovative concepts that support these objectives are actively sought by the program. New ideas are usually first analyzed in feasibility studies which may lead to the design of an experimental demonstration. Application of concepts in different size cities or with variations that appear to be warranted are generally necessary to understand how and under what conditions a viable concept has the most potential.

Both large and small communities are encouraged to consider submitting a proposal for SMD Program funding of an innovative transit service. One of the criteria for site selections is the likelihood of continuation of the service after demonstration funding is terminated and the potential for expansion, under local initiative, into a broad program of service improvements. For operational tests of ideas that are more experimental in nature, there is less expectation and less weight in funding decisions given to whether the services or methods implemented will be continued beyond the completion of the demonstration.

Over 36 demonstration project grants have been awarded since the inception of the SMD program in 1974. Ten of these projects have been completed, and, as of the end of FY77, 24 demonstrations are currently underway or in the final implementation stages. In addition to operational tests, many studies of new concepts have been conducted to determine feasibility and identify important issues. Research has also been undertaken to develop and improve methodology for planning and evaluation of transit services.

The immediate impacts of demonstration projects upon the quantity and quality of urban transit are threefold: (1) innovative concepts tested in demonstration projects have been replicated in other cities; (2) specific features of a demonstration are adopted by other localities to improve services, reduce costs, etc.; and (3) findings from studies and project evaluations have been used in the planning process to provide better estimates of the local transportation service requirements, costs, and impacts.

This report contains a brief summary description of the activities and accomplishments of the SMD program during FY 1977. Emphasis is given to highlighting the services and methods being tested, the gaps that still exist in our understanding of their effectiveness, and the direction of future efforts to fill these gaps. Project findings are organized into four generic program areas: (1) Conventional Transit, (2) Pricing and Service Innovations, (3) Paratransit, and (4) Special User Groups.

CONVENTIONAL TRANSIT SERVICE INNOVATIONS

Conventional transit service innovations are those that improve the effectiveness and efficiency of fixed-route, fixed-schedule transit. These techniques should have the impact of increasing transit and other high occupancy vehicle use in lieu of auto travel as a result of improved transit travel time, coverage, and reliability. SMD projects within this program area are grouped into four categories: (a) priority techniques for high-occupancy vehicles (HOV's), (b) downtown traffic improvements, (c) schedule and service coordination, and (d) vehicle innovations.

HOV Priority Techniques

During the past decade, many HOV priority treatments have been shown to be effective in reducing transit travel times in congested corridors. Demonstrations of these techniques, reported in FY75 and FY76 SMD Annual Reports, include busways, contra-flow lanes, and ramp metering with preferential entry. Other similar treatments, about which less is known, are being examined in current demonstration projects. These include concurrent flow freeway lanes, express lanes on arterials, and traffic signalization strategies.

The future of physically non-separated concurrent-flow reserved lanes on freeways remains in doubt. An SMD demonstration project in Los Angeles (Santa Monica Freeway) and a locally initiated project in Boston (Southeast Expressway) have been terminated as a result of strongly adverse public reaction stemming from the removal of an existing freeway lane and restricting its use to HOV's. SMD evaluations of these two projects also reveal other major problems:

1) The potential for accidents is higher due to lane changes and the large speed differential,

2) The high number of violations and difficulty of enforcement; and

3) The negative impact on auto speed and travel times.

Unfortunately, these problems overshadowed the improvements in travel time and reliability experienced by HOV passengers and the fact that increases in transit patronage and carpooling did occur. The increased transit ridership appeared to have been as much a result of increases in coverage and schedule frequency as it was influenced by travel time and reliability improvements.

Where a concurrent flow reserved lane is added or dedicated at the opening of a new freeway, the prosepcts for public acceptance and increases in vehicle occupancy are much greater. In Miami, where a reserved lane in each direction was added to the I-95 freeway, all users benefited from decreases in travel time and a 14 to 28 percent increase in person throughput was achieved.

It appears that concurrent-flow non-separated reserved lanes can be beneficial in situations where an existing lane is not removed from general use. If there is a large imbalance in peak directional flows, then contra-flow or reversible lanes are more appropriate.

Bus-priority treatments for major arterials were also tested in the Miami project, along the same corridor as I-95. Traffic signal preemption by buses and signal progression were tried, with buses traveling both in mixed traffic and on a reversible-median reserved lane. It was found that each of the techniques caused a reduction in bus and auto travel times on the arterial (NW 7th Avenue). Signal preemption together with the reserved-bus lane produced the lowest bus-travel times. Signal preemption requires more service and maintenance than signal progression, and in most cases, signal progression would be preferable for express buses in arterial streets.

The violation rate on the reserved arterial-median bus lane was not excessively high. Although auto accidents were not affected by the priority system, bus accidents increased substantially during the early stages of the reserved lane, and decreased somewhat as drivers became more experienced in using the reversible lanes.

Manuals have been developed to aid localities in planning applications of proven HOV techniques. Cities which stand to benefit from these improvements, but have been slow to adopt them, are being selected as sites for the demonstration of HOV treatments. The Manuals will be used in the design and implementation of these projects.

<u>Auto Restricted Zones</u>

Auto restricted zones (ARZ), which are areas in which auto traffic is restricted or prohibited, are a promising means of revitalizing the downtown environment by improving traffic conditions and pedestrian access. A feasibility study completed in FY 1977 concluded that there are substantial opportunities for ARZ's in the United States, and a wide range of elements such as peripheral parking, ring roads, and linear transit malls that can be tailored to the site and local objectives. It was also determined that while city size is not critical to the viability of an ARZ, a strong activity base is required, and accessibility to and within the area is a crucial component.

ARZ Demonstration designs are being prepared for five sites: Times Square (NYC), Boston MA, Memphis TN, Providence RI, and Burlington VT. These projects will provide an opportunity to test the ARZ concept in different urban environments and with considerably different design approaches.

Transit malls typically involve restricting autos on a downtown street and adapting it to pedestrian and transit traffic. They have already been constructed in a number of cities, and the SMD program has conducted a study of malls in six U.S. cities to document costs and impacts and provide information regarding the applicability and potential benefits to other areas. The findings of the study suggest methods of phasing and relocating facilities which minimize the impacts of construction on the activities in the area. In general, the malls were found to have a very positive impact on the vitality of the area, including retail business and pedestrian accessibility. Traffic diversion has not caused congestion on alternate routes, and transit service and use have improved. Fewer violations of traffic restrictions occurred in and around malls with exclusive transit use of the roadway, as compared to malls with partial auto access.

<u>Transit Schedule and Service Coordination</u>

One of the major reasons for the decline of transit patronage over the last few decades has been transit's inability to compete with the auto in terms of the quality of service and convenience. Another reason has been the vast development of low density suburban communities and the inherent problems in providing transit service to these areas.

A comprehensive study of transit service reliability has recently been conducted. Major findings include the following:

1) There is considerable evidence that travelers perceive reliability to be a major determinant of their travel choices. In making both mode and trip departure time decisions among other factors, travelers are likely to trade off shorter travel times and improved reliability based on their preferences and the available alternatives.

2) It is evident that a variety of transit operator decisions influence the reliability of bus service, thus impacting operating costs and revenues. Although many operator decisions involve implicit tradeoffs among travel times, travel time components, and reliability, these decisions are based primarily on maximizing schedule adherence and do not take account of traveler's preferences.

3) Factors which are both inherent in transit modes and environmental factors, such as traffic congestion and demand variations are natural causes of service reliability problems. Basic techniques for improving service reliability include priority schemes, control strategies, and structural changes in service provision, as well

as changes in routes, schedules, and driver/vehicle allocations.

4) There appears to be considerable potential for obtaining improvements in the reliability of transit service in a wide variety of contexts.

New techniques are being developed to improve transit service. Timed Transfer Focal Point is a method of improving route coordination and reducing transfer time by modifying transit service. Routes intersect at activity centers and schedules are coordinated so that buses arrive simultaneously at transfer points, reducing transfer wait time. This technique, which is employed successfully in the Canadian cities of Vancouver and Edmonton, has been analyzed prior to its use in demonstration projects aimed at improving suburban bus service. It was found that the concept can lead to reduced travel times for riders between widely scattered origins and destinations, and that the location of the transfer point and facility design are major determinants of service efficiency and operating cost. Many questions remain regarding the potential applicability of timed transfer, and a demonstration in FY 1978 will further test its operational feasibility.

Beltway bus service, which also addresses the need for better service for suburban residents, is being analyzed prior to operational test. In cities with circumferential freeways, or beltways that ring the urban area, there is potential for providing transit service where almost none exist, by modifying the freeway interchange areas to permit easy transfer between intersecting routes.

Zoned bus service, a technique for reducing the complexity of the route structures of large urban bus systems, will be demonstrated. Because of the large number of routes and corresponding schedules, infrequently made trips are complex and often require access to an array of system-wide route and schedule information. A zoned bus system of trunk and feeder routes would be easier to understand and could reduce travel time as well because of the higher frequency of service on the trunk line. However, one of the possible drawbacks is the inconvenience of the transfers required between feeder and trunk lines, and a demonstration will explore the tradeoffs among number of transfers, travel time saving, and ease of use.

Vehicle Innovations

Occasionally, situations arise when transit vehicles need to be tested in a different application or environment to determine how the public will respond and how the vehicles are received by the transit operator. Even though a vehicle may be in revenue service in other countries, transit providers may be reluctant to risk committing scarce operating funds on it; i.e., in the absence of comparable operating experience that reflects such factors as maintenance requirements and public acceptance.

The application of double deck buses represents an example of this situation. They had been out of service in the United States for so long that transit companies were uncertain as to the public response and how well they would perform, also their acceptability, maintenance, safety, security, etc. However, they provide increased capacity at a less than proportionate increase in operating cost, making them an economically attractive vehicle for use on routes marked by heavy demand.

Two demonstrations of double deck bus service were completed in FY 1977: British Leyland buses (capacity: 83 passengers) were operated on two heavily patronized routes in downtown Manhattan. German Neoplan buses (capacity: 84 seats plus standees) were introduced into service between the suburbs and the central business district in Los Angeles.

The double deck buses were very well received by passengers, who preferred them to conventional buses. Security was not a problem on the unattended upper level, or was the use of internal stairs. Maintenance costs for the Los Angeles buses were somewhat higher due to premature brake wearout, a problem which appears to have been corrected. Operating data indicate that double-deck buses require the same dwell time per passenger as conventional buses. An analysis of the project findings has generated recommended operating conditions which offer potential for substantial savings over conventional buses.

Waterways in many major urban areas in the United States offer untapped potential for public transportation routes which would reduce the pressures on existing highways and mass transit facilities. Direct over-the-water transit is being investigated, with emphasis on applications that show promise of major saving in travel time during peak periods. A waterborne demonstration project in New York City is planned to determine the acceptability of such a service and the economic and operational feasibility of using high speed hovercraft as the transport vessel. A variety of services will be introduced in FY79, including commuter service between several locations and Manhattan, night ferry service, and mid-day service between Manhattan and LaGuardia airport.

PRICING AND SERVICE INNOVATIONS

Pricing policies can be used as a mechanism to ration urban transportation resources and shape travel choices so as to maximize the use of higher occupancy modes. Current practices in this area have been limited in scope, simply because local planning staffs currently lack an empirical basis for predicting the impacts of these policies and their comparative merits with respect to service improvements.

The SMD program has embarked on a coordinated series of experiments in metropolitan areas of different character to demonstrate and evaluate the extent to which a range of pricing policies can alleviate urban problems. Experience gained from these efforts should also shed light on the prospective tradeoffs between pricing and service variations, and serve to provide a basis for formulating guidelines for use in setting transit fare and service policies.

Pricing policies that will be investigated include transit fare reductions, fare-free transit, fare prepayment techniques, integrated intermodal fare structures, graduated fares based upon the chosen level of service, and a variety of road pricing strategies including corridor pricing, spot pricing, and parking pricing. In addition to the demonstrations, analytical studies are being conducted to provide a firm background understanding of current and past practices, and to study the feasibility of new concepts and to develop site-selection criteria.

Transit Fare Policies

A series of demonstration projects are underway to test and compare transit fare reduction, free fare, and fare prepayment. Two methods of fare prepayment are being examined in demonstration projects: the distribution and promotion of prepayment instruments through employers via payroll deduction was implemented in Sacramento CA, and Jacksonville FL; and periodic temporary discounts (transit sales) of prepaid passes to the general public has begun in Austin, TX and Phoenix, AZ. With payroll deduction, an increase in the use of passes can stem from convenience in the method of payment and occasional transit agency/employer sponsored discounts. Periodic temporary discounts are a promotional technique based on the premise that some of the new riders attracted by the discount will become regular patrons after the discount period ends, and that some existing patrons will switch from cash payment to prepayment.

Fare abolition is intended to enhance downtown mobility, reduce boarding times, and lead to other service improvements. On the other hand, there are concerns over whether fare abolition is a cost effective means of improving transit efficiency. Concerns also exist regarding equity issues, especially income distribution effects of spending the large sums required for subsidizing the total cost. These questions have motivated the development of a series of experimental fare-free projects - experimental because the intent is to understand better the issues and potential related to fare abolition rather than promote the concept at this point in time. Project results should provide the basis for making comparisons between fare-free and reduced fare policies.

An off-peak systemwide fare-free demonstration has begun in Mercer County NJ, to study the effect of fare abolition on redistribution of demand by time of day, overall fare-collection costs, and service quality. A second site, Denver CO has characteristics that differentiate it from the first city, such as a high-peak/off-peak ridership ratio, relatively high off-peak fare, and high concentration of poor people who are captive transit riders.

Central area fare-free transit will be developed under controled conditions in two cities, Albany NY and Knoxville IN, to assess the impact on mobility, downtown revitalization, and attraction of fare-paying riders traveling beyond the central area. Case studies of other cities that independently introduced downtown fare-free transit are being conducted to extend further the understanding of these impacts.

Methods for Improving Transit Productivity

The key to providing effective public transportation is the efficient utilization and management of transit resources - labor, equipment, facilities, and services offered. To allocate these resources according to demand, it is necessary to measure demand periodically and compare costs and revenues for various services. An evaluation of the conventional practices for monitoring and managing transit service has indicated that more exacting measures must be adopted which permit disaggregation of data by routes and rider characteristics (i.e., low income, handicapped, elderly, etc.). A system for collecting, analyzing, and presenting these data have been developed by

UMTA and will be applied in a set of experimental demonstration projects to determine usage costs, and assess its potential for measuring and improving resource productivity.

Pricing Disincentive Policies

In recent years, pricing disincentives have been viewed with increasing interest as an effective approach for reducing congestion by restricting and discouraging use of low occupancy vehicles in favor of transit and ride-sharing options. Charges applied to auto use and parking can have the effect of reducing transit travel times and providing revenues needed for transit service expansion. Feasibility and site selection studies of road pricing policies have been completed, and candidate demonstration sites are being evaluated. A demonstration of corridor pricing, where users of low occupancy vehicles are priced along a heavily used corridor served by a major expressway, will provide information on how motorists shift travel times, modes, or routes. Spot pricing, which involves pricing the use of highly congested zones such as expressway entrance ramps or access points to heavily used activity centers, is intended to encourage the use of alternate routes or specifically provided transit shuttle service.

Another strategy for controling auto use in congested areas involves parking pricing, which might be in the form of a parking license, morning peak surcharge, parking space tax, or parking revenue tax. Parking pricing may be one of the most effective and least costly ways to improve traffic conditions, and provide substantial local revenues for upgrading other elements of the transportation system. A demonstration in the planning stage in Madison WI will involve a morning surcharge, increased rates for long term parking, and reduced shopper parking. Other sites will be identified to test other strategies for parking pricing of autos.

A parking pricing study is being considered in Boston MA and Madison WI which will lead to recommendations for a demonstration. In Honolulu, discussions are underway for studying corridor and parking pricing policy innovations.

Cities with an interest in applying these techniques or incorporating them into Transportation System Management plans are being encouraged to apply for demonstration funding.

Future Concepts in the Development Stage

New pricing concepts are in various stages of development, from investigation of feasibility to candidate site selection and design work. Flexible transit pricing, a means of balancing the demand with the most efficient service through the use of fare structures which are concomitant with convenience and quality of service, is being examined. This approach necessitates a better understanding of price and service elasticities which will lead to integrated fares that maximize the convenience of using different modes for the total trip. Self service fare collection, automated billing systems, and credit card fare collection demonstrations will be implemented as a means of providing the capability for flexible pricing schemes. There are no guidelines at present regarding choice of fare prepayment methods; discount levels, distribution, and instruments (tokens, passes, credit cards, etc.). Demonstrations of these methods will be conducted to determine preferred prepayment systems based upon the type of city and mix of transit services.

Similarly, the potential of fare discount promotions for achieving permanent increases in transit ridership will be investigated in demonstrations to develop recommended methods and generate estimates of overall benefits and costs. Research in the area of price and service variations is being continued to broaden the understanding of their relative merits, and to develop equivalency measures which permit comparison of price and service changes. Toward this end, data from transit operations are being analyzed to provide measures of impacts of fare changes and price and service elasticities.

PARATRANSIT SERVICES

Paratransit services are those forms of intraurban transportation which are available to the public, are distinct from conventional fixed-route bus or rail transit, and can operate over the highway and street system. The SMD program is focusing on those services that can be offered on a shared-ride basis, such as subscription bus, jitney, carpools, vanpools, and a variety of demand responsive services using taxis or transit vehicles.

Paratransit systems often contain a mix of service components tailored to specific travel markets. Subscription service, vanpooling, and carpooling are often used during the peak period. In the off-peak, many-to-many trips can be served by dial-a-ride or shared-taxi operations.

Results of applications of paratransit service in recent years have revealed that the appropriate form of paratransit varies with such factors as population density, size, and socioeconomic characteristics of the area to be served, type of trips and time of day, and the mix of existing public and private transportation providers. The effectiveness and viability of a paratransit system depends to a great extent upon the suitability of the service components to the service area and travel markets.

The current paratransit projects are designed to fill in the gaps in our understanding of how and where these service concepts are most effective. Institutional and regulatory structures have a great deal to do with the climate for paratransit. These important issues have been identified and dealt with in demonstration projects. Moreover, with the trend toward involving private providers and coordinating a mix of existing transportation resources that can be utilized more efficiently, there is a need for development of institutional models in conjunction with the testing of an integrated array of service models.

Therefore, the SMD paratransit program is working on two fronts: the development of component demonstrations, which are concerned with a particular technique, such as shared-ride taxi (SRT) service; and the institutional demonstrations, which have a broader scope and involve the development of an institutional framework for coordinating a variety of public transportation services. As individual techniques are developed in the component demonstrations, models for management structures and regulatory reform to accommodate these services are evolving through institutional demonstrations. Also, since the larger urban areas have a more complex institutional infrastructure, component services tend to be tested first in smaller projects in small cities before being transferred and integrated into large urban transportation systems.

Areawide Integrated Transit

Areawide transit projects are demonstrating ways to integrate paratransit service with fixed-route operations. Comprehensive transit coverage can be achieved by coordinating demand responsive transit (DRT) feeders to fixed-routes and providing DRT service components in low density areas. Another approach involves offering DRT as a complement to fixed-route service for special markets, such as elderly and handicapped persons. A complementary DRT service can also be introduced into an area already served by a fixed-route system, providing consumers with service to areas not covered by bus routes, and a choice as to whether to use the lower-cost fixed-route option or pay more for premium door-to-door service. The paratransit mode may offer a suitable alternative to the auto for persons who would not otherwise use public transit as well as for those who are not well served by the fixed-route system. While component integration can be achieved without duplication of services, transfer coordination strategies are required because neither mode, by itself, provides areawide coverage. Complementary paratransit services require an extensive fixed-route network, and usually necessitate a pricing policy which discourages use of doorstep service by those who are conveniently served by fixed-route buses.

Two operating examples of coordinated areawide service in a metropolitan region are in a demonstration project in Rochester NY, and an independently initiated transit system in Ann Arbor MI which was evaluated by the SMD program. In Rochester, the public transit authority operates many-to-many and subscription services in two suburbs and demand responsive feeders to bus routes to the downtown area. The Ann Arbor system employs dial-a-ride service within specific geographic zones, and connects the zones with fixed-routes serving the downtown area. A major difference between the two operations is that in Ann Arbor, dial-a-ride vans arrive at transfer points at prescheduled times, while in Rochester, fixed-route and demand responsive vehicles rendezvous at a designated transfer point only upon request.

Rochester and Ann Arbor utilize computer technology to assist in dispatching and driver communications. Rochester uses an automated dispatching system developed by UMTA, and Ann Arbor adopted a computer-assisted dispatching system which stores tour information to facilitate manual dispatching.

In addition to computerized dispatching and areawide coordination, the Rochester project tested a wide variety of innovations, including route rationalization (replacing selected fixed-routes with demand responsive service) and shuttle services incorporating route deviation. Because a variety of new vehicle designs were used, the project was plagued by major vehicle reliability problems, which had an adverse impact on quality of service and public acceptance.

Both projects have been evaluated, and have yielded a number of important implications, including the following:

a) Computerized dispatching has been successfully implemented, and shows potential for increasing the efficiency of large demand responsive systems.

b) Route rationalization, or the replacement of established bus routes with demand responsive coverage, may reduce the level of service for those living near the route and cause a decrease in patronage.

c) Regularly scheduled transfers betwen DRT and fixed-route service are more reliable, and result in lower wait times than demand actuated transfers.

d) Tailoring of services to demand by time of day is a useful method of maximizing system productivity; however, a system which has many configurations and service levels can become too complex from the user's standpoint.

Another demonstration of coordinated DRT and fixed-route service is beginning in St. Bernard Parish LA, a suburb of New Orleans. This project is the first example of the provision of shared-ride taxi-feeder service to fixed-route buses. Users pay a joint fare which covers the taxi-feeder and line haul segments of the trip. Service connects all sectors of the parish to New Orleans.

A project underway in Westport CT is testing the feasibility of contracting with a private taxi operator to extend the spatial and temporal coverage of the existing fixed-route minibus service. Supplemental fixed-route service to local rail stations, many-to-many SRT, package delivery, and subscription DRT are included in the service package. A fare differential between fixed-route and SRT service is intended to encourage use of the cheaper mode where possible. Preliminary results reveal that total system ridership has increased substantially.

Shared Ride Taxi

Taxi companies represent a huge, underutilized resource that can provide some public transportation services more efficiently and economically than fixed-route transit. In shared-ride taxi service, the operator is permitted to carry two or more passengers traveling to and from different points, thus increasing vehicle productivity and substantially lowering per passenger costs compared with conventional exclusive-ride taxi (ERT) operation.

Current projects are demonstrating the effectiveness of SRT service in a variety of roles including feeding fixed-route buses (St. Bernard Parish), many-to-many public transit service (Xenia and Westport), and provision of DRT for special user groups (discussed in a later section of this summary).

Analysis of SRT operations to date has shown that, because of the utilization of small vehicles, lower overhead and labor rates, and skilled, efficient dispatching, taxis can often deliver trips at lower cost than a publicly provided demand responsive operation. In addition, taxi supply can be varied in response to the demand, (especially when ERT taxis are available for SRT trips), thus maintaining a high level of service during periods of heavy demand. Some other important findings regarding users, service levels, cost, and issues related to contracting with private operators are summarized below:

1) Higher fares can be charged for SRT service, permitting revenue to cost ratios that are higher than most public DRT and fixed-route operations.

2) Wait times and travel times for SRT operations are generally lower than other demand responsive systems.

3) The UMTA labor protection clause (Section 13(c)) can prolong or hamper efforts to initiate para-transit services, however, this has not proven to be an insurmountable barrier thusfar.

4) SRT service can attract a previously untapped market and can stimulate increased transit use (especially with taxis feeding fixed-route buses).

In Westport, a taxi operator who was the losing bidder initiated litigation against the transit districts, claiming that the publicly subsidized SRT service represented unfair competition. The court ruled in favor of the transit district, concluding that when a private operator is selected through an open bidding process, losing bidders are not protected by Federal law even if they are franchised to provide similar service. However, local ordinances may protect the private operator against publicly subsidized competition and it is essential that localities considering SRT service investigate thoroughly the legal and regulatory context pertaining to public and private operators.

The operational viability of SRT service is no longer in doubt, and future efforts are primarily aimed toward testing institutional frameworks for incorporating private operators into a transit supply system. Models for dealing with regulatory, labor, and institutional issues are needed to pave the way for more widespread use of SRT, especially in the more complex institutional environments in large urban areas.

Transportation Brokerage

The transportation broker concept is an institutional method for identifying transportation needs of various market segments, and matching them with the appropriate transportation resources. Broker functions include contracting with private operators, modifying existing transit services, establishing carpool and vanpool programs, and coordinating social service agency travel. Another important broker activity involves the removal of regulatory or institutional barriers to more efficient use of resources.

Because of the differences in urban areas, the transportation broker model will vary, both in terms of the institutional base and functions performed. Three examples of transportation brokerage are being demonstrated. In Westport CT and Minneapolis-St. Paul MN, the regional transit authority has assumed the role of broker. In Knoxville TN, the transportation broker is part of the city government. All three brokerage offices have conducted market research activities to identify and segment markets prior to developing or adapting transportation services.

Vanpool programs have been established in Minneapolis and Knoxville. An important accomplishment of the Knoxville broker has been to effect regulatory changes exempting ride-sharing vehicles from economic regulations, and to bring about a published insurance rate structure for vanpools, which has resulted in lower insurance rates in many cases. In Westport, contractual arrangements with a private taxi operator and coordination of public and privately operated transit have been established. As the brokerage projects mature, additional activities will be getting underway.

Vanpooling

Vanpooling is a form of ridesharing that has significant potential for energy savings. Most of the current vanpool operations have been sponsored by employers; however, a larger potential market exists if workers at different sites can be matched by a public agency. A group of vanpool projects have been initiated during FY77 to test various methods of providing vans through a transportation brokerage office (Knoxville), a public transit authority (Norfolk VA and Marin County CA), or a private third party under contract to the transportation broker (Minneapolis-St. Paul). In all of these projects, vans are leased to drivers and fares are either set by drivers or by the leasing authority. These projects should provide valuable information on the potential of vanpooling for those commuter trips which are not well served by public transportation.

Two comprehensive reports describing current experience with over 30 vanpooling programs around the country were completed during FY77. These documents cover the planning, organization, and operation, including information on how to set up and administer employer-based programs.

<u>Future Projects and Studies</u>

Paratransit service concepts and applications are not likely to be widely adopted until their potential is much better understood. Some are being examined through detailed case studies while others are in the feasibility study stages leading to a demonstration.

Unregulated paratransit services are operating in many inner city areas, yet very little is known about these neighborhood-oriented operations since they are not regulated. A study is being undertaken to analyze supply-demand characteristics, pricing, and services offered.

Shared-ride auto, a concept which involves licensing commuters to carry passengers for profit on the trip to and from work, represents a strong positive incentive to ride-sharing. It has been studied to determine its feasibility and acceptability. A number of potentially serious legal and regulatory barriers exist, including insurance, taxes, and liability of the registering SRA agency. However, by designing the system to reflect a particular institutional setting, it appears that in many cases these barriers are not insurmountable.

Past uses of subscription bus service have involved relatively long-trip distances. A demonstration project is underway to provide short-haul subscription bus service to a large non-CBD employment center in Los Angeles. Because of existing staggered work hours at the site, and shorter-trip distances, a vehicle can make multiple trips per peak period, greatly increasing vehicle and labor productivity and reducing cost to the user.

A critical problem local planners face when designing DRT systems is the difficulty of forecasting patronage. Demand models developed for fixed-route, fixed-schedule transit cannot accommodate the inherent variability in DRT wait and travel time. In response to this need, the SMD program has sponsored the development and validation of a computer-based DRT forecasting package that utilizes disaggregate travel demand models for predicting level of service and demand for work and non-work trips. Demand and level of service models are solved simultaneously, and an iterative procedure is used to obtain the equilibrium travel pattern. Both a detailed model and a sketch planning version have been completed and tested. Validation tests indicate that both models predict total daily ridership within 30 percent of actual levels.

TRANSPORTATION SERVICES FOR SPECIAL USER GROUPS

"Special User Groups" is a term referring to those who, because of age, income, or disabilities do not have the use of an auto, and are dependent on public transportation or special arrangements to meet their mobility needs. This encompasses a broad segment of our society who are especially in need of adequate public transportation, and includes a subgroup, the handicapped and elderly, to whom most of the recent emphasis on development of special user group services has been directed. Many in this latter group have either had a great deal of difficulty or been unable to use conventional transit because of existing accessibility barriers in conventional fixed-route transit: (1) inability to get to/from a bus stop; (2) inability to board the vehicle; (3) difficulties in keeping balance on a moving vehicle; and (4) problems with understanding transit routing and scheduling information.

Public transit's inability to be responsive to these special needs prompted UMTA regulations stipulating that special efforts to serve the elderly and handicapped were to be made in the planning and design of all Federally funded public transportation projects. The SMD Program has, through a structured series of demonstration projects, been developing concepts and testing new equipment intended to make transit far more usable and attractive to all elderly and handicapped persons.

Efforts to test alternatives for consideration by local planners started with the basic demand responsive, door-to-door service model. Early demonstrations provided operating experience related to service variables, policies for serving low demand densities in large areas, eligibility and registration practices, operating cost, and user impacts for DRT systems designed especially to serve the elderly and handicapped.

More recent projects have tested methods for providing this service more efficiently, utilizing the existing resources and providers in the most cost-effective ways. In addition, the potential of fully accessible buses (wheelchair lift or ramp, lower steps, handrails, etc.) in fixed-route service, and the extent to which they represent a solution to the elderly and handicapped travel problem is being examined.

A major study of the transportation problems of the transportation handicapped has been proceeding in parallel with the demonstration project activities. The overall objective is to determine travel requirements for different classifications of handicapped people and to recommend the type of service alternative required. A central part of the study is to examine cost/benefit tradeoffs between modifying existing public travel systems and instituting specialized services. Research findings thus far have been fed into demonstration project designs, and will be made available to localities in the form of standards and guidelines for use in planning special user group services.

Service models being demonstrated represent a wide range of service designs, vehicle type, institutional frameworks, providers, and funding arragements. However, they can be discussed in terms of three conceptual areas:

a) Coordination, consolidation, and brokering of transportation needs and resources, including services provided by human service agencies for their clients.

b) The application of user-side subsidies as a technique for selectively subsidizing special user-groups and allowing private providers to compete for this market.

c) The application and impacts of accessible fixed-route bus service.

Coordination and Brokering

The provision of transportation to clients by social service agencies is an integral part of most agency programs. Travel to clinics, agencies, nutrition programs, rehabilitation centers, recreational centers, and other activities is either supplied or paid for (reimbursed) by a multitude of human service agencies. This has resulted in a proliferation of special transportation projects where each agency typically serves its own clients and/or may either own its own vehicles, or have contracts with private providers.

Since there has been little coordination among agencies to avoid duplication of services, inefficiencies and fragmentation of resources have prompted DOT and HEW to adopt a policy calling for efforts to make more productive use of these resources.

A variety of approaches to service coordination are being tested. These include: provision of agency client transportation by the public transit authority under contract to the local agencies; centralized dispatching of agency vehicles; and pooling of agency equipment and drivers into a consolidated operation. The role of private and private non-profit operators in these contexts is also being examined.

The concept of coordinating transportation services for the elderly and handicapped has been the prime focus of five current SMD demonstrations. Two of these, in the Naugatuck Valley CT and Mountain View CA, were completed during FY77. Two others, in Portland OR and New York City are still in progress, and the fifth, in Mercer County NJ, is in the final stages of implementation.

Both the Mountain View and Naugatuck Valley demonstrations utilized a brokerage scheme to generate and match trip requests with a transportation provider. In Naugatuck, the brokering was accomplished by a community council, while in Mountain View the broker, who was also a driver, was employed by a local taxi operator.

The Naugatuck project was the first example of the use of automated credit card fare collection and third party billing to social service agencies for contract bus service. Ridership is comprised of agency clients, other elderly and handicapped persons, and a number of users from the general population. Coordination of social service agency trips was successful, and vehicle productivities were boosted by the extent of subscription service provided. Higher fares charged the riders from the general population helped to cross-subsidize the trips made by the elderly and handicapped target market.

The service model developed in Naugatuck has been applied in Portland OR to test its viability in a medium-size urban area. The public transit operator is providing demand responsive (advance reservation and subscription trips) transportation both to social service agency clients and transportation handicapped persons from the general population. Private taxis are used when necessary to augment the capacity of a fleet of lift-equipped minibuses. Ridership, which is split almost evenly between agency sponsored and general passengers trips, is still increasing. Agencies and general public passengers have been able to obtain transportation at fares well below the previous alternatives. However, because of the size of the city and difficulties in grouping medical trips, the average cost per ride of $7.40 has been higher than expected. Emphasis during the second year of the project will be placed on increasing the operating efficiency and using taxis more where they offer a cost savings over the minibuses. Automated fare-collection equipment was purchased for the demonstration, but has not yet been sufficiently reliable to be used as a source of trip data for billing and management purposes.

Another service model for the coordination of transportation for agency clients will be demonstrated in a project in Mercer County NJ, which is scheduled to begin operation in FY78. Centralized dispatching of all vehicles owned by towns and agencies will be performed by an independent agency within the county human services department. Once the centralized dispatching has been achieved, the next stage of the project involves consolidation, or taking over agency transportation budgets and responsibility for the operation and maintenance of all vehicles owned by participating agencies. Other agencies may purchase transportation services under coordination arrangements. This project will provide important findings regarding the merits of the consolidation model, and permit comparison with the coordination approach exemplified in the Portland OR project.

Agreements established in Portland, Naugatuck, New York City, and Mercer County have demonstrated that there are no insurmountable barriers to coordination of transportation for clients of social service agencies, nor are they any real difficulties in billing, scheduling or other activities required by coordination. The major remaining question, which will be answered at least partially during the next year, is whether and to what extent current agency transportation costs can be reduced by coordination and consolidation.

A demonstration project operating in New York City is providing a centralized source of transportation for agency clients and elderly and disabled persons living on the Lower East Side. Advance reservation, and door-through-door service for persons in the target area are free for all except subscription work trips. The number of trips per vehicle-hour is limited by the dispersion of destinations and high average trip lengths. However, results may indicate that scheduling all client trips from a dense target area through a single provider will permit greater efficiencies than would otherwise be possible.

The SMD program is funding a number of site-specific planning studies leading to a choice of the most effective coordination strategy and service provision plan, and subsequently, a project design. These studies are underway in Dallas TX; New York City; Brockton MA; and Chicago IL.

The community-broker concept referred to above was demonstrated in a one-year project in Mountain View CA, which ended in FY77. The broker, who was also the driver, worked with elderly residents of two apartment complexes to plan and organize group rides on a pre-scheduled basis to shopping, church, and other activities. It was found that, by organizing trips on a shared-ride basis, users could make more trips less expensively than otherwise. However, the revenues fell far short of covering total costs of brokering and transporting riders. Also, because of the time required for brokering activities, a single driver/broker could only spend 40 percent of his time providing transportation. However, if the transportation brokerage were integrated into a program of primary services (health, legal services, etc.), operating costs could be partially subsidized from program funds.

A different approach to the transportation broker concept, in a demonstration project in Pittsburgh PA, will be implemented in FY78. In this project, the feasibility of using a broker to contract with transportation providers (public and private), obtain social service agency participation, and perform scheduling and dispatching functions will be tested.

<u>User Side Subsidies</u>

Another family of special user group demonstrations is testing the viability and effectiveness of the user-side subsidy concept. Under this type of subsidy mechanism, selected user groups are provided with tickets or transportation vouchers at less than face value which the transportation provider (i.e, private taxi, or bus operator) redeems at face value from the agency administering the program. In contrast to the conventional provider side subsidy, this approach in effect subsidizes the provider only for rides delivered, and not just for operating the service. Hence, this concept should stimulate competitive providers to offer a higher quality service to increase ridership, since users can choose among providers based upon fare and service quality. User-side subsidies are also a method of selective subsidization, offering the possibility of varying the discount based upon eligibility factors, agency policy, trip type or purpose, and transportation modes used.

User-side subsidy demonstration projects have progressed from an initial experimental testing phase in one city to a series of replications under various conditions which are currently underway in four cities. These projects will extend the user-side subsidy to include fixed route transit and a mix of public and private providers.

The initial experimental project in Danville IL involved 50 to 75 percent discounts for the handicapped and elderly using shared-taxi service. Findings obtained during FY77 demonstrate the basic viability of the subsidy mechanism from an administrative standpoint and its acceptability to users and providers. In Phase II, which began in early FY78, the use of the subsidy has been extended to include a new public fixed-route transit service.

User-side subsidy projects in Montgomery AL and Kingston NC began in FY77. A fourth demonstration is nearing implementation in Lawrence MA. These sites differ in sociodemographic characteristics, city size, and forms of transit (public and private bus, taxi) available. Projects at these sites will employ different eligiblity criteria, discount rates, use limits, and subsidy mechanism (tickets and vouchers). Findings from the evaluation of these projects should provide a comprehensive base of experience and recommendations regarding the application of user-side subsidies. Preliminary results from the three sites in operation reveal that tickets are administratively easier to handle than vouchers for provider reimbursement, but not for complex fare structures. The cost of administering the new subsidy program in Danville (using vouchers) was approximately 20 percent of the average subsidy per trip.

Accessible Full-Size Bus Service

While there are many examples of specialized demand responsive services for the handicapped and elderly, there has been practically no fixed-route operating experience using full-size transit buses equipped with wheelchair lifts and other special features. The Secretary of Transportation's decision requiring that all buses purchased after September 1979 be accessible to the handicapped has created an immediate need for examining the economic and operational issues related to specially equipped buses and to assess the extent of their use by handicapped persons.

Because of the limitations of fixed-route transit coverage, a fully accessible fixed-route bus sytem will probably not meet all the needs of the transportation handicapped. Evaluations of the projects underway should help to identify unmet travel needs and determine appropriate supplemental services to meet these needs.

Evaluations of full-size accessible bus service will analyze: use by handicapped persons; operational and maintenance costs; equipment performance; impacts on service to the general public; the interface with complementary specialized DRT services; and the planning process for route selection, headways, etc.

Independently initiated accessible fixed-route bus services operating in San Diego CA and St. Louis MO are being examined. In San Diego, only 5 buses were specially equipped as part of a test project providing service on two heavily patronized routes. Initial demand has been very low, probably due to the limited regions and destinations served; however, the lift devices have been operating reasonably well.

In St.Louis, 157 accessible buses are operating on 17 routes and a demand responsive service for handicapped persons has been initiated in a suburban area where there is only limited fixed-route coverage. Both services will be evaluated to assess their effectiveness in providing mobility to transportation handicapped persons and the extent of trips involving transfer between demand responsive and fixed-route components.

In Los Angeles, 200 accessible buses are being deployed on 23 routes over a large area at headways ranging from 20 to 60 minutes. This will be the second major implementation of a partially accessible fleet and should provide important ridership and cost data for accessible bus service in a mild climate and for comparison with the St.Louis operation.

Two SMD demonstration projects in Champaign-Urbana IL and Palm Beach County FL will begin operating a fleet of accessible full-size buses on all routes in late FY78. Both systems are much smaller than St.Louis and Los Angeles in terms of fleet size (40/50 buses) and number of routes (10 and 20), and will permit an assessment of the utilization of a fully accessible system in a small urban area.

A subscription service using accessible full-size buses in Atlanta GA which began operation in late 1977 is also being examined by the SMD program to compare cost and ridership with fixed-route and demand responsive services for the elderly and handicapped.

DEMONSTRATION PROJECT EVALUATION

The SMD program represents a cooperative and coordinated effort in applied policy research involving organizations at the Federal, state, and local level. The performance of individual demonstration evaluations does not take place in an isolated laboratory setting, but rather is intimately related to the conduct of the demonstrations themselves. The process which is employed for planning and implementing the evaluation allows for close and frequent interaction among the various participating organizations to ensure appropriate dovetailing of demonstration and implementation activities and to secure agreement as to respective responsibilities.

The SMD program attempts to maximize the quality and utility of information gained from the demonstrations by developing and employing a consistent, carefully structured approach to a demonstration evaluation, and using state-of-the-art data collection and analysis techniques. Each evaluation addresses three basic questions -- What changes were made to the transportation systems? What are the impacts of these changes on travelers, providers, and other groups? Why did these impacts occur? -- through careful documentation of the events and circumstances surrounding the implementation and operation of the project, as well as a detailed analysis of impacts and cause-and-effect relationships. The emphasis on a consistent conceptual framework and analytical approach does not, however,preclude recognition of the unique learning potential or special circumstances surrounding each demonsration. Since demonstrations vary in terms of objectives, relevant issues, complexity, content, and context, the scope and emphasis of each evaluation are tailored to the specific characteristics of the demonstration.

INFORMATION DISSEMINATION

Service and Methods Demonstration projects and other program activities can only have the intended nationwide impact on public transportation improvements if the technical findings are made available in the appropriate form to planners and decisionmakers. Therefore, effective information dissemination is essential to achieving the ultimate goal of technology transfer.

There are a large number of ways in which demonstration project findings can bring about beneficial transit improvements in other cities and towns. Innovations that were demonstrated are being replicated elsewhere according to recommendations in the evaluation reports. Findings regarding the resolution of complex issues that surface during a demonstration can be very helpful in avoiding adverse impacts of similar implementations elsewhere. Project evaluations provide specific recommendations on the applicability of service concepts and conditions where they are likely to be most effective. Even in cases where the overall project concept was found to be unworkable or costly, certain components of a demonstration often have potential in other contexts. Finally, project cost and service results are being used by planners and policymakers in conducting alternative analyses leading to investment decisions; and data from project evaluations are being used in developing improved tools for transportation planning and forecasting purposes.

Project findings are disseminated to a variety of target groups, including transportation planners, transit operators, and local and state governments. Therefore, much effort has been devoted to identifying these target audiences, and developing the appropriate channels of communication. Since the SMD program attempts to facilitate change and improvement, it has adopted an agressive approach to communicating important findings to those who might benefit, and in publicizing the projects underway, and the products that are being made available.

A variety of types of publications are produced and distributed, containing findings from project evaluations, results of analytical studies, and guidelines for planning and implementing innovative projects. Project evaluation reports contain both a detailed assessment of project impacts and implications for transferability that are useful to decisionmakers. Case studies of innovative practices initiated outside of the SMD program are conducted where it appears that the service concept has sufficient applicability to warrant a wide dissemination of findings which would not otherwise occur. Manuals prepared for distribution to urban areas provide guidance for implementing and planning new services that have been proven in demonstration projects. These manuals are published in separate volumes intended for policy level officials, project leaders, and the planning team.

Publications are distributed widely to planning agencies, transit operators, regional transportation commissions, and transportation professionals in universities and private organizations. In addition to the standard distribution, copies are sent in response to individual requests.

SMD staff regularly participate in a wide variety of technical conferences dealing with public transportation. Seminars and workshops are sponsored by the SMD program where they can serve a purpose in bringing together key industry representatives for dissemination or discussion purposes. Site visits by representatives of other urban areas to demonstration projects are actively encouraged. They offer a unique opportunity to observe an operation and meet with the local management and planning staff.

Audio-visual media are an effective means of presenting introductory and conceptual information about transportation alternatives to a wide audience. Audio-visual products can better illustrate the operation and use of public transportation systems than written material by itself, and in some cases, can serve as a substitute for a site visit to an innovative operation or a group of similar transportation systems.

A film illustrating examples of four transit service alternatives appropriate to small cities, Transit Options for Small Communities, produced in FY1976, has been seen by over 30,000 persons in 47 states during the first year of its distribution. Another film, illustrating recently developed techniques for providing public transportation for the elderly and handicapped, is in production. Reports or case studies describing the operations shown in these films are prepared in conjunction with the film to serve as backup documentation for transportation professionals who can benefit from more detailed technical information.

CHAPTER 1

INTRODUCTION

PROGRAM DEFINITION AND PURPOSE

The Service and Methods Demonstration (SMD) Program is intended to improve existing transit operations by sponsoring the implementation of new techniques and services throughout the United States. These innovations, which rely on existing transit technology, are intended to produce short range improvements in the quality and quantity of public transportation. Emphasis is placed on effective methods for providing total coordinated transportation for an entire trip, rather than a particular mode. In most cases this requires a combination of modes, integrated and coordinated to supply a variety of transportation services for a variety of users, trip purposes, and travel patterns.

These efforts are intended primarily to develop public transportation improvements and to encourage their widespread adoption in conjunction with other UMTA and DOT programs. This function supports the Transportation Systems Management Element (TSME) of the joint planning and programming regulations issued by UMTA and FHWA which require that local areas consider techniques such as pricing, traffic management, and paratransit to improve transportation efficiency in the preparation of Transportation Improvement Plans. Some of these techniques have already been proved feasible through SMD demonstrations.

New services and methods which meet the SMD transit improvement objectives will also support such important national objectives as improved environmental quality and energy conservation. These improvements will also have more immediate impacts than activities with a long lead time such as the development of a new technology or the implementation of major new facilities.

Public transportation improvements must address the travel needs of the mobility-limited and transit-dependent segments of the population. From the beginning, the Service and Methods Program has had a strong interest in transportation for the handicapped and elderly. Several projects have been developed to test or demonstrate techniques for serving these population segments. These projects were intended to publicize and expand the range of proven methods for providing handicapped and elderly persons with mass transportation services that they can effectively use. In this way, the SMD Program has provided insight on some alternative approaches in support of the national policy that handicapped and elderly persons should have the same right as other persons to utilize mass transportation facilities and services.

PROGRAM STRUCTURE

In order to carry out the purposes of the SMD program, a conceptual framework has been established, and from this a functional structure has evolved. Conceptually, the program activities are built around the development of operational techniques for achieving the program objectives. Criteria for project funding and priorities are derived from this and from the relationships between the Office of Service and Methods Demonstrations and other UMTA and DOT administrations. The conceptual framework and functional elements of the SMD Program are described in the following paragraphs.

Program Objectives

The SMD Program has established a series of objectives by which transportation improvements can be judged and which could be attained through demonstrations. The following objectives were initially chosen to categorize projects for program planning purposes:

- Reduce travel time by transit.
  This is an important factor in increasing transit ridership and improving vehicle productivity.

- Increase the area coverage of transit service.
  This is important for increasing transit ridership, yet responding with cost-effective approaches to public pressure for new transit service in lower density suburban and non-urbanized areas.

- Improve the reliability of transit service.
  This is one of the most important factors in maintaining and increasing ridership.

- Increase the productivity of transit vehicles.
  This is most important in the continuing struggle to reduce operating deficits while maintaining or improving service.

- Improve the mobility of transit dependents.
  The development of promising techniques to achieve this is necessary to respond to increased pressure for better mobility among people without automobiles.

These objectives have been used since the beginning of the SMD Program but are subject to replacement or augmentation as other objectives become important to the fulfillment of UMTA's long-range transportation goals.

Functional Elements

The SMD Program is divided into four functional elements: concept development, demonstrations, evaluation, and information dissemination. The first element, concept development, deals primarily with the study and development of ideas for improving transit services that are not presently in use in this country or perhaps which have not been carefully assessed even though they may be in use at one or a few sites. Two approaches to concept development are thus taken depending on the situation: (1) case studies have proven to be an effective mechanism for briefly assessing existing applications of new ideas; (2) where no implementation of an idea is found, feasibility studies or theoretical analyses have been used to determine desirability of testing the concept in an actual demonstration. If the concept appears worthy of further consideration, the next step is normally the demonstration stage.

The demonstration projects can be categorized as either primarily exemplary or experimental in nature. Exemplary demonstrations are conducted to encourage widespread application of proven innovative transit services and methods by increasing the exposure to these practices. Experimental projects are conducted in order to evaluate the effectiveness of promising new concepts in actual operating environments. Demonstrations by themselves are of little value, however, without the other SMD elements of evaluation and information dissemination.

Evaluation, the third element, plays a particularly important role in the demonstrations. Evaluations generally report on the institutional, operational, and economic results of the service or method demonstrated and on the impacts on the users, suppliers, and the general public. It is the evaluation which determines whether the new transit service or method is worthy of promulgation through the SMD Program, whether further testing or replication under different conditions is necessary, or whether the results were sufficiently disappointing as to not warrant promulgation or further study. Guidelines for evaluating SMD projects have been developed to help ensure consistency of evaluations and permit transferability of results to other cities.

The fourth element of the program is information dissemination. Considerable effort has been devoted to developing effective methods of communicating findings of the program so that appropriate applications of new services and methods can be utilized by urban areas with transportation needs. Recognizing that published reports are not always the most effective way to disseminate information, the program has conducted seminars and workshops, participated in transportation conferences, and produced audio-visual material for public distribution. An important mechanism for maintaining communications with urban governments is the Transportation Task Force of the Urban Consortium, which is composed of representatives of major urban areas. The Task Force acts, in part, as a contact for a two-way exchange of information between U.S. DOT and local decision-makers. The Consortium identifies transportation problems and priorities which are communicated to UMTA and others; these are given consideration in project planning and site selection. Information on promising service concepts and techniques developed by the SMD Program are distributed to the Consortium.

Demonstration Criteria and Funding

For demonstrations of proven techniques, criteria for site selection include the potential for continued use at the demonstration site and an achieved level of effectiveness for the site commensureate with the long-range operating costs. These demonstrations should have a potential for expansion under local initiative into broad programs of transit service improvements. In addition, each potential site must demonstrate a desire and capability, both financially and operationally, to continue and expand the service improvement beyond the termination of the demonstration period.

In order to foster these ends, the local area will be expected to contribute financially to the demonstration. Over the demonstration period, the federal contribution will decline and the local funding will increase, until the entire service is fully supported on a local basis. Thus, before a demonstration begins, a federal disengagement strategy and local funding mechanisms will have been defined.

Federal funding sources other than the Service and Methods Program may also be sought for such investments as new vehicles or roadway modifications. Participation by the UMTA Capital Grants program and the Federal Highway Administration will be solicited for these funds. Therefore, the program involves a high degree of cooperation among various offices in UMTA and DOT modal administrations, as well as among the Federal Government, states, and urban areas.

For operational tests of new ideas, since they are more experimental in nature, there is less expectation that any services or methods implemented will be continued beyond the completion of the demonstration. The Federal Government may provide full financing for any or all elements of the demonstration. The only local commitment required may be operational cooperation for the duration of the experiment. Should an experimental demonstration prove particularly useful, however, the locality may independently elect to continue the service or method.

In years prior to the formation of the Service and Methods Demonstration Program, a variety of demonstration projects were conducted. Since the current program philosophy and structure are an outgrowth of the experience gained from the demonstrations preceding it, a review of these earlier demonstration efforts is appropriate. This background should also be useful as an introduction to the current activities and accomplishments during Fiscal 1977, which are reported in the subsequent chapters.

HISTORICAL PERSPECTIVE

The authority to conduct demonstrations to improve facilities, equipment, methods, and techniques was the first authority granted by Congress in initiating a Federal Government role in mass transportation in 1961.

In the early years of the UMTA demonstration program, the emphasis was on implementing a wide variety of demonstration projects. However, only limited consideration was given to project coordination relative to program goals or to a structured process of implementation, operation, evaluation, and dissemination.

Another characteristic of this period was the overemphasis placed on a transit system's breaking even financially: the success of a project was judged heavily on its ability to produce sufficient farebox revenue to meet operating costs. Public tax support of operating costs was not generally accepted at any level of government. The projects operated in an environment of declining transit ridership, little local financial support for transit, and a relatively passive attitude on the part of the federal government. Yet in spite of meager local resources supporting transit, several demonstration services did continue to operate after Federal support was withdrawn.

These earlier UMTA demonstrations pioneered the application of transit service innovations that are in widespread use today. Many transit properties have replicated the concepts demonstrated and benefitted from the lessons learned in the implementation and operation of these projects. Examples of projects initiated prior to the formation of the SMD Program are listed below, noting the year when demonstration funding terminated. Almost all of the innovations listed are still in operation. Final results of these have been analyzed and reported in the FY 1975 and 1976 SMD Annual Reports.

Express Bus Service

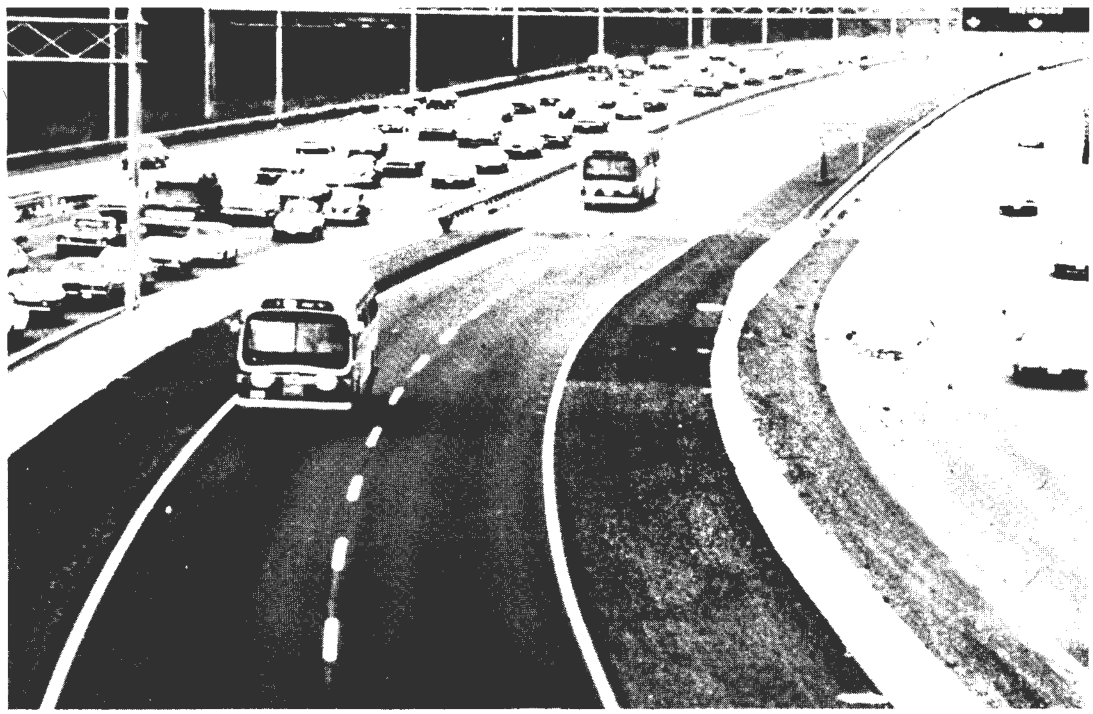
- Shirley Highway Busway: Exclusive Bus/Carpool Lanes, Washington, DC, 1975
- Minneapolis (I-35W): Metered Ramps with Bypass Lane for Express Buses (1975)
- New Jersey (I-495): Contraflow Bus Lanes at the approach to the Lincoln Tunnel (1975)
- Cincinnati Sun Run Express Bus Service (1975)
- Blue Streak Express Bus Service (1975)

The express bus services listed above were among the first examples of techniques for improving transit reliability and travel time improvements, and inspired many cities to initiate express services incorporating features of the demonstration projects.

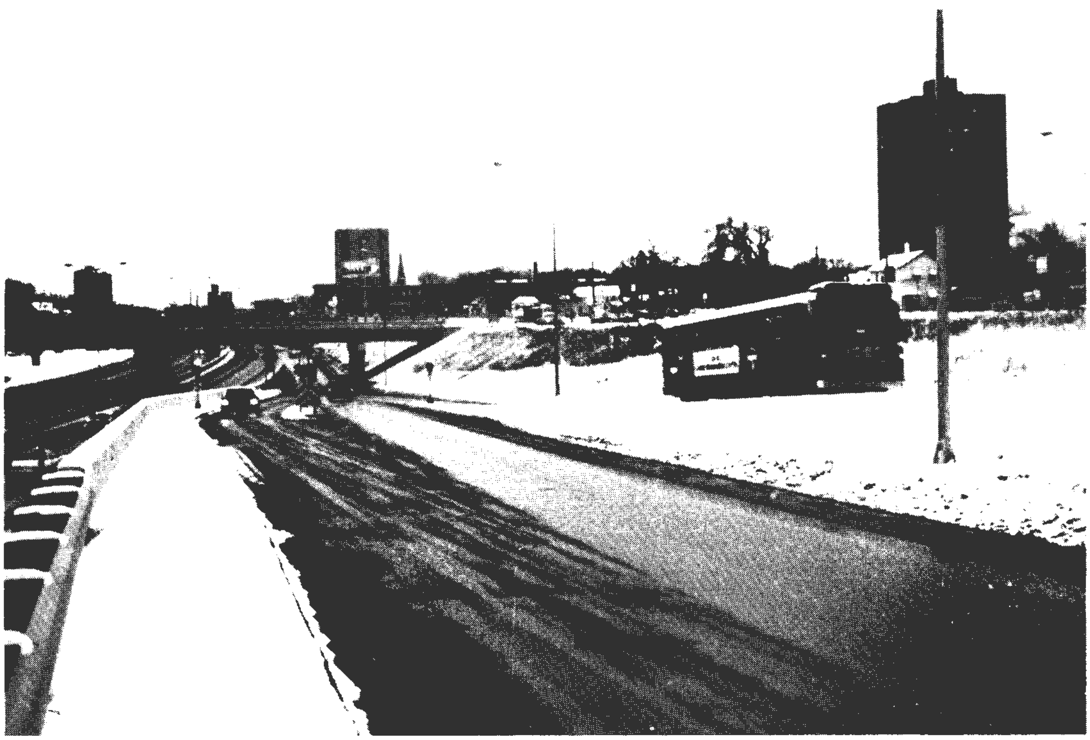
Demonstrations of preferential treatments for transit vehicles (and carpools in some instances) led to the adoption of these techniques in a number of urban areas. Table 1-1 illustrates the evolution of preferential treatment concepts over the last 8 years. Both the demonstration projects and independently initiated

TABLE 1-1. APPLICATIONS OF PRIORITY TREATMENTS FOR HIGH OCCUPANCY VEHICLES

TECHNIQUE	Before 1970	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	After 1980
Non-Separated Concurrent-Flow Freeway Reserved Lanes	San Francisco, Oakland Bay Bridge					Boston, I-93 at I-95 Junction Honolulu, Moanalua Freeway San Francisco (Marin County), US 101 San Diego, Route 163 (bus only)	Portland, Banfield Freeway San Francisco, I-280	Los Angeles, Santa Monica Freeway Miami, I-95 New York, Gowanus Expressway	Boston, Southeast Expressway		San Francisco (Marin County), US 101 (Extension)	New York, Gowanus (Extension)	
Contra-Flow Freeway Reserved Lanes		New York (New Jersey), I-495	New York, Long Island Expressway Boston, Southeast Expressway	San Francisco (Marin County), US 101						Houston, IH45 North Freeway			
Metered-Ramp Bypass Lanes (number)					Los Angeles, I-405 (1)	Minneapolis, I-35W (8) Los Angeles, I-405 (1) I-5 (GS) (1) I-10 (4)	Minneapolis, I-35W (1) Milwaukee, E-W Freeway (1) Los Angeles, I-5 (GS) (2) I-10 (5) Dallas, N.C. Expressway(1)	Los Angeles, I-10 (1) I-11 (5) San Francisco, I-280 (1)	Los Angeles, I-5 (GS)(10) I-10 (1) US 101 (1) I-605 (2) I-5 (SA (5)	Los Angeles, I-405 (2) I-605 (12) Planned (47)	Los Angeles, (111) Dallas, I-30 (1)	Los Angeles (21) San Diego, Route 94 (4)	Los Angeles (22) (1983)
Exclusive Access Ramp		Seattle, I-5	Pittsburg, Braddock Ave. Parkway East			San Diego, Route 163	Chicago, O'Hare		Miami, I-95			Seattle, I-5 (Extension)	
Separated Rights-of-Way	Washington DC, Shirley Highway (1969-1975)				Los Angeles, San Bernardino Freeway El Monte Busway				Pittsburgh, S. PATway San Francisco, Route I-580			San Francisco, I-580 (Extension)	New York, Long Island Expressway Pittsburgh, E. PATway (1981) Hartford, I-91 Washington DC, I-66 (Virginia) (1981) Boston, Southeast Expressway (1982) Los Angeles (possible 40-100 miles) Portland, I-205/Banfield (1983)
Reserved Bus Lanes Arterials w=with-flow c=contra-flow r=reversible m=median	Baltimore (w) Buffalo (w) Indianapolis (c) New Orleans (m) Washington (w) Seattle (w)	Madison (c)	Honolulu (c) Philadelphia (w) San Juan (c)		Honolulu (c)	Miami, NW 7th Ave. (r) Miami, US 1 (w + c) Seattle, SR-522 (w) Arlington (w)				Portland (r)			
Bus Priority Signal Systems on Arterials and CBD Streets pre=preemption pro=progression				Louisville (pre) Washington DC, (pre)		Miami, NW 7th Ave. (pre + pro) Miami, US 1 (pro)		Sacramento (pre)	Santa Cruz (pre)	Dallas (pre) Houston (pre) Memphis (pre) Santa Clara (pre) Portland (pre) Concord (pre)	Minneapolis (pre)		



Shirley Highway Busway and Exclusive Bus
and Carpool Lanes, Washington, D.C.



Minneapolis I-35W: Metered Ramp with
Bypass Lane for Express Buses

replications in other cities are shown. The order and sequence of applications of these concepts is indicative of the impact of demonstration projects upon the diffusion of innovations.

Conventional Transit Improvement:

- Washington, DC Low Fare Downtown Off-Peak Service (1974)

- Amherst Free Fare Transit Service (1975)

The low fare off-peak circulation system in the central business district in Washington, DC proved to have a positive impact on CBD mobility and was used by 4000 riders per day. Replication of low and fare free service has occured in many downtown areas since the above projects in Washington, DC and Amherst.

Special User Groups:

- Cranston (TRANSVAN) Door-to-Door Transportation for the Handicapped and elderly (1974)

- St. Petersburg (TOTE) Door-to-Door Transportation for the Handicapped & Elderly (1975)

- Baton Rouge Special Transportation Services for the Elderly and Handicapped (1975)

- Cleveland Coordinated Neighborhood Transportation for the Elderly (1976)

Until recently, public transit has not been responsive to the needs of the special user groups such as the handicapped and elderly who cannot make use of conventional mass transit. The initial phase of projects addressing this need demonstrated the role of demand-responsive transportation as a special service for those who cannot use the local fixed-route system. Current demonstrations of services for special user groups are testing techniques for more efficient service delivery, including coordinating human service agency travel, user-side subsidies, and arrangements which involve the private operator.

Although most of the earlier projects involved some degree of evaluation, the lack of consistent procedures for carrying out the various evaluation activities and the lack of standardized performance measures hindered, and in some

Special Transportation Services for the Elderly
and Handicapped, Baton Rouge, Louisiana

Bus Used in the Neighboorhood Elderly
Transportation Project, Cleveland, Ohio

cases precluded any useful comparison of results of one project to another or any extrapolation of project results to other interested cities. These projects produced reports which were printed, distributed and placed in the National Technical Information Service (NTIS). But the lack of widespread knowledge of the results of these projects indicates that the dissemination approaches used were too passive.

In recognition of the deficiencies and problems, the Service and Methods Demonstration Program was established in Fiscal Year 1974 to provide a consistent and comprehensive framework within which to formulate, implement, evaluate, and disseminate results of demonstrations. In addition to increasing the number of demonstration projects and expanding information dissemination, it remains important to continue to explore and develop new concepts which might upgrade transit service and urban mobility.

The thrust of the SMD program toward the development of new concepts has been increasing steadily since the inception of the program. Before a promising new technique is likely to be adopted in complex urban environments, there must be sufficient experience about its costs, impacts, and acceptance to encourage innovation outside of the SMD program. For an untested service concept, the selection of an appropriate demonstration site and careful structuring of the implementation and evaluation is crucial to the success of the test. A lack of resources for developing this kind of R&D capability at the state and local level has hampered innovation in the transit industry. On the other hand, there is a growing national need to identify, test and recommend immediate action to improve public transportation. Therefore, the development of new concepts and the conduct of experimental demonstrations are key roles of the SMD program. They constitute a major portion of the activities reviewed in this report, and the emphasis on projects of this type will continue into FY 1978.

CONTENT AND STRUCTURE OF THIS REPORT

The chapters that follow contain a description of all demonstrations and activities being carried out under the SMD program. Results of the demonstrations are summarized and compared to permit an overall understanding of what has been learned about the applicability and effectiveness of various techniques for improving the quality of public transit. Discussions of demonstrations are organized into four program areas: (1) Conventional transit, (2) Pricing and Service Innovations, (3) Paratransit and (4) Special

User Groups. Chapters 2-5 report on demonstration project findings and other activities which support transit improvements in these areas.

Chapter 2 describes techniques for improving conventional transit services, including commuter service, downtown circulation and suburban coverage. Innovative transit and road pricing policies, together with comparative analyses of tradeoffs between transit fare and service improvements, are discussed in Chapter 3. Chapter 4 covers projects providing paratransit service for the general public, including dial-a-ride, vanpooling, shared-ride taxi, and transportation brokerage. Chapter 5 discusses examples of innovative transportation services for special user groups, with emphasis on the handicapped and elderly.

Chapter 6 discusses the philosophy and approach to the evaluation of demonstration projects. Chapter 7 summarizes information dissemination mechanisms used by the program and includes a list of major products and activities in this area.

More detailed information about SMD projects can be obtained from a variety of published sources, including project evaluation plans, interim and final project evaluation reports, and appendix sections from the FY1975 and 1976 SMD Annual Report. References to published reports describing demonstration projects and concept development studies within each program area are listed at the end of each chapter.

REFERENCES

1. P. Benjamin, et al., Service and Methods Demonstration Program Annual Report, Report No. UMTA-MA-06-0049-75-2, November 1975.

2. D. Kendall, et.al., Service and Methods Demonstration Program Annual Report, No. UMTA-MA-06-0049-77-2, April 1977.

CHAPTER 2

CONVENTIONAL TRANSIT SERVICE INNOVATIONS

INTRODUCTION

The goals of the Conventional Transit Service Innovations Division are to provide more efficient transit service and to promote transit ridership in lieu of auto travel. By encouraging more people to leave their automobiles at home and to use public transportation, scarce energy resources will be conserved, new and costly facilities for the automobile will not have to be built, and the urban environment will be improved.

The Conventional Transit Service Innovations Division is oriented towards achieving these goals in the following ways:

- Developing techniques that provide priority for buses and other High Occupancy Vehicles (HOV's)
- Improving the system characteristics of urban transit through schedule and service coordination
- Demonstrating to potential users the benefits of vehicle innovations

Conventional transit service innovations may be divided into four project areas: priority treatment for buses and other high occupancy vehicles, auto-restricted zones, schedule and service coordination, and vehicle innovations. The following paragraphs provide a brief introduction to these concepts.

1. Priority Treatment for Buses and Other High Occupancy Vehicles

There are several ways to give buses and other HOV's significant time savings advantages in congested corridors. Most of these corridors are readily oriented towards the Central Business District (CBD). During the past decade, many HOV priority techniques have been shown to be effective in reducing travel times. These techniques include busways, contra-flow lanes, ramp metering with preferential entry, signal preference, and special toll plaza lanes. Other techniques such as concurrent flow freeway lanes or curb lanes on arterials remain to be proven or improved upon.

For the most part, HOV priority techniques have been effective only in congested CBD-oriented radial corridors. CBD-destined travel, however, accounts for only about 10% of the journeys to work and less than 10% of all urban travel. Therefore, in order to have a more significant impact on the mode split of the overall urban travel market, a wide variety of other comprehensive and universal transit system improvements are likely to be needed.

2. Auto Restricted Zones

Several techniques are available for improving the downtown environment for pedestrians and transit: limitations on the use of the automobile in congested areas, street closings, transit malls, reserved bus lanes on city streets, and traffic signal preemption and progression. An auto restricted zone combines several of these elements into a comprehensive traffic management scheme. A two year feasibility study has been completed and four or five auto restricted zones are to be implemented over the next several years.

3. Schedule and Service Coordination

Most urban travel takes place in suburban areas. Approximately 50% of all journey to work travel and over 50% of <u>all</u> urban travel is intra-suburban. It is difficult for transit to compete against the convenience of the automobile in this environment in which roads are not congested and parking is free and readily available. The intent of the SMD program in this regard is to find ways of providing a <u>system</u> of improved service that is not unreasonably more expensive. Several transit systems in the U.S. and abroad have made <u>system</u> improvements that have attracted significantly increased patronage. This was accomplished through comprehensive improvements of coordinated bus services that are more reliable and provide improved transfer possibilities.

4. Vehicle Innovations

The fourth major area of innovations concerns transit vehicles. Current demonstrations involve testing higher-capacity buses on regular or express service on high volume routes. One way of lowering the cost per passenger is by reducing the driver/passenger ratio through the use of larger capacity vehicles such as double-deck or articulated vehicles.

Another transit vehicle to be demonstrated is an over-the-water vehicle or ferry. There are a number of situations in the U.S. where waterborne transit makes sense, e.g., providing a short cut across an unbridgeable body of water.

The remainder of this chapter is organized according to the four project areas mentioned above. Each section contains an overview describing the previous thrust and future direction of the projects in that particular area. This is followed by a description of each project or study and the findings. Where appropriate, cross-comparisons are made among similar projects. Future projects are described. The chapter concludes with a summary and implications about each concept.

PRIORITY TECHNIQUES FOR HIGH OCCUPANCY VEHICLES

Overview

During the past several years, many well tested and proven priority techniques for High Occupancy Vehicles (HOV) have been adopted through local initiative or under the impetus of Transportation Systems Management (TSM) requirements. Experience has shown that a number of these priority techniques, such as busways, ramp metering with HOV preferential entry, freeway and arterial contra-flow lanes, transit malls, and auto restricted zones, can be effective in reducing travel time for HOV vehicles, making transit more reliable, and improving the urban environment.

The future of physically non-separated concurrent-flow reserved lanes on freeways remains in doubt. Several experiments with this technique in Los Angeles, Miami, Boston, and Portland (see Table 2-1) have revealed problems of safety, enforcement and public acceptance. Termination of the Santa Monica Freeway "Diamond" Lane operation is considered a serious setback to the implementation of HOV lanes in the nation's second largest urban area, Los Angeles, and elsewhere. Several things were learned, however, from the demonstrations:

- The absolute necessity of a carefully prepared public information program well in advance of implementation

- The desirability of implementing transit service prior to the HOV facility

- The importance of well located, large and accessible park-and-ride facilities with frequent transit service

TABLE 2-1. COMPARISON OF FOUR NON-SEPARATED CONCURRENT-FLOW PREFERENTIAL LANE PROJECTS

PROJECT	FACILITY	LENGTH (miles)	OPERATING DATES	LANE RESTRICTIONS	LANE ORIGIN	HOURS OF OPERATION	SPECIAL FACILITIES
Boston: Southeast Expressway	Freeway, 3 or 4 lanes each direction, including use of shoulder in peak direction during peak period	8	5/04/77-11/02/77	Buses and carpools (3 or more occupants)	1 existing lane reserved (inbound)	6:30-9:30 a.m. inbound only	Plastic inserts space 20-40 feet, freeway "metering" for 3 months
Miami: I-95	Freeway, 4 or 5 lanes each direction	7.5	3/15/76-present	Buses and carpools (3 or more occupants, changed to 2 or more)	2 lanes built in median area	6-10 a.m. (changed to 7-9 a.m.) inbound; 3-7 p.m. (changed to 4-6 p.m.) outbound	Flyover connecting major park and ride lot to I-95 after one year
Los Angeles: Santa Monica Freeway	Freeway, 4 or 5 lanes each direction	12.9	3/15/76-8/09/76	Buses and carpools (3 or more occupants)	2 existing lanes reserved	6-10 a.m. (changed to 6:30-9:30 a.m.) 3-7 p.m. inbound and outbound	Ramp metering, some with preferential bypass
Portland Oregon: Banfield Freeway	Freeway, 3 or 4 lanes each direction	3.3	12/15/75 present	Buses and carpools (3 or more occupants	resurfaced, removed shoulder, narrowed lanes	24 hours/day changed to 6:30-9:30 a.m. inbound and 3:30-6:30 p.m. outbound	Newly constructed turnout in lieu of continous shoulder

TABLE 2-1. COMPARISON OF FOUR NON-SEPARATED CONCURRENT-FLOW PREFERENTIAL LANE PROJECTS (CONTINUED)

PROJECT	ACCESS/EGRESS	ENFORCEMENT	TRANSIT	EXPRESS BUS AVERAGE FARE
Boston: Southeast Expressway	Only at beginning and end	Voluntary for first 5 months, enforced last 2-1/2 weeks; increase in police	Minor changes to existing express and feeder bus, rapid rail, commuter rail, and commuter boat; new park and ride route	$1.25
Miami: I-95	Unlimited	Little enforcement; no increase in police	Park and ride and feeder/express bus service increased from 18 to 52 trips per day; new large park and ride lot	.60
Los Angeles: Santa Monica Freeway	Unlimited	Fifty percent increase in police, reduced to normal by 12th week	Four existing feeder/express bus routes increased to 9; 3 new park and ride routes and lots	.61
Portland Oregon: Banfield Freeway	Unlimited	High level of enforcement	Ten express buses added	-

- The likely negative reaction of non-users to a loss of capacity and deterioration of quality of travel

- The desirability of using barriers or buffer zones to control access to HOV lanes in settings in which origins and destinations are scattered over the length of the project

- The necessity of independent, third-party evaluations of controversial projects

- The need to include all affected public agencies and officials, and the public as well, in the planning process.

Because of the increasing acceptance and adoption of most HOV priority facilities, the Conventional Transit Service Innovations Division of SMD is altering somewhat its principal thrust. The most successful and most adopted HOV priority technique innovations benefits express buses in line haul operation on freeways and arterials. However, the time saved during the line haul portion of the trip is frequently lost (or appears to riders to be lost) in central business district (CBD) operations. Therefore, our attention has recently turned to HOV priority techniques that improve the CBD bus operation such as transit malls and auto restricted zones (ARZ) that include a major transit component. These CBD-based projects are discussed in a following section.

Current Projects and Findings

Santa Monica Freeway Diamond Lanes

The Santa Monica Freeway, which connects the City of Santa Monica and downtown Los Angeles, is one of the most heavily-travelled freeways in the world. It is served by a variety of sophisticated traffic control devices, including metered on-ramps with preferential entry provisions at selected locations, a computerized surveillance system, and centrally-controlled electronic displays. On March 15, 1976, the California Department of Transportation (CALTRANS), in conjunction with the California Highway Patrol (CHP) and local bus operators, reserved the lane nearest the median in each direction of a 12-mile segment of the Santa Monica Freeway for the exclusive use of buses and carpools carrying three or more occupants. The reserved lanes, known locally as the Diamond Lanes, operated in each direction during the peak hours of traffic flow. No barrier

Diamond Lane in Operation Showing Electronic Sign and Autos Waiting at Metered On-Ramp, Santa Monica, California

Autos Waiting at Metered On-ramp with Bypass Lane for Buses and Carpools, Santa Monica Freeway, California separated these lanes from the remaining flow of freeway traffic. Implementation of the Diamond Lanes was accompanied by the introduction of a variety of express bus services and the opening of three new Park-and-Ride lots in Western Los Angeles. The Santa Monica Freeway project marked the first time preferential lanes had been created by taking busy freeway lanes out of existing service and dedicating them to the exclusive use of high-occupancy vehicles.

The Santa Monica Freeway Diamond Lanes operated amid much controversy for 21 weeks until August 9, 1976 when the U.S. District Court in Los Angeles halted the project and ordered additional environmental studies prior to its continuation. Much of the controversy at the time consisted of conflicting claims regarding the ability of the project to accomplish its stated objectives of conserving energy, improving air quality, and expanding effective freeway capacity by increasing the occupancy of buses and automobiles using the freeway. Some of these objectives had been attained by the close of the demonstration, although the cost in accidents, congestion, and public outrage was far greater than anyone had anticipated. Major findings on the positive side of the ledger were:

- During the last seven weeks of the project, the Santa Monica Freeway carried 1.8% fewer people in 10.1% fewer automobiles than it had carried prior to the project in the morning and evening peak periods. The entire corridor, including parallel surface streets, carried 1% more people in 5% fewer vehicles.

- The number of carpools on the freeway increased by 65% during the project.

- In response to both the Diamond Lanes and a significant increase in transit routes and service frequencies, daily bus ridership between the Westside study area and the Los Angeles CBD more than tripled, increasing from 1,171 riders per day prior to the project to 3,792 riders per day during the last week of Diamond Lane operation.

- Speeds recorded by carpoolers in the Diamond Lanes were both faster and more consistent than pre-demonstration speeds. Carpoolers traveling the length of the Diamond Lanes were able to save between two and three minutes over pre-project travel times and approximately five or six minutes over travel times in other lanes.

However, certain hoped-for benefits failed to materialze during the short life of the project:

- After an initial increase, fuel consumption levels on the freeway and adjacent city streets dropped slightly during the last seven weeks of the project, falling an estimated 0.8% below pre-project levels.

- Although it is impossible to make conclusive statements about air quality on the basis of the limited samples taken during the life of the project, estimates of vehicle emissions made on the basis of mileage computations indicate that emissions increased early in the project and dropped to pre-project levels by the close of the demonstration.

Moreover, the positive and neutral impacts of the project were counterbalanced by the following negative considerations:

- Freeway accidents rose markedly during the project. An average of 24 accidents per week occurred during Diamond Lane operating hours, roughly 2.5 times the weekly pre-project average.

- During the Diamond Lane demonstration, freeway speeds for non-carpoolers were both slower and less predictable than they were before the demonstration. Although speeds improved as the demonstration progressed, freeway driving time for non-carpoolers traveling the full length of the Diamond Lanes over the last seven weeks of the project were slightly more than one minute longer than pre-project levels in the westbound direction during the P.M. peak and more than four minutes longer in the eastbound direction during the A.M. peak.

- Average delays at the busiest metered ramps increased between one and five minutes per car during the peak hours of morning and evening operations.

- Combining ramp delays and slower freeway speeds, measured increases in total trip times for non-carpoolers traveling eastbound on the freeway in the morning ranged from six minutes per trip at the western end of the freeway to negligible increases at on-ramps near the CBD. Corresponding increases for westbound travelers in the evening ranged from seven minutes per trip for drivers entering near the CBD to insignificant delays west of La Cienega Boulevard for drivers entering midway along the length of the project.

- Aggregate travel speeds on surface streets paralleling the freeway slowed slightly during the demonstration, dropping by about 4.5%.

- The weight of the media and public opinion was solidly against the project. Eighty-six percent of corridor drivers surveyed, including the majority of carpoolers, felt that the Diamond Lanes were either harmful or of no benefit whatever.

After the close of the demonstration, conditions on the freeway approximated those before the project. Although bus service continued and bus patronage remained high - at more than two and one-half times pre-project levels -- the number of carpools dropped to within 5% of the number on the freeway before the Diamond Lanes were implemented.

Thus, the Santa Monica Freeway Preferential Lane project succeeded to some degree in attracting riders to carpools and transit, and increased freeway capacity with a minimum amount of additional construction and enforcement costs. However, the project brought about a significant increase in freeway accidents; energy savings and air quality improvements were insignificant; non-carpoolers lost far more time than carpoolers gained; and a heated public outcry developed which has delayed implementation of other preferential treatment projects in Southern California and given planners and public officials in other areas ample cause for reflection before attempting to implement similar projects.

Miami I-95/Northwest 7th Avenue Preferential Treatment

A three and a half year demonstration project was established in Miami in September 1973 to develop more efficient people-moving capabilities in the I-95/NW 7th Avenue corridor.

An evaluation of the project was performed by the University of Florida Transportation Research Center. The project was divided into two phases. The first phase involved the implementation and evaluation of several bus priority techniques on NW 7th Avenue and the second phase

Reserved Bus and Carpool Lane, I-95, Miami, Florida

Reversible Reserved Bus Lane with Traffic Signal Preemption; N.W. 7th Avenue, Miami, Florida involved the implementation and evaluation of a reserved bus/carpool lane in each direction of Interstate 95 (I-95). A 1320 car parking lot was constructed in the Golden Glades Interchange area and was designated the Golden Glades Park and Ride Facility. Twenty forty-seven passenger buses were purchased for the project and operated as directional peak-period express buses between the Golden Glades Park and Ride Facility and one of four major service areas. Some of the express buses also operated on feeder routes in the residental area north of the Golden Glades Park and Ride Facility.

The following arterial bus priority methods were evaluated during Phase I:

Stage 0	No priority; buses operating in mixed traffic
Stage 1	Traffic signal pre-emption by buses in mixed traffic
Stage 2	Reversible reserved bus lane and signal pre-emption
Stage 3	Reversible reserved bus lane and signal progression
Stage 4	Reversible reserved bus lane and signal progression and pre-emption

The following conclusions were reached:

- Each of the bus priority techniques was successful in reducing the bus travel times and auto travel times on NW 7th Avenue.
- Operational Stage 2, signal preemption and the exclusive bus lane, produced the lowest bus travel times and also produced auto travel times which were quite low.
- Operational Stage 3, signal progression and the exclusive bus lane, produced the lowest auto travel times and also produced bus travel times which were quite low.
- A higher service and maintenance requirement was associated with the signal preemption system. Many of these were false calls due to some short signal phases during preemption operation.

- The violation rate was not excessively high. However, it was higher at the beginning of the project and decreased as the motorists learned about the operation of the bus priority system.

- The accident rate of auto traffic was not affected by the bus priority systems.

- The initiation of the exclusive, reversible bus lane was associated with a significant increase in bus accident rates. The bus accident rates later decreased somewhat and this suggests that part of the initial high bus accident rates was caused by start up problems such as drivers' unfamiliarity with the system.

- When an exclusive bus lane is provided, e.g., the type of traffic pattern on NW 7th Avenue, the provision of bus priority by means of traffic signal progression produces more benefits to the auto traffic flow than does the provision of bus priority by means of bus preemption of traffic signals.

- During the peak periods the (Orange Streaker) express bus system was able to move up to 25% of the total passengers on NW 7th Avenue while the express buses represented only 1-2% of the total vehicles in the traffic stream.

- The route structure and operating schedule of the express bus service produced extensive deadhead time and travel as well as a low number of trips per bus per day.

- The feeder segment and the line haul routes which serve the Miami International Airport and the NW 36th Street employment district operated with consistently low load factors. Elimination or restructuring of these routes should decrease the operating deficit of the system.

- The fare structure did not provide adequate revenue generating capability for the high quality of service that was provided. A restructuring of the fares could reduce the operating deficit.

- The Orange Streaker ridership increased to a total of about 1450 persons for both peak periods. The modal split increased from about 3.0% of the project trips before the Orange Streaker system to about 8.6% of the project trips on the Orange Streaker system.

- If the Golden Glades Park and Ride Facility were not provided, about 30% of the express bus passengers would not have used the express bus service.

- The Orange Streaker service had an extremely high operating deficit but produced substantial benefits to its users. Increased fares and some route restructuring hold potential for increasing the economic viability of the service.

- The decision on whether to provide an exclusive bus lane on a bus improvement project ought to depend upon the volume/capacity ratio in the street and the policy regarding the provision of priority service for buses.

- In most cases, traffic signal progression would be preferred to traffic signal preemption as a bus priority service for buses on an arterial street.

Miami I-95 Results

The newly constructed reserved lanes on I-95 opened in March 1976. The lanes were restricted to buses and carpools with 3 or more occupants and operated for 4 morning hours in the inbound direction and 4 evening hours in the outbound direction. Due to the inability to enforce the lane restrictions, the carpool requirement was reduced to 2 occupants per vehicle and the hours of operation cut in half in January 1977. In February 1977 the flyover connecting the lanes and the park and ride lot opened.

With the opening of the lanes, travel times decreased for everyone because of the 25 to 35 percent increase in freeway capacity. Express buses experienced a decrease in freeway travel time of 40 percent (12.8 minutes to 7.8 minutes) during the 3 person carpool requirement phase and a decrease of 27 percent (to 9.4 minutes) during the 2 person carpool requirement phase compared to the 1974 pre-project period.

The number of vehicles travelling I-95 during the peak periods increased 5 percent during the 3 person phase and 20 percent during the 2 person phase over the February 1976 figure. Much of this increase was due to the population growth in the region. The corresponding increases in person throughput were 14 and 28 percent. Three person carpools increased from 390 just before the lanes were opened to 680 during the 3 person phase, an increase of 74 percent and dropped to 540 during the 2 person phase. An average of 122 carpools used the Golden Glades parking lot for formation. Average auto occupancy increased from 1.23 to 1.28. Express bus ridership increased from 1431 daily trips just before the lanes were opened to 1577 during the 3 person phase, a total increase of 10 percent and to 1683 during the 2 person phase, a total increase of 18 percent.

Nineteen million dollars was spent on the construction of the two reserved lanes, a parking lot, and a flyover. Total project costs were $23 million.

Since there was no median strip, the highway patrol found it almost impossible to apprehend violators safely. As a result there was little enforcement of the lane restrictions, and the violation rate soared to 75 percent. When the carpool restrictions was cut to 2 occupants, the re-defined violation rate declined to 37 percent.

There was no statistical increase in the number of accidents during the operating hours of the project. However, there were a number of reserved lane related accidents attributable to two design elements of I-95: the elimination of the grassed median shoulders that had formerly speared the two flows and had been available for use by distressed motorists, and the solid 8-inch line that demarcated the lane. Distressed motorists unable to reach the right shoulder would stop in the reserved lane, particularly during offpeak hours, thinking it was a breakdown lane. This situation was ameliorated by changing the solid line to a striped line and installing warning signs. The other major cause of accidents was the lane changing activity required for access to the exclusive lane.

Boston Southeast Expressway Reserved Lane

A non-separated, concurrent-flow lane was instituted on Boston's Southeast Expressway on May 4, 1977. On November 2, 1977 it was terminated. The motivating force for the reserved lane was the reconstruction of a portion of the Expressway that reduced its capacity by up to 25 percent. This was not an SMD project; however, SMD funds were used to assist in the evaluation.

The project was divided into three distinct phases. During Phase I (May) a voluntary reserved lane was instituted. Phase II, the construction period, began in

Reserved Bus and Carpool Lane,
Southeast Expressway, Boston,
Massachusetts

June and continued until mid-October. Phase III began on October 17 with the enforcement of the lane restrictions.

The project's primary goal, to alleviate the potential congestion caused by the roadway reconstruction, was achieved: the congestion never materialized and travel conditions actually improved compared to the March pre-implementation period. Some of this success was due to the increase in vehicle occupancy on the Expressway. In addition, the many public announcements warning drivers to avoid the Expressway did much to discourage people from using the facility, at least during the morning peak. As a result, when the construction began, about 4,000 cars normally travelling the Expressway near the construction bottleneck either shifted to alternate routes or did not make the trip.

It was expected that people would shift from single-occupancy vehicles to carpools and buses. There was a substantial increase in the number of carpools, an increase of 32 percent the first month of lane operation and 71 percent during the enforcement phase. A carpool information booth had been placed next to the Expressway before the project began. Bus ridership increased by only 5 percent. This small increase can be explained, in part, by the fact that almost no new coverage was provided, headways on existing routes were not decreased, and the travel time savings in the reserved lane was only a fraction of total travel time. Ridership on a parallel rapid rail line increased by about 12 percent by the end of the project. During the peak hours in June, 50 percent of the persons on the Expressway were in the reserved lane and experienced a congestion-free ride.

During the summer months, travel conditions on alternate roadways did not deteriorate. The seasonal decrease in total corridor traffic combined with the dense arterial network and considerable excess capacity was sufficient to absorb many of the trips diverted from the Expressway to the arterials.

During Phase I and Phase II the reserved lane restrictions were voluntary, and only illegal weaving in and out of the lane was enforced. The result was a violation rate as high as 80 percent.

The public was informed of the lane restriction through a one-month media campaign. The public was told that the scheduled construction was necessary, and the only way to maintain person throughput on the facility was through the implementation of the reserved lane. The temporary nature of and need for the lane combined with the lack of enforcement appeared to be the primary reasons for the public's willing acceptance of the project. During Phase III, when the construction had been completed and the restrictions were being enforced, the public's attitude changed drastically.

The State officials responsible for the operation of the lane were cautious and flexible in their approach, and their attitude did much to ensure the success of the project during the construction period. The reserved lane was instituted four weeks before construction was scheduled to begin in order to give corridor users a chance to understand and grow accustomed to the concept and make changes in their travel patterns before the restriction in capacity began. During this four week period the operation of the lane was modified as needed: the entry point to the lane was blocked so that all vehicles had to begin from the normal lanes; violators were sent letters requesting that they obey the restrictions; additional plastic inserts were used where heavy weaving was occurring; and the police began enforcing illegal weaving.

The reserved lane succeeded during the summer months because the public perceived a need for it, the capacity limitations were imposed during a less heavily travelled period, the transportation system had sufficient excess capacity to absorb trips diverted from the Expressway, and state officials were willing to fine-tune the project as the need arose. During August and September the situation on the Expressway deteriorated and there appeared to be little difference between the reserved lane and the regular lanes in terms of congestion and vehicle occupancy.

On October 17 the police began enforcing the lane restriction by taking license plate numbers of violators and sending $20 citations through the mail. The legality of this was based on a Massachusetts Department of Public Works regulation that if a police officer cannot reasonably stop a violator on the side of the road, then a summons can be sent through the mail.

Enforcement proved to be an unpopular change in project operations. The violation rate went down to 35 percent, and the number of carpools increased by 72 percent over the before period. However, congestion in the regular lanes became intolerable, and an average trip took 7.5 minutes longer on the Expressway. Articles began appearing in the local newspapers calling the reserved lane a "flop" and a "war against commuters." Two bills were sponsored in the State Legislature, one to prohibit the implementation of preferential treatment systems (voluntary or mandatory) for multi-passenger vehicles travelling the Southeast Expressway and the other to change the restriction to vehicles with two more occupants. No significant constituency appeared to support the reserved lane project. On November 2 after two and one half weeks of intense political pressure and with no apparent political support from the state government (1978 is an election year), the Massachusetts Department of Public Works announced the immediate suspension of the "controversial" Southeast Expressway reserved lane.

Houston North Freeway Corridor Improvements

The Houston North Freeway Corridor Improvement Project evolved from a comprehensive study of four corridors approved by UMTA in July 1975. Preliminary investigations by the City of Houston and the State Department of Highways and Public Transportation (SDHPT) together with data from three park-and-ride lots in other Houston corridors have suggested the feasibility of developing an exclusive contra-flow lane for about 10 miles on the IH45 North Freeway between the CBD and the Houston city limits. Initially, the lane would carry only buses, airport limousines, and registered commuter vans. Most of the buses would be running between the CBD and a park-and-ride lot at the north terminus of the contra-flow lane.

The geometric designs for each terminus and a special entrance/exit at the IH610 Loop have been developed by the SDHPT, and construction began in early 1978. The City of Houston has developed plans for a 750-space parking lot and expects 25 to 30 bus trips per peak period to serve this lot. Park-and-ride service from this lot will be initiated one month prior to the introduction of contra-flow lane service in October 1978. Evaluation planning adjustments to reflect the finalized plans and construction schedule are underway.

Cross-Comparison of Results of Reserved Lane Projects

The three non-separated concurrent flow reserved lane projects in Boston, Los, Angeles, and Miami have met with differing degrees of success and failure. The reserved lane on the Southeast Expressway survived for 6 months only to be cancelled suddenly two and a half weeks after the lane restrictions became mandatory. A Federal judge shut down the Santa Monica project after 21 weeks of operation because an environmental impact report had not been filed. In

Miami, the inability to enforce the lane restrictions led to a lowering of the lane qualification to two or more persons per car.

The three projects resulted in an increase in the occupancy rate of those vehicles using the facility. However, in both Boston and Los Angeles person throughput on the freeways decreased. A promising trend had developed in Los Angeles, and when the project was terminated the Freeway was carrying only 1.8 percent fewer persons in 10.1 percent fewer vehicles. In Boston, the total number of persons carried by the Expressway during the peak period was 8 percent less during the two week enforcement period than it had been before the lane was implemented. Since the dominance of Boston's core area as an attraction zone indicated a much greater potential for carpooling and bus ridership than in Los Angeles, it was possible that an increase in person throughput similar to that experienced in Los Angeles would have developed had the enforcement period continued.

At all three sites the greatest benefits accrued to users of the lanes, carpoolers and bus riders, who experienced decreases in travel times and increases in arrival time reliability. These benefits need to be weighed against any decreases in level of service experienced by users of the reserved lanes. In Los Angeles travel times increased for non-diamond lane users. In Boston, users of the regular lanes experienced a decrease in travel times during the pre-enforcement period but a large increase during the enforcement period. In Miami all users of the facility benefited, but this was a result of the opening of the two additional lanes, at a cost of $19 million, and had little to do with the lane restrictions.

A disappointment with the reserved lane projects was their inability in and of themselves to attract large numbers of new bus riders. In Los Angeles and Miami a large portion of the ridership increases appeared to have been the result of the increase in coverage and schedule frequency and not the travel time savings and increased reliability resulting from the reserved lanes. For most runs, the time spent in the reserved lanes did not represent a major portion of total in-vehicle travel time. However, the reserved lanes were useful in providing a focal point for the transit marketing campaigns and in creating a perceived, as well as a real, time advantage in the minds of the bus passengers. In Boston, where there were almost no transit level of service changes except decreased bus line-haul travel times, express bus ridership increased by only 5 percent.

While the feeder/express routes in Miami and Los Angeles proved to be very popular, they also proved to be very costly, since few buses could make more than one run during each peak period. Park-and-ride lots at the three sites met with mixed success, and this was a function of where they were situated and the frequency of the bus service. In Miami, the success of the park-and-ride service was due, in part, to the placement of a large parking lot 11 miles from the CBD at the confluence of several major highways. Buses travelled to four destinations, and headways were low.

Another disappointment with the reserved lane concept was the number of lane violations that occurred and the difficulty of enforcing the lane restrictions. In Boston the plastic inserts did not prevent drivers from weaving in and out of the lanes. A median strip, where police could station themselves and stop violators, helped keep the violation rate in Los Angeles between 10 and 20 percent. Stiffer fines might have proven to be a deterrent, but the probability of being caught was not that great, especially if upon seeing an officer, the illegal driver was able to weave into the adjoining lane. In Boston and Miami a median area was not available. When Boston began enforcing the lane restrictions by sending tickets through the mail, the violation rate fell from 80 to 35 percent.

One of the most serious problems with the reserved lane projects was the potential for accidents. Accidents were caused by the large speed differential between the reserved lanes and the normal-flow lanes and people making unsafe lane changes, weaving by violators to avoid detection, and by distressed motorists mistaking the reserved lane for a breakdown lane during non-operating hours. Lane changes could be limited by closely spaced plastic inserts, and reserved lane access and egress could be restricted to coincide with major entrances and exits. Boston did this to the extreme by permitting only one entrance and one exit, but motorists still managed to violate the no-weaving restrictions.

At all three sites carpooling increased by about 70 percent. Carpool matching programs did not meet with great success. In Miami no carpool matching program was attempted since such a program had been tried on another project and failed. In Los Angeles, Commuter Computer estimated that it was responsible for the formation of only 193 carpools. In Boston about 400 persons filled out carpool matching questionnaries. It was not known how many of these persons actually formed carpools. Most carpools in Los Angeles were formed among co-workers.

The results of the three non-separated, concurrent-flow projects described here point out the many generic weaknesses in this concept: the large number of violators and the difficulty of enforcement; the potential for accidents; the inability of the reserved lanes by themselves to attract large numbers of new bus riders and carpoolers; and the political problems associated with removing an already existing lane from general use.

Based on the Boston and Santa Monica results, it is not recommended that an existing lane be re-dedicated for preferential use unless there is a pressing need such as a reduction in capacity due to freeway reconstruction. If there is to be a decrease in freeway supply available to non-high occupancy vehicles, this decrease should be phased in order to cushion its effects and to encourage single occupant auto drivers to switch early to other modes or routes. A corridor whose transportation facilities are not already saturated will cushion the transition from pre-project to post-project equilibrium by allowing former users of the freeway the option to switch to alternate routes or other modes of transit if these are preferable to carpooling, taking an express bus, or staying on the freeway's normal lanes. These concepts were well-illustrated in Boston.

A comparison of the performance of these non-separated reserved lane projects with the Shirley Highway reversible lanes and the El Monte busway indicates that when concurrent flow lanes are separated from the general lanes by a concrete barrier or a common shoulder, the accident and enforcement problems are virtually eliminated and the reserved lanes are better able to perform their function of attracting and carrying high occupancy vehicles. The appearance of permanence seems to contribute a great deal to convincing people to switch to HOV's.

Quite often these permanently or semi-permanently separated configurations are not feasible for economic and/or engineering reasons. Boston attempted the minimum in physical lane separation by installing plastic inserts every 20 or 40 feet between the reserved and regular lanes. Unfortunately, these inserts did not prevent a large amount of illegal weaving between the two lanes. Not only did non-carpoolers switch into the reserved lane, but carpoolers illegally left the lane to exit the Expressway.

The evidence indicates that there should be a median strip between the two directions of flow to provide both an area for motorcyle police to station themselves to control the violation rate and a safe area for distressed motorists to stop. To reduce the dangers of lane changing between two lanes travelling at significantly different speeds, the reserved lane entry and exit points should be limited to the beginning and end of the reserved segment and to a few intermediate points.

If space permits, the median shoulder could be shifted to the area between the reserved lane and the normal lanes as is the case with the El Monte Busway Permanent plastic inserts would separate this safety lane from the rest of the roadway. The inserts would be spaced far enough apart so that this empty lane could be accessed by slow moving police and distressed motorists.

Concurrent-flow lanes are applicable when the flow is balanced in each direction. When there is a large imbalance in peak directional flows, and if sufficient capacity exists in the off-peak direction then contra-flow or reversible lanes would be more appropriate.

In addition to the careful selection of the most appropriate form the HOV lanes will assume, factors related to site characteristics, implementation procedures, transit operations, and media treatment must be considered. The primary characteristic of the site that defines the market potential for the reserved lanes is a CBD that is the focal point for regional employment. Any increase in express bus operations should focus on the development of new feeder/express routes with the feeder component used to expand transit coverage, preferably serving more densely populated neighborhoods that currently may have poor access to transit. Park and ride service should be provided only from lots that are distant from the CBD, have good transit and highway access, and are adjacent to the freeway. The public should be made aware of all aspects of the reserved lane project as early as possible. Ramp metering, freeway metering, and pricing can be used along with, or in lieu of, reserved lanes.

Future Projects

Future projects in the bus/HOV priority area address problems or issues for which solutions have lagged. These include two basic kinds of problems or issues:

1. Further development through demonstrations of various HOV priority techniques that have not yet been widely or successfully adopted such as concurrent flow reserved freeway and arterial lanes, traffic signal priority, auto restricted zones, etc.

2. Development of manuals and other documents to aid localities that have been slow to adopt tested and proven HOV priority techniques. A reasonably good body of literature covering technical points now exists to assist in implementing HOV priority projects. However, until recently there has been little to assist localities in the often more vexing institutional problems. A manual has recently been developed that addresses such problems as community involvement, multi-agency cooperation, police enforcement, public information, etc.

Therefore, several future demonstration projects listed below are specifically designed to address these issues.

1. Additional Priority Techniques Demonstrations

   A. Concurrent Flow Reserved Freeway Lane (new lane constructed)
   B. Traffic Signal Priority

2. Testing of Manual to aid design and Implementation of HOV Priority Techniques in the following sites:

   A. Buffalo
   B. St. Louis
   C. San Francisco
   D. San Jose

AUTO RESTRICTED ZONES

Overview

An auto restricted zone (ARZ) is an area created in a congested portion of the city, such as the central business or shopping district, where automobile traffic is prohibited or restricted. At its core is a pedestrian and transit enhancement zone, a space set aside for predestrians and improved transit access. To this core a host of elements can be added: linear transit malls that extend or connect the core to other pedestrian activity centers, reserved bus lanes, transit and taxi facilities, peripheral parking garages, internal or feeder shuttle service, ring roads for the re-routing of through traffic, underground rapid or light rail facilities, congestion pricing for entry into the ARZ, and priority treatment on highways providing access to the area.

An ARZ has several essential elements:

1) it is, in general, two-dimensional and not the linear pedestrian shopping streets that can be found in many American cities;
2) it has a core area where the automobile has been completely prohibited such as a transit or pedestrian plaza;
3) through traffic has been diverted around the area;
4) pedestrian amenities have been enhanced;
5) transit service to (and within) the ARZ has been improved;
6) it is linked to other urban activity centers by transit or pedestrian ways;
7) there is an internal circulation system for transit, delivery, and emergency vehicles.

An ARZ generally requires a comprehensive redesign of a CBD street system to simultaneously benefit all classes of traffic - transit vehicles, trucks, pedestrians, through auto traffic, parked vehicles, etc. Because of the complex nature of most CBD circulation systems, a comprehensive approach to traffic improvements is mandatory. The planning and implementation of an ARZ is a long and costly process; however, the results are likely to be worth the effort. Recent European experience shows ARZ's to be enormously popular with the public and commercially successful. Although the United States is substantially different socio-economically from Europe, the positive results of the Minneapolis, Philadelphia and Portland Transit Malls and other CBD pedestrian areas such as Boston's Faneuil Hall - Quincy Market are positive indicators of the potential for similar success elsewhere.

The principal transportation benefit of transit malls and ARZ's in CBD's is considered to be the increase in reliability. By contrast, the reduction in average travel time has been small. Another important benefit of transit malls and ARZ's beginning to appear is the strengthening and revitalization of the CBD. Such a result is of considerable importance since the CBD historically has been and will continue to be the focus of the majority of urban transit service.

Feasibility Study

A two year study to evaluate the feasibility of the auto restricted zone (ARZ) concept and to develop initial demonstration designs in several selected cities has been completed. The following conclusions about ARZ planning and implementation have been reached: there are substantial opportunities for ARZ's in American cities; city-size is not critical to ARZ success; a strong activity base is required; a wide range of auto restriction techniques is available; the complete prohibition of auto traffic is not the only option; ARZ size is a key determinant of transportation impacts; and the key transportation factor is maintaining accessibility to existing activities.

ARZ Demonstration Sites

Results from this study have been used to select prospective ARZ sites and to develop initial plans for demonstrations. The five ARZ demonstration projects (New York, Memphis, Burlington, Vt., Providence, and Boston) are summarized in Table 2-2. They offer considerable variation within the ARZ theme and provide an opportunity to test the ARZ concept in different types of environments and with different designs. Broadway Plaza is the only linear ARZ in the study. It is composed of an auto free area from 45th to 48th Streets in the heart of the Theater District and a transit mall from 48th to 49th Streets. Additional sidewalk treatment will extend to 59th Street. The area is filled with street activity and is well accessed by bus and rapid rail transit. The Times Square area is deteriorating and is characterized by novelty shops and fast-food outlets. Economic conditions in the area are weak; it is hoped that Broadway Plaza will revitalize the area economically and provide a pleasant environment for workers, shoppers, tourists, and theater goers.

The Memphis ARZ is the simplest of the plans and, by itself, is really not an ARZ. However, the city has already constructed the mile-long Mid-America Mall, and the project will add a second dimension to the pedestrian treatment as well as provide a strong connecting transit link with a major employer, the Medical Center. Also included is the development of a downtown transit terminal, sidewalk improvements, Medical Center shelters, and shuttle service between the CBD and the Medical Center.

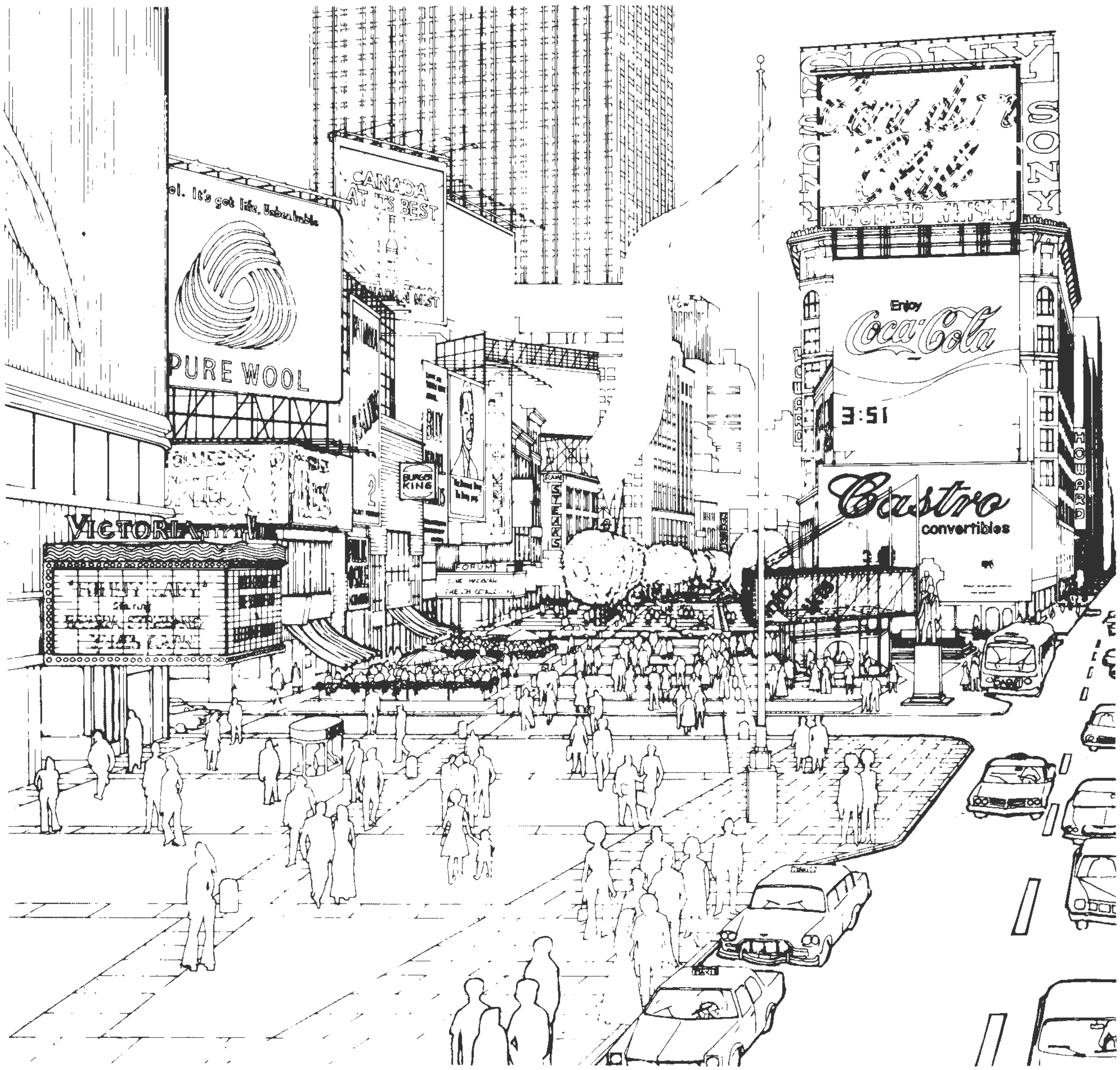
While in both New York and Memphis the ARZ is small relative to city size, and the impact on the rest of the city can be expected to be minimal, this is not the case in

TABLE 2-2. CHARACTERISTICS OF THE FIVE PROPOSED AUTO RESTRICTED ZONE DEMONSTRATION PROJECTS

Characteristics	New York (Manhattan)	Memphis	Providence	Boston	Burlington
Project Area	Broadway, between 45th & 59th Sts. (includes Times Square).	Existing special taxing district in the Memphis CBD & Medical Center area, 1.25 miles outside CBD.	Various parts of Providence CBD.	Core retail & financial districts of Boston CBD.	Four to five block area, comprising majority of Burlington CBD.
Area Land Use	Theater District, offices, service & light retail uses	Office, banking & retailing uses.	Financial district, retail center, Kennedy Plaza, & Union Station.	Retail (principally) & office uses.	Retail, local governmental, institutional & office uses.
Transit Availability	Times Square is a major subway terminal; it is served by 3 bus rtes, operating 60-76 buses/hour; it is also focus for special bus operations ("Culture Bus")	CBD served by 51 transit rtes, which serve areas to north, south, & east. 23 are peak hour routes.	Within statewide transit system, 32 rtes serve CBD & carry 30,000 passengers/day.	CBD is hub of regional transit network that offers a broad array of services (rapid transit, local bus, express bus, shuttle bus, rail & taxi).	Regional transit system operates 7 regular bus routes, all of which converge on CBD where they are interconnected.
Pedestrian Activity	Most north-south blocks in project area carry several thousand pedestrians at midday & evening peaks.	Mid-America Mall is a major pedestrian area, linking 2 important areas, Court Square & Civic Center Plaza.	Pedestrian activity peaks during lunch time; a 2nd high period is between 4 & 6 p.m. Westminster Mall & section of Weybosset St. adjacent to Mall carry high volumes.	At peak, pedestrian volumes on Washington, Tremont, Summer & Franklin are in 5,000-9,000/hour range; facilities to accommodate these volumes lacking.	Noon hr. pedestrian volumes show Church St. as major pedestrian corridor, with high of 581 pedestrians by City Hall This is considered high within the scale of Burlington.
Economic Viability	Area considered "weak" although census figures show Manhattan CBD, including Times Sq., faring better than most CBD's as retail center.	CBD retail position weakening in face of competition from suburban retail outlets.	After construction of Westminster Mall, retail sales in CBD increased by 1.5%, compared to a 20% decline in rest of city.	Since 1972, a 14% constant dollar decline in retail sales; however, vacant retail floor space is minimal & major retail establishments are showing commitment to CBD.	CBD still viable, although 14 suburban shopping centers have reduced the City's share of retail market; currently, plans to build a large suburban mall may affect economic viability.
Project Status	Construction beginning fall 1978; completed after 12-14 months.	Construction during fall 1978; completed summer 1978.	Construction during spring 1979; completed fall 1980.	Construction during summer 1978; completed Sept. 1978.	Delayed indefinitely.
Project Cost	$6,250,000.	$1,241,820.	$5,866,000.	$3,217,955.	$6,073,000

TABLE 2-2. CHARACTERISTICS OF THE FIVE PROPOSED AUTO RESTRICTED ZONE DEMONSTRATION PROJECTS (CONTINUED)

	New York (Manhattan)	Memphis	Providence	Boston	Burlington
Funding Sources	UMTA (Sec.3) $2,368,000 UMTA (Sec.6) 500,000 Urban Systems 1,498,000 State & Local 1,234,000 HUD Community Development 650,000	UMTA (Sec.6) $960,000 State 100,000 Local 181,822	UMTA (Sec.3) $3,925,000 UMTA (Sec.6) 960,000 Local 981,000	UMTA (Sec.3)$ 795,000 UMTA (Sec.6) 1,516,955 Urban Systems 906,000	Uncertain
Primary Objectives	To promote economic development of area & create focal point to promote identity of Times Square.	To connect independent elements of downtown & to coordinate their operation for short-range downtown improvement.	To connect downtown districts, enhance pedestrian environment, improve transit service, disperse traffic, provide adequate facilities for goods delivery.	To increase retail sales, bus ridership & pedestrian volumes.	Stimulate downtown economy, improve accessibility, provide positive urban image & environmental quality, encourage use of non-auto modes
Vehicle Restrictions/ Road System Changes	Broadway between 45th & 48th closed to all traffic; between 48th & 49 a 1-block transitway; between 49th & 59th, priority treatment for buses.	No major changes.	Auto traffic eliminated from Dorrance & Francis (transit malls), Kennedy Plaza/Union Station area & 1-block extension of Westminster Mall.	Auto traffic eliminated from all of Winter, Hawley, Temple Place & portions of 4 other streets Circulation pattern simplified.	Church closed to traffic. 4 streets converted to throughway operation. Traffic redistributed to periphery of CBD.
Transit Modifications	Revised bus rtes. due to detour caused by Broadway Plaza; special taxi & transit loading areas; transit information center.	Shuttle bus service to Medical Center area; new downtown bus terminal; 2 Medical Center bus shuttles.	Through bus routing & free fare zone downtown; new transit terminal berths, busway & terminals.	Bus routes changes;exclusive transitways & contraflow bus lanes; 5 new taxi stands.	Route changes, new transit terminal, 10 new buses.
Goods Movement Changes	Deliveries before 11 a.m.	No major changes.	Re-routing, creation of loading areas, & loading restrictions.	Deliveries before 11 am except for certain time dependent deliveries permitted after 2 p.m.	Planned options include off-peak deliveries or a series of loading zones.
Parking Changes	On-street parking eliminated.	Elimination of 89 on-street spaces.	Elimination of 242 spaces.	Elimination of 600 spaces.	Elimination of 196 spaces; 400 created by new parking garage.
Changes in Pedestrian System	Pedestrian plazas & sidewalk improvements.	Sidewalk improvements.	Exclusive pedestrian areas; sidewalk improvements.	Full pedestrianization of some sts. Increased space on others.	4 block pedestrian zone with amenities.
Expected Impacts	1-5 min.increases in bus travel time; thru-auto traffic adversely affected;delays on cross sts;improved pedestrian environment & meeting place;economic development.	500 passengers/day on shuttle bus;economic development;improved physical & functional quality of pedestrian environment;thru-auto trips affected adversely.	CBD transit trips up 10%; auto trips down 3.2%; improved transit travel times; improved environment; thru-auto traffic adversely affected; beneficial historic impact.	Increased regional transit ridership(2.2%); goods movement costs(6.5%);retail sales & congestion; improved accessibility to CBD;improved air & noise environs; reduced pedestrian conflicts.	Increased pedestrian activity (40-60%),goods delivery (2.6%), retail sales (10-20%); improved air & noise environment; reduced pedestrian conflicts; thru-auto redistributed to periphery.



Artist's Conception of Broadway Plaza ARZ, New York City

Burlington where the proposed four by five block ARZ includes the majority of the CBD area. The Burlington ARZ consists of a pedestrian mall on the major shopping street, other street closings and improvements, a large parking garage on the periphery, the re-routing of buses through the ARZ, and a shuttle bus service connecting the ARZ with the University of Vermont campus.

While Providence is much larger than Burlington, it, too, has a compact downtown. The ARZ project in Providence covers only a small portion of the CBD area but will provide an important pedestrian and transit link between the other major CBD activity centers; the retail district that already has a pedestrian mall, the financial district, and the refurbished Amtrak Union Station. Limited right-of-way space is to be re-allocated to pedestrians and transit while major through circulation for automobiles has been moved to the periphery. The plan calls for a main transit terminal, two busways, a bus lane, and a pedestrian plaza in front of City Hall. Through-routing of transit vehicles and a fare-free zone is also planned.

The Boston ARZ calls for a transit mall, the closing of several streets, and the re-routing of buses to provide access directly into the ARZ. It will serve to link the Washington Street shopping area to the other major pedestrian activity centers: the Boston Common, the Waterfront, and Government Center.

Demonstrations at these sites are expected to be funded, implemented and evaluated over the next several years.

Transit Malls Study

A transit mall is a street on which standard transit vehicles are given exclusive or near-exclusive use, sidewalks are widened, and amenities are added for pedestrians and waiting transit patrons. As a compromise between preferential treatment for transit vehicles and a full pedestrian mall, transit malls may have an impact on transit service and economic conditions. The New York and Boston ARZ projects include a transit mall component. Since the late 1960's, three transit malls have been implemented and about 10 more are in some stage of development in the United States.

The multi-city transit malls study consists of a completed site report and an ongoing evaluation. The transit malls included in the study are not all SMD-funded.

The site report covers two cities with completed malls (Minneapolis, MN and Philadelphia, PA) and four cities with malls in various phases of planning, design, or construction (Denver, CO; New York, NY; Madison, WI; and Portland, OR). Table 2-3 summarizes the transit mall projects. Figure 2-1 contains examples of two transit mall block designs. It was found that expected economic benefits are usually the main reason for building a mall, and that implementation often depends on the involvement and cooperation of local businessmen. Rerouting of bus lines on to the malls, new shelters, and information displays are common transit service changes. Total costs range from $3.8 to $16.9 million; per sq. ft. costs range from $15 to $37.50. The extent of amenities and number of blocks involved help explain these cost variations. The choices of a one or two street mall, one or two directional flow, roadway curvature, midblock pedestrian crossings, and signal timing at cross streets affect the capcity for buses and bus speed. These factors can be used to enforce a bias toward pedestrian or transit use. Funding has been the primary bottleneck to implementation. Major sources are UMTA capital grants, transit authority or city funds, and property assessments. The last is the most difficult to arrange due to resistance to costs and problems of "equitable" assessment among property owners. Additional bottlenecks include fears of congestion on streets receiving diverted autos; maintaining access (or paying compensation) to parking establishments; arranging goods delivery by means of off-hour, cross street, or rear alley loading; and fear of interrupting business during construction.

The evaluation phase focuses on the malls in Minneapolis, Philadelphia, and Portland (under construction) and on a peak-hour buses-only street in St. Louis. Preliminary results are as follows:

- Transit travel time remains the same.
- Transit reliability is improved.
- The bus system is better understood by the public.
- Traffic diversion does not cause congestion on alternate streets.
- Malls with exclusive transit use of the roadway encourage motorists to obey the traffic

TABLE 2-3. CHARACTERISTICS OF FIVE TRANSIT MALLS

SITE	PROJECT STATUS	PROJECT COST	FUNDING SOURCES	PRIMARY PROJECT BACKERS	AREA LAND USE	EXPECTED BENEFITS	TRANSIT TYPE
MINNEAPOLIS Nicollet Mall	Completed 1967	$3,800,000 $1,170 per ft. $15 per sq. ft.	74% Assessment district 13% UMTA demonstration grant 13% Urban Beautification grant	Downtown business	Retail core Offices	Retail improvement. Improve bus service/ operations.	Standard transit buses. Shuttle minibuses. Re-routing onto mall.
PHILADELPHIA Chestnut Street Transitway	Completed 1976	$7,000,000 $1,300 per ft. $22 per sq. ft.	80% UMTA capital grant 16.7% State DOT 3.3% City capital funds	City govt./ planners Downtown business	Retail core Offices	Improve retail environment. Transit for Bicentennial crowds. Upgrade transit	Standard transit buses. Tourist buses. Minor re-routing
PORTLAND – Fifth & Sixth Streets Malls	Under construction; expected completion by mid-1978	$15,000,000 $2,700 per ft. $33 per sq. ft. Plus $1– 1.5 million added utility costs	80% UMTA capital grant 20% Tri-Met Plus utility costs by city depts./utility companies	City govt./ planners Downtown business	Office core Intersects retail core	Increase transit use & operational efficiency Retail/pedestrian environment Reduce suburban sprawl.	Standard transit buses Re-routing onto mall
MADISON – State Street Mall/ Capitol Concourse	Pedestrian mall complete 1975. Capitol Concourse construction scheduled 1977-78. State St. in design phase, completion 1979.	$7,800,000 $1,150 per ft. $16 per sq. ft.	Mix of City, University, UMTA Sec. 3, & assessment district (varies by phase — see text)	City govt./ planners	Retail Government	Improve pedestrian environment Upgrade retail area Upgrade transit	Standard transit buses Shuttle buses
NEW YORK – Broadway Plaza	Under design, construction to begin 1978	Estimated $4,500,000 $2,370 per ft. $23 per sq. ft.	City capital budget plus federal funds (UMTA capital, FAUS, community dev.)	City govt./ planners	Mixed retail, office, theatres	Improve pedestrian environment Upgrade economic conditions Symbolize city commitment to area.	Standard buses, special loop, tour, & airport buses.

TABLE 2-3 (cont'd) CHARACTERISTICS OF FIVE TRANSIT MALLS

SITE	NON-TRANSIT USES	BUS VOLUME	PEDESTRIAN VOLUME	TRAFFIC SIGNAL TREATMENT	MOVEMENT OF GOODS	AMENITIES
MINNEAPOLIS – Nicollet Mall	Taxis Emergency vehicles Bicycles	Peak hr.: Before: 20/ea. way After: 60/ea. way	Before: 1,068/block side/hr., 12-hour period After: 1,114/block side/hr., 12-hour period	Re-set for cross traffic flow (computerized traffic control system scheduled).	Alley loading; mall loading by special permit.	Extensive, including electric snow-melting mats, sign ordinance, bus shelters
PHILADELPHIA – Chestnut Street Transitway	Taxis at night, one block only day Emergency vehicles General traffic (1 block only)	Peak hr.: Before: 43 (one way) After: 41/eastbound 11/westbound	After: 3,016/block side/hr., peak periods on major blocks	Bus-triggered mid-block warning light. Signal timings set for expected bus speed. Timings on nearby street reset.	Cross st. loading; on mall by special permit in off-hours	Typical, with mid-block crossing area.
PORTLAND – Fifth & Sixth Streets Mall	General traffic on one lane for 3/4ths of blocks	Peak hr.: Before: 32 6th Ave. 85 5th Ave. Expected After: 207 6th Ave. 211 5th Ave.	Before: 444 6th Ave./ 686 5th Ave./ block side/hr., off-peak periods.	Computer controlled with progression to be adjusted for buses.	Cross st. loading; on mall by special permit in off-hours	Extensive, including bus shelters and concession booths, CRT information display.
MADISON State Street Mall/ Capitol Concourse	General traffic on Capitol Concourse	Peak hr.: Before: 60 (2-way on State St., 1-way on Capitol Square)		On Capitol Square set to make leaving concourse difficult.	Loading on alleys, cross streets, some curbside during restricted hours.	Typical
NEW YORK – Broadway Plaza	General traffic on 5 blocks Taxis on 1 block, plus special loading area.	Peak hr.: Before: 60-76 (1-way) Expected After: No Change	Before: 7,500/block side/ hr., peak hr. on major block	Possible regressive signalization to discourage use on Broadway, Seventh Ave. signals re-set.	On pedestrian mall: loading during morning hours in emergency r-o-w.	Typical, including ticket booth and information center/performing platform.

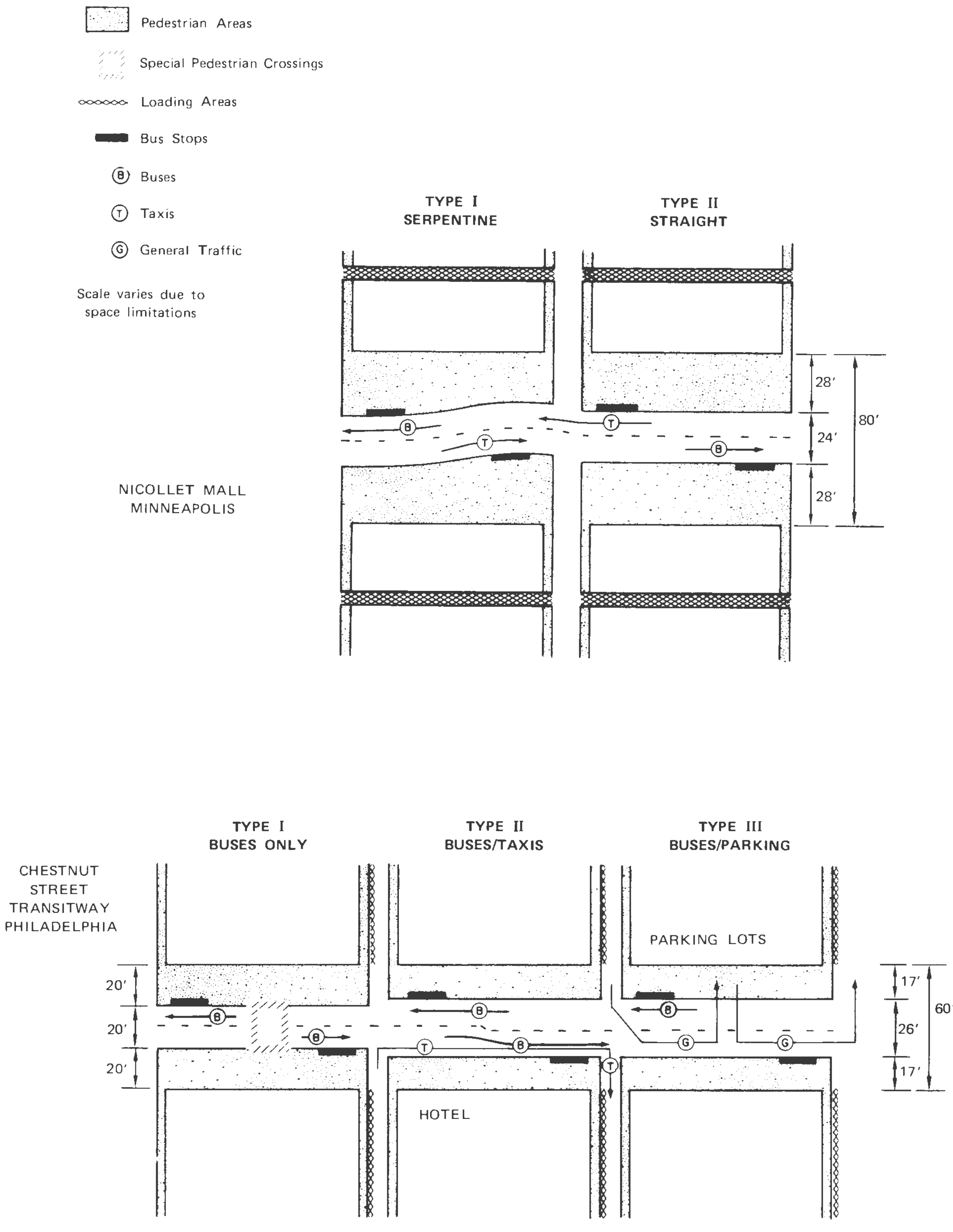


FIGURE 2-1. TYPICAL TRANSIT MALL BLOCK DESIGN

restrictions, compared to transit malls with partial auto access.

- Malls create an attractive and popular environment for pedestrians.
- Jaywalking is common.
- Auto ban may lead to an increase in pedestrian injuries.
- Malls support the retail business climate.
- Particular businesses are hurt by inconvenient access for delivery vehicles and motorists.
- Minimal relocation of utilities, special walkways, and careful phasing of work limits the impact of construction.

SCHEDULE AND SERVICE COORDINATION

Overview

About 90% of all non-walk trips in U.S. urban areas are by auto. Transit modal split is about 5%-7%. Bicycle, motorcycle and taxi modes account for the rest. Such an overwhelming dominance of the urban travel market by the auto is the result of the auto's clear superiority of service characteristics. Auto travel is dominant for obvious reasons; it is convenient (almost instantly available day or night), reliable, flexible, and provdes nearly ubiquitious access. The auto and highway network provdes a complete SYSTEM of travel service allowing for the widest range of travel desired.

If transit advocates expect transit to compete more successfully, they must also recognize that transit should provide a higher quality of the service characteristics desired by travelers. Transit patronage has declined by about 2/3 in the last 30 years although transit vehicle mileage declined by only 1/3 in the same period. This reduction in patronage is partly due to the increased usage of automobiles for trips made previously (same O&D) and partly due to development of vast low-density suburban areas not served well or at all by transit. These new suburban areas are characterized by multi-nucleated centers of activity. Most suburban travel is entirely intra-suburban--never entering the central city. New transit techniques that are adapted to the more dispersed origin destination travel in the suburbs are required.

A relatively new transit service technique known variously as Timed Transfer Focal Point, Pulse Point, Transit Center, etc. has been identified to more efficiently serve the dispersed suburban travel. This technique modifies or augments the existing transit service so that routes intersect preferably at activity centers on schedules designed to insure a transfer time between routes of less than five minutes. The technique has been working successfully in the Canadian cities of Vancouver and Edmonton for several years. A number of U.S. cities will be implementing timed transfer operations in the next couple of years.

Aside from alteration of routes and schedules, a Timed Transfer operation should be accompanied by significantly improved public information programs and physical improvements such as bus platforms, shelters, benches and priority facilities where necessary at the transfer points. Timed Transfer services should be operated on a consistent "clock" schedule to permit easy memorization of schedules. This will enhance the usability of system for irregular users. Experience from Vancouver and Edmonton show that successful Timed Transfer services can be operated at 15 or 30 minutes headways. Admittedly, 15 or 30 minute headways are not as convenient as the auto but can be found acceptable if schedules are reliable. Transit reliability, therefore, is another important area for improvement. Several techniques for improving transit reliability already working in France and Ireland have been identified. These techniques will be tested in actual demonstrations in the coming years in the U.S. The timed transfer and service reliability projects are discussed below.

Timed Transfer Bus Service

The SMD Program is examining the concept of Timed Transfer bus service as a means of improving suburban transit travel. As discussed above, the Timed Transfer concept is a fixed-route planning and scheduling technique for metropolitan areas with widely scattered trip origins and destinations but with insufficient passenger demand to justify a high frequency transit system. The central feature of the concept is the scheduling of buses to meet simultaneously at transfer points to permit across-platform transfers and minimize transfer wait time.

Bus routes which operate on a timed transfer basis ideally should have the same headway as all routes they meet; but Timed Transfer services operate successfully without all buses meeting. Transfer points are usually located at major activity sites such as shopping centers or town centers which are themselves origins and destinations of transit travel. Such locations are desirable operational techniques but not essential ingredients of the concept.

Time transfer transit services in Vancouver, British Columbia, and Edmonton, Alberta, cities operating multi-node timed transfer bus services, were investigated. Major findings from this effort were as follows:

- Implementation of the concept leads to reduced travel times for riders between widely scattered origins and destinations and may increase the number of households that satisfactorily meet their daily transportation requirements by transit.

- The timed transfer concept entails numerous facets which may increase operating costs. These include less efficient route design, frequency of service which is determined by network rather than local demand, and time losses in entering and exiting the transfer facilities, as well as waiting for the completion of the transfers.

- Operational problems with timed transfer are particularly severe during rush hours, when road congestion can make it impossible to obtain schedule adherence without excessive layover times.

- The detailed location and design of the transfer facilities are major factors affecting the efficiency of the service, both in terms of travel times and operating costs. Good transfer facilities require off-street sites which have easy access from and egress to the arterial street network, and which are within easy walking distance of traffic generators. Nearly all capital costs generated by timed transfer operations are associated with the land acquisition for and the design and construction of the transfer facilities.

The SMD Program is actively pursuing a site for a demonstration of timed transfer transit service to further test its operational feasibility.

Transit Service Reliability Study

A comprehensive study of transit service reliability has been conducted which examines the impact of reliability on travel behavior, reliability from the transit operator's perspective, empirical measures of reliability, causes of reliability problems, strategies and techniques for improving reliability, and future studies needed to gain a better understanding of the impact of reliability on transit operations and travel behavior. For the purpose of this study, service reliability has been defined as the invariability of level of service attributes including, but not limited to, travel time and its components.

The goals of this study include; (1) the fostering of transit reliability improvements through the dissemination of new awareness of the role and importance of transit reliability; (2) the identification and development of improvement strategies that can be demonstrated; and (3) the improvement of the measurement and evaluation of reliability in complex demonstration settings. This study is nearing completion; some findings can be offered.

Attitudinal studies have indicated that reliability is considered an important determinant of travel choices. Conceptually, in planning trips, travelers may be thought of basing their behavior not only upon the average values of relevant service characteristics, but also on the variability of these characteristics. For this reason, the reliability of travel alternatives will potentially influence trip frequency, destination, mode, and route choice. Reliability may also be a strong determinant of travel behavior once these basic travel choices have already been determined. For example, when it is necessary for travelers to reach destinations by a particular time, most travelers will base their departure times on both average travel times and travel time variability.

Preliminary analysis suggests that transit reliability improvements will tend to reduce average transit wait times and in-vehicle travel times as well as their variability and will enable many travelers to obtain travel time savings. Significant improvements in transit reliability may also encourage users of other modes to switch to transit.

Transit operators typically view unreliability in terms of aggregate system performance (e.g., adherence to schedules) and view unreliability as a system characteristic which increases the cost of providing service. This is because the operator must allot greater amounts of slack time or layover time to counteract the probabilistic nature of transit service. Improvements in reliability, therefore, are likely to benefit transit providers through a reduction in the vehicle-hours and driver-hours required to produce the same amount of service, or through an increase in the amount of service that can be provided with the same expenditure of resources.

The importance of transit reliability to both travelers and operators indicates the need to identify and develop meaningful measures of transit reliability. Because service attribute distributions are likely to be non-symmetric, three separate measures for each relevant attribute are recommended to assess the reliability impacts. A measure of compactness is desirable to indicate the predictability of the service attribute; a separate measure of the tail is useful to examine the likelihood of extreme values; finally, the mean value of the attribute is useful for comparative analysis.

Specific causes of unreliability in transit service, apart from vehicle reliability problems, have been found to be inherent in the transit service concepts as well as the result of exogenous factors. Examples of transit concepts with inherent unreliability include the basic instability of fixed-route services in terms of headway (i.e., the tendency of buses to cluster and bunch as they proceed along a route) and the inherent variability associated with dynamic routing in demand-responsive system. Similarly, exogenous factors such as traffic signals and traffic congestion are strong determinants of service reliability.

A variety of strategies has been identified for improving reliability. These include priority techniques such as exclusive lanes, signal preemption, and merge/freeway access. Operational strategies may entail reserve fleets and drivers, express service, improved schedule planning, payment schemes, and computer dispatching. Finally, bus control strategies include holding, passing, turnback, skip stop, and speed modification.

Future research should include analytical studies that pursue further the importance of reliability and its effects on operator and travel behavior. Demonstration projects could examine utilization of control point holding strategies, priority schemes, restructured routes, rescheduling, and traffic engineering strategies for improving transit service reliability. Limited results to date have shown promise in these areas.

Future Projects

Future projects in the schedule and service coordination area address improvements to suburban transit services and simplification of transit route structures. Transit typically serves only about 2% of intra suburban trips. If the U.S. is to achieve its goal of reducing its heavy reliance on the auto and its concomitant high energy consumption, then ways of improving suburban transit service must be developed.

Several projects that address this issue are currently in planning and approval phases. An additional timed transfer demonstration (mentioned previously) will be funded. A new technique, Beltway Bus Service, will also be tried. Because of the Interstate Highway program, most U.S. cities of significant size are now ringed by a beltway or limited access circumferential freeway. These roads, which _could_ be used to provide improved circumferential transit service for the suburban trip, are now almost totally devoid of transit service. One reason for this is that the freeway design does not permit easy access and egress or transfer between a beltway transit service and a connecting radial arterial service.

A Beltway Bus Service demonstration would involve the improvement of both the transit services and modification of the freeway interchange area to permit easy transfer between intersecting transit routes. Interchange modification should address the integration of carpool, vanpool, shared-ride and other paratransit services. It is believed that, at a minimum, Boston, Baltimore, Washington, Atlanta, Chicago, Portland and Los Angeles have the appropriate combination of suburban density and beltway configuration to provide a valid test of this concept. The Beltway Service would probably require significant capital resources for interchange modification, and additional Beltway transit service would also be costly because it would probably tend to service proportionately more peak-period trips, which would aggravate the peak-to-base ratio which always increases transit operation cost.

Another technique to simplify large urban area systems, Zoned Bus System, will be demonstrated. The user of a conventional, fixed-route and fixed-schedule system usually must have knowledge of all of the routes and schedules (if headways are greater than 10 minutes) of the services to be used. This is most difficult in large systems. For example, there are over 750 different, discrete routes in the Washington Metropolitan Area Transit Authority system. This number of routes makes it virtually impossible to convey the necessary system-wide route and schedule information easily. For a traveler making a repeat round trip between home and work, this is of little concern. However, a nonregular trip would require access to a system-wide array of route and schedule information, or a phone call to the transit information number. This often can be an arduous and/or inconvenient process.

What is needed is a system whereby route and schedule information can be communicated easily to the user. The desired goal is something simple enough to be memorized, or have its route and schedule/headway information conveyed on one pocket-sized document. Such a simplified system with its attendant improved information qualities would encourage more nonregular (non-work trip) patronage which would occur during off-peak hours when excess capacity is available for no increase in cost of operation.

Zoned Bus, or a trunk and feeder-route, system was implemented in one corridor in Osaka, Japan, in 1974, with significant positive results. Average travel time was reduced 10%, the maximum travel time was reduced 30% and patronage increased about 10%. Other expected benefits of the zoned bus system included:

- Reduction of problems of knowing scheduled departure times. Because of the long distance traveled on congested arterials, it is difficult to keep the normal bus system service on schedule. With the zoned bus system's significantly higher frequency of trunk service, precise schedule adherence is less important. It may, therefore, be possible to improve system efficiency by reducing the required slack time.

- Greater efficiencies in matching vehicle size to load. In a zoned bus system, it may be possible to tailor-fit different sized buses for different uses. For example, large or "super-buses" of 90-100 passengers (articulated or double-deck) can be used on the heavily patronized trunk routes, and therefore, improve the passenger/operator ratio. Smaller, lighter and quieter buses can be used on the feeder routes that penetrate residential neighborhoods.

- Compatibility with Timed Transfer concept. The zoned bus system is felt to be highly compatible with another transit improvement concept being tested in an FY 1978 demonstration project. The timed transfer concept involves circumferentially oriented routes intersecting at suburban nodes on a schedule designed to minimize transfer time. The branch or feeder lines of the zoned bus system could simultaneously be the circumferentially oriented suburban lines.

A possible drawback might include resistance by passengers to transfers. It is well known that transfer and transfer waiting times are major impedances to transit passengers. All other things being equal, transfers tend to have a negative effect on transit patronage. It is hoped that attention to minimizing wait times and improved transfer facilities such as shelters, across transfers, etc., will reduce the negative impact of transfers.

VEHICLE INNOVATIONS

Overview

The Service and Methods Demonstration Program is concerned with improving service to individuals and not the development of new hardware or equipment. Occasionally, however, a situation arises in which some "off the shelf" equipment is proposed for a new application, or a technology which is proven and used in other countries is tested in the U.S. market to determine how the public will respond and how transportation providers perceive the usefulness of the equipment. Even though equipment may be accepted in other countries, there may be a reluctance for transportation providers to risk their scarce resources on it if they do not have a knowledge of such factors as public reaction and maintenance history.

This was the case of the double-deck bus. This type of vehicle had been out of use for so long in the U.S. that transit companies were uncertain how riders would respond, whether they were as safe as U.S. buses, whether they would hold up under local driving condition and whether they would be easy to maintain. The projects were conducted not to develop new hardware, but to gain data for making a national decision as to the acceptability of such buses in the U.S. market.

The same situation is true with the forthcoming waterborne transit demonstration. Water rights of way are underutilized in many cities, are relatively inexpensive to develop and could prove useful in providing fast, economical transit service to particular market segments. The approach is to take an available boat and test it in revenue service on major commuter and off-peak routes. The data generated by the experiment will allow planners to better assess the utility of high speed boats in transit use.

Another innovation in this area is the transit bicycle integration demonstration that will demonstrate the feasibility of coordinating bicycle transportation with fixed-route bus transit. The project will employ bicycle trailers and bicycle storage lockers as methods for improving access to bus routes for bicycle users. The double-deck bus, waterborne transit, and transit bicycle integration demonstrations are discussed below.

Double Deck Bus Demonstration

The Double Deck Bus Demonstration Project involved the purchase and operation of contemporary double-deck buses in New York City and Los Angeles. Through experience in daily revenue service it was possible to ascertain the operational and economic feasibility of the double-deck bus for several types of transit service conditions. In New York eight British Leyland double-deckers operated on two Manhattan routes characterized by congested traffic, heavy passenger loads, frequent stops, and frequent passenger turnover. In Los Angeles the two German Neoplan buses operated between the suburbs and the central business district, providing a combination of express and collection/distribution/park-and-ride services. The specifications of the double-deck buses and the conventional buses used for comparative purposes are given in Table 2-4. Table 2-5 gives important characteristics of the demonstration.

The Double Deck Bus Project was hampered by problems related to the purchase of foreign vehicles and vehicles that had undergone re-design to meet American requirements. The situation can summarized as follows:

- Dealing with a foreign manufacturer resulted in project delays, poor communications (in Los Angeles), unfamiliar mechanical design, and a lack of adequate and easily accessible spare parts.

- The prototypical nature of the vehicles resulted in an unsatisfactory level of mechanical reliability and recurring maintenance problems.

TABLE 2-4

SELECTED DOUBLE-DECK AND CONVENTIONAL BUS SPECIFICATIONS

Specification	New York British Leyland Double Deck	New York GM Conventional	Los Angeles Neoplan Double Deck	Los Angeles Flxible Conventional
Passenger Capacity:	81	68	98	71
Seated-Upper Level	43	-	57	-
Seated-lower level	25	45	27	47
Seated - total	68	45	84	47
Standing-lower level*	13	23	14	24
Length (feet)	33.3	40	39.3	40.0
Width (feet)	8.3	8.5	8.5	8.5
Height** (feet)	14.5	10.4	14.0	10.0
Wheelbase (ft)	18.5	23.8	22.5	23.8
Cost Per Bus ($)***	99,000	80,000	150,000	72,000

*Estimated at 50% of lower-level seated capacity.

**Dynamic rebound adds a minimum of two inches to the effective vehicle height.

***Cost at time of purchase of double-deck buses.

TABLE 2-5

DOUBLE-DECK BUS DEMONSTRATION CHARACTERISTICS

	New York	Los Angeles	
Route Number	M4/M5	760	480
Route Type	Manhattan, local service, congested traffic, heavy passenger loads, frequent stops, frequent passenger turnover	Park & Ride/ Express, limited stops, 75% on freeway	Collection/ Distribution/ Express, 50% on freeway
Coverage Area	Middle to upper - middle class residential, high density commercial	Middle income suburbs/LA CBD	Middle/ upper middle income suburbs, LA CBD
Length (miles)	12	15	30
One-way travel time (min.)	60	60	90
Ratio of double deckers to conventionals	8:37	1:7	1:20
Fare ($)	.50	1.00	.90

British Leyland "Mancunian" Double-Deck Buses to be used by the New York City Transit Authority

Neoplan Double-Deck Buses to be used by the Southern California Rapid Transit District

- A thorough design effort should have included representatives from the transit authority's management, maintenance, and driver staffs.

- The double-deckers should have been treated as prototypes and undergone extensive on-site testing and redesign before the fleets were produced and accepted.

Vehicle-related problems delayed the project and hampered the evaluation activities. Revenue service, which had been scheduled to begin April 1975 in Los Angeles and July 1975 in New York, did not begin until June 1976 and September 1976 in the respective cities. Vehicle-related problems also decreased the efficiency of the vehicles from the perspective of the transit operator:

- The major mechanical problems were caused by the air conditioning and heating systems in New York and the air conditioning, brakes, and the steering bell crank in Los Angeles.

- At both sites the double-deck vehicles were out of service more than the conventional couterparts due to these mechanical difficulties. In New York the double-deckers averaged 1200 miles per bus per month while the conventionals averaged 2000 miles per bus per month. The corresponding figures in Los Angeles were 3300 and 8700 miles per bus per month. However, some of this difference in Los Angeles was due to scheduling policy.

- The New York double-deckers averaged 5.5 road calls per 1000 revenues miles while the conventional buses averaged 2.3 calls per 1000 revenue miles. In Los Angeles the double-deckers averaged .61 road calls per 1000 revenue miles while the conventional buses averaged .38 calls per 1000 revenue miles.

- Maintenace costs in New York were unavailable. Maintenance costs for the Neoplans in Los Angeles averaged 3.8 times those for the conventional fleet: 18.26 cents per mile versus 4.84 cents per mile. This cost differential was due primarily to the inadequate braking system on the Neoplans.

Once the problems caused by the protypical nature of the vehicles are solved, it does not appear that repair and maintenance costs and reliability will differ significantly between bus types.

There were two other operator-related problems:

- Due to their height, the double-deck buses could not be stored or maintained at all the New York and Los Angeles facilities, and they could not be used on all routes.

- The double-deckers, with their greater passenger-carrying potential, tended to fall behind schedule more often than the conventional buses. In New York the double-deckers averaged 3 minutes late for a 60 minute run while in Los Angeles they averaged 4 minutes late for a 1 hour 30 minute run.

On the positive side of the ledger, the double-deck buses had the following impacts on the transit operator:

- The unattended second level was not more susceptible to vandalism and crime in either New York or Los Angeles.

- Operating costs (fuel, oil, and driver's salaries) were nearly identical for the two bus types. The New York drivers received an additional $0.25 per hour premium pay.

- An analysis of dwell time per throughput passenger indicated no significant different between bus type and between peak and mid-day service. The double-deck buses processed passengers at the same rate as did the conventional buses.

- Based on schedule adherence results, several feasible scheduling options are available for the double-deck bus:

  (1) using only double-deck buses on a route:

  (2) mixing double-deck and conventional buses on a route, but using the double-deckers on a skip-stop basis; and,

  (3) using the double-deck buses on express routes with a limited number of stops at either end.

- The transit operator would realize substantial savings by substituting double-deck buses for conventional ones at a ratio based on seating or total capacity.

Passenger reaction to the double-deck bus was overwhelmingly positive:

- Passengers preferred the double-deck bus to the conventional bus.
- Passengers preferred the upper level to the lower level.
- Preference was independent of trip length.
- There were no serious problems with the use of the internal stairs. In New York there were four accidents associated with the use of the stairs but no injuries. In Los Angeles, there were no accidents associated with the use of the stairs.
- In all cases the double-deck bus passengers were more positive towards their vehicle's accommodations than were the conventional bus passengers.

<u>New York City Waterborne Mass Transportation</u>

The use of the nation's waterways, particularly to transport commuters, could serve to reduce the pressures on existing highways and mass transit facilities. This waterborne demonstration project will determine consumer and general community acceptance of such service in the New York City area. In addition, information will be provided on the economics of the service, operational problems, and recommendations for improvements in the design of the craft.

Three high speed Hovermarine HM-2 Mark 4 Surface Effect Ships (SES) will be used to provide a variety of services. These services include:

- Night Ferry Service - The substitution of smaller high speed vessels for large ferries will substantially reduce operating costs for the City.
- Peak Period Commuter Service - The demonstration will provide service between several locations and Manhattan.
- Airport Service - Mid-day service will be furnished between Manhattan and La Guardia Airport.

- Recreational Service - Summertime service between several recreation areas in New York and New Jersey is planned.

Transit Bicycle Integration

A large number of communities in the United States have a relatively high usage of bicycles, and many have explored ways to promote increased bicycle usage as part of a total transportation system. Because ot its climate and the existence of a large student population, the Santa Barbara Metropolitan area has significant bicycle usage. This demonstration will employ facilities and techniques to promote increased transit use by bicycle riders.

By making it easier for bicycle users either to store their bicycles at transit access points or to take their bicycles with them on buses, this demonstration could stimulate increased transit ridership and effectively expand the transit service area. The two major components of the demonstration, to be implemented by the Santa Barbara Metropolitan Transit District (SBMTD), are the use of bicycle trailers and bicycle storage lockers. The trailers have been used on a very limited basis in several locations including Santa Barbara but have never received adequate evaluation. The trailers would permit bicycle users who need their bicycles at both ends of a bus trip to take their bicycles along. Six trailers will be used on selected routes throughout the Santa Barbara system. The project may also employ bicycle racks which can be installed on the rear of the bus. San Diego Transit recently implemented a small program to test the use of bicycle racks on a limited number of buses. However, the program has not been rigorously evaluated and has produced no data on ridership, ease of use, or comparisons between the bicycle trailers and racks.

The second element of the demonstration will be the use of bicycle storage lockers at key access points which will permit "bike and ride" type operations. Up to 50 storage units, each holding ten bicycles, will be employed.

The two year demonstration will include a five month planning phase. During this phase market research will take place to facilitate locating the storage lockers and determining the most appropriate routes for use of the trailers and/or racks.

Evaluation of the demonstration will produce information on such issues as impact on ridership, effect on regular transit service including scheduling, and perceptions by non-bicycle using bus riders. Costs associated with the various facilities, their ease of use, and safety experience will be documented. The project will document experience with potential application in many communities particularly in the southern tier of states.

SUMMARY AND IMPLICATIONS

Evaluation of the conventional transit service projects has generated a number of implications regarding further applications of the concepts demonstrated. These are grouped by category and summarized in this section.

Priority Treatment for Buses and Other High Occupancy Vehicles

Non-Separated concurrent-flow freeway HOV lanes

- Auto occupancy rate increases
- Carpooling increases
- Travel time for users of the reserved lane decreases
- Provides a focal point for transit marketing
- Creates a perceived, as well as real, time advantage in the minds of bus passengers
- Violation rate by ineligible users of reserved lanes is typically high
- Restrictions are difficult to enforce without a median area
- Plastic inserts separating the rserved lane do not prevent weaving
- Accidents typically increase
- Re-dedication of an existing lane for concurrent flow priority use is not recommended; the two projects doing this were terminated due to a strong negative reaction from the media and the public and lack of political support
- Concurrent-flow lanes should be separated from normal lanes by a physical barrier or a safety

lane to minimize problems of accidents and violations

Contra-flow priority lane facilities

- Contra-flow lanes have proven to be effective, generally quite safe (following an initial familiarization period), inexpensive, publicly acceptable technique for freeways, arterials, and CBD streets

Busways

- Opening busways to carpools does not significantly erode bus ridership
- Opening busways to carpools increases ridesharing
- Permitting carpools on busways does not slow down or appreciably reduce the reliability of bus operations provided the number of carpools is controlled by occupancy restrictions and/or access points

Ramp Bypass Lanes

- Bypass lanes on metered freeway ramps have proven to be an effective, safe, easily enforceable, relatively inexpensive, and publicly acceptable way to provide HOV priority on freeways

Bus service on reserved facilities

- Long-haul suburban to CBD transit service for commuters is very expensive; such service typically gets only one scheduled revenue trip per peak period, and deadhead mileage is high
- Fare increases for high quality priority transit service have not had a significant negative impact on transit patronage; many of these services are underpriced considering how much they cost to provide
- Increased transit patronage is highly correlated to increased transit level of service in the form of expanded coverage and reduced headways as well as to the reduced travel time of a priority facility

- Priority treatment techniques increase vehicle productivities and reduce resources required to move people in major urban corridors

Park-and-Ride Lots

- Lots should be distant from the CBD and have good transit and highway access
- Lots should be adjacent to the freeway offering the priority treatment
- Lots should be large enough to support low headway service to several major destinations
- Lots should be guarded, well lit, highly visible to the motorists, and contain amenities such as sheltered waiting areas, telephones, and toilets

Traffic-Signal Priority for Buses on Arterials

- Traffic-signal priority systems in CBD grids appear to offer small marginal reductions in CBD bus travel time; simulation studies and actual street tests show only about a 10 percent or less reduction in bus travel time in CBD grids
- Traffic-signal priority techniques have proven effective in reducing travel times for buses on arterials; the most effective application is for express buses traveling on a reserved lane; local buses or buses in non-reserved lanes have to stop frequently for passenger service or because of traffic congestion and, therefore, signal priority techniques, whether pre-emption or progression, are not as effective
- There is some question about the relative cost effectiveness of signal pre-emption versus signal progression for express bus operation on reserved arterial lanes; signal progression appears to be nearly as effective as pre-emption at a significantly lower cost; since many cities already have inter-connected traffic signals on their arterials, a bus-optimal progression system can be implemented at minimal cost

Auto Restricted Zones

- There are substantial opportunities for ARZ's in the U.S.
- City size is not critical to ARZ success
- A strong activity base is required
- The area should be intrinsically attractive and/or offer some historical, cultural or recreational cpportunities
- A wide range of techniques is available
- The complete prohibition of auto traffic is not the only option
- ARZ size is a key determinant of transportation impacts
- The key transportation factor is maintaining accessibility

Transit Malls

- Transit travel time is not significantly decreased but reliability is improved
- The bus system is better understood by the public
- Traffic diversion does not cause congestion on alternate routes
- Malls with exclusive transit use of the roadway encourage motorists to obey the traffic restrictions, compared to transit malls with partial auto access
- Malls create an attractive and popular environment for pedestrians
- Jaywalking is common
- The auto ban may lead to an increase in pedestrian injuries
- Malls support the retail business climate; some businesses may be hurt by inconvenient access for delivery vehicles and motorists

- Minimal relocation of utilities, special walkways, and careful phasing of work limits the impact of construction

Schedule and Service Coordination

Time Transfer

- Timed transfer leads to reduced travel time
- Operating costs increase
- Operational problems are severe during rush hours due to the difficulty of schedule adherence
- The location and design of the transfer facilities are major factors affecting the efficiency of the service.

Reliability

- Reliability is likely to be an important determinant of travel behavior in general and a major factor in influencing trip timing.
- A variety of strategies has been identified for improving reliability: exclusive lanes, signal pre-emption, merge/freeway access, reserve fleets, express service, improved schedule planning, payment schemes, computer dispatching, and bus control strategies

Vehicle Innovations

Double-Deck Bus

- The use of foreign vehicles and vehicles that have undergone re-design to meet American requirements can result in delays and unsatisfactory performance; to prevent this from occuring, a thorough design effort should include representatives from the transit authority's management, maintenance, and driver staffs.
- Once the problems caused by the prototypical nature of the vehicles are solved, it does not appear that repair and maintenance costs and reliability differ between double-deckers and conventional buses

- The transit operator would realize substantial savings by substituting double-deck buses for conventional ones at a ratio based on seating or total capacity

- Passenger reaction to the double-deck bus has been overwhelmingly positive

REFERENCES

1. Billheimer, John W., et.al., The Santa Monica Freeway Diamond Lanes, Report No. UMTA-MA-06-0049-77-12/13, September 1977.

2. Crain, John, Third Year Report Evaluation of Express Busway on San Bernardino Freeway, prepared for Southern California Association of Governments, 1976.

3. HOV Lane Project Quarterly Report, Oregon Department of Transportation, April 1977.

4. Kalauskas, Charles, et.al., Southeast Expressway Evaluation of the Downtown Express Lane, Central Transportation Planning Staff, December 1977.

5. Koffman, David and Richard Edminister, Streets for Pedestrians and Transit: Examples of Transit Malls in the United States, Report No. UMTA-MA-06-0049-77-11, August 1977.

6. Simkowitz, Howard J., A Comparative Analysis of Results from Three Recent Non-Separated Concurrent-Flow High Occupancy Freeway Lane Projects: Boston, Santa Monica, and Miami, Report No. UMTA-MA-07-0049-78-2, U.S. Department of Transportation, Transportation Systems Center, June 1978.

7. Simkowitz, Howard J., Southeast Expressway High Occupancy Vehicle Lane Evaluation, Report No. UMTA-MA-06-0049-78-4, U.S. Department of Transportation, Transportation Transportation Systems Center, June 1978.

8. Simkowitz, Howard J, and Chester H. McCall (CACI, Inc.), Double Deck Bus Evaluation Results, Report No. UMTA-MA-06-0049-78-7, U.S. Department of Transportation, Transportation Systems Center, June 1978.

9. Alan M. Voorhees and Assoc., Inc., Cambridge Systematics, Inc. and Moore-Heder Associates, Review of Potential ARZ Demonstration Sites, December 3, 1976.

10. Alan M. Voorhees and Assoc., Inc., Cambridge Systematics, Inc. and Moore-Heder Associates, Auto Restricted Zone Background and Feasibility, March 1976.

11. Alan M. Voorhees and Assoc., Inc., Cambridge Systematics, Inc. and Moore-Heder Associates, Auto Restricted Zones/Multi-User Vehicle System Site Selection Methodology, March 1976.

12. Alan M. Voorhees and Assoc., Inc., Cambridge Systematics, Inc. and Moore-Heder Associates, Multi User Vehicle Systems Feasibility Assessment, April 1976.

13. Wattleworth, Joseph, et.al., Evaluation of the N.W. 7th Avenue Express Bus and Bus Priority Systems, prepared for Florida Department of Transportation, September 1977.

CHAPTER 3

PRICING AND SERVICE INNOVATIONS

INTRODUCTION

An integral part of the planning process directed at increasing the efficiency of our existing transportation system is the application of pricing policies to control selectively volume, pattern, and composition of traffic, and to reduce automobile usage directly and deliberately in favor of high occupancy modes. Typically, pricing has not been used as a mechanism to ration the scarce resources of the urban system or to shape travel choices so as to alleviate major urban transportation problems--particularly congestion. Instead, the government's response to these problems has been to increase supply by such actions as new freeway construction. Only in a very few instances has pricing been used as a deliberate mechanism to alter travel demand among modes, geographical areas, or time periods.

A recent review of numerous Transportation System Management plans proposed by a variety of cities indicated that pricing strategies were not suggested for implementation because local staffs lacked technical familiarity with the concepts. The limited experimentation which has occurred in the areas of pricing incentives and disincentives has failed to provide local planning agencies with the empirical information necessary to evaluate the impacts these techniques may have in their locales. There is, therefore, a clear need to embark on a series of demonstration projects to advance the knowledge about the impacts of these techniques and to disseminate this information widely to local area planners and political officials.

In 1974, Title II of the National Urban Mass Transportation Assistance Act was created, providing for the "research and development, establishment and operation of demonstration projects to determine the feasibility of fare-free transit." The Title provided authorization to appropriate funds, but during its duration only $1.5 million was allocated specifically for this purpose. However, the Urban Mass Transportation Administration (UMTA), through the Office of Service and Methods Demonstrations (SMD) had been developing plans for pricing experiments in its demonstration program. It incorporated the concept suggested by Title II along with a broader spectrum of fare policies and service improvements within the SMD Pricing Division. The SMD Pricing Policy Division developed as a coordinated effort to embark on a series of experiments in metropolitan communities to demonstrate and evaluate the extent to which a range of pricing policies can alleviate urban problems and help achieve major social goals.

During FY76, the $1.5 million appropriated from Title II was used to design a demonstration program, to support limited experimentation in this area, and to study some of the more innovative fare and service variations being implemented in the country. The design of the experimental program included a delineation of the general program objectives and enumeration of the types of experiments which could be successfully implemented. These experiments include:

(a) Controlled Service Improvements Demonstrations - These demonstrations will examine and evaluate the effect of selected service improvements on ridership.

(b) System-wide Fare-Free Demonstrations with Controlled Service Variation - These demonstrations will assess the market response to fare elimination and determine whether the benefits of free transit justify the cost of providing it.

(c) OffPeak System-Wide Fare Reduction or Elimination - These demonstrations will provide an opportunity to study the effect of offpeak fare elimination on the system peak factor, on transit demand, and on business activity.

(d) Central Area Fare Elimination - These demonstrations will provide guidelines to the transit industry on how to best select downtown zones that support a free-fare policy and on the administration and operation of this concept.

(e) Fare Incentives as a Promotional Basis - These experiments are designed to employ various types of fare incentives for the purpose of enticing auto users onto transit.

(f) Transit Fare Prepayment Demonstrations - These demonstrations will provide an opportunity to increase ridership and improve the cash flow position of the transit operator by increasing the proportion of revenue which is prepaid.

These demonstration concepts merged the ideas of the Service and Methods Demonstration (SMD) Program and those suggested by Title II. In FY76 another area of interest emerged in the area of:

(g) Pricing Disincentives - These experiments are designed to improve urban transportation efficiency, reduce air pollution, and conserve fuel by encouraging the use of high occupancy modes and diverting some peak hour travel to offpeak periods.

The work now planned under the general category of Transportation Pricing Policy comprises a coherent effort to test and evaluate a broad spectrum of pricing strategies which will establish the basis for more definite UMTA policies regarding the expenditure of future effort in this area. The program has evolved primarily into two major areas: transit pricing and service variation demonstrations and pricing disincentives for auto use.

CURRENT DEMONSTRATION PROJECTS

Transit Pricing and Service Variations

Overview

Transit pricing and service variation demonstrations are designed to encourage transit usage as cost effectively as possible. They are primarily fare related activities that attempt to increase the convenience and decrease the cost of using the mass transit system so as to put it on a more competitive basis with the automobile. Demonstrations conceptualized in this area will provide the basis for formulating guidelines on the impact of transit fare policies on system ridership, cost, and revenue. Related to the fare activities are efforts to monitor ongoing projects to sharpen our evaluation of the relative impact of several changes on ridership and productivity. In addition to this monitoring, special short range demonstrations will be implemented for determination of service elasticities which can be compared with fare elasticities. The demonstration projects which are currently underway or planned for implementation in the near future are summarized in Table 3-1.

In order to inform transit agencies of the development of the pricing program and the specific concepts under consideration for implementation, UMTA through the Pricing Program has distributed a document inviting communities to submit statements of interest for participation in the

TABLE 3-1. SUMMARY OF OPERATIVE AND PROSPECTIVE DEMONSTRATION PROJECTS

Projects	Demonstration Impact on:				Site Characteristics		
	Off-Peak Travel	Peak Travel	Down-town	System-wide	Base Fare Peak/ Off-Peak	Population (SMSA, 1972)	Persons per Sq. Mile
Trenton	X			X	.15/.30	304,000	1,334
Denver	X			X	.50/.25	1,320,000	335
Albany	X		X		.40	721,910	326
Knoxville	X	X	X	X	.40	400,337	282
Austin	X	X		X	.15/.30	295,516	292
Phoenix	X	X		X	.35	967,522	105
Jacksonville		X		X	.25	528,865	691
Sacramento		X		X	.35	800,592	234

program. The information obtained from this solicitation will be used to plan for future budget requests and to aid in the selection of possible demonstration sites. Approximately seventy agencies responded to the initial solicitation.

Two demonstration concepts in four cities were implemented this fiscal year to better understand the use of various transit fare prepayment instruments. In Sacramento, California and Jacksonville, Florida employers are being solicited to promote and distribute transit fare prepayment instruments at the workplace. The primary payment method will be payroll deduction -- the inconvenience to employees of purchasing prepaid tickets and passes will be minimized. In Austin, Texas, and Phoenix, Arizona, transit fare prepayment instruments are being sold at reduced prices during two temporary discount periods. The objective of this type of discount promotion is to attract nonriders to transit, and to encourage cash-paying riders to use prepaid forms.

An offpeak systemwide fare-free demonstration is currently being implemented in Mercer County, New Jersey and Denver, Colorado. The effects of fare elimination on the quality of service, on fare collection costs, and on the peaking of transit demand, will be studied.

During fiscal year 1977, several activities were initiated to develop demonstration concepts budgeted for fiscal year 1978. One of these activities involves design work for a more comprehensive demonstration of transit fare prepayment instruments than has been tested. This work will expand on the modest effort of prepayment demonstrations initiated in FY 1977.

A second major activity is a comprehensive study of central area or central business district (CBD) fare-free policies. A review of the past and current implementation of reduced fare zones is underway in order to identify generalizable knowledge and specific applications worthy of further evaluation. This review will be the basis for structuring demonstration concepts and selecting sites for implementing them.

A third effort has been the study of policies and procedures employed by transit operators in the development of routes, schedules, and fare structures. The purpose of the review is to identify specific research or demonstration projects which will advance the state-of-the-art in this area.

In the sections which follow, each of the demonstration and research activities will be discussed in greater detail. For additional information on any of the topics the reader may refer to the bibliography at the conclusion of the chapter.

Transit Fare Prepayment

Demonstration projects involving the promotion of transit fare prepayment (TFP) instruments are currently underway at a number of sites. The question which is being addressed in these demonstration projects is whether through marketing promotions of TFP instruments, new transit ridership can be attracted and existing cash fare patrons can be induced to switch to prepaid forms. At the present time, two variants of TFP promotion are being assessed: reduced price promotion and promotion of prepayment through employers.

Reduced-Price Promotion Projects

The reduced-price promotion is a novel technique to encourage expanded use of prepayment instruments and of transit. In Austin, Texas, and Phoenix, Arizona discounts of 20% and 40% on prepaid tickets and passes are being offered during two one-month sale periods. At the same time, the number of ticket sales outlets is being increased and a marketing campaign is being conducted to increase public awareness of the transit system and available payment types. In Table 3-2, characteristics of the sites and projects are presented and compared.

The first TFP sale was conducted in Austin in October of 1977. Discounts of approximately 40% on peak period monthly passes, off-peak period monthly passes, unlimited monthly passes, and 20-trip punch cards were offered. A second discount, featuring price reductions of 20% on the same TFP instruments, will be conducted in March of 1978. An extensive marketing campaign preceded the first discount period featuring radio, television, newspaper, poster, and billboard advertising. In conjunction with the promotion, the number of TFP sales outlets was increased to approximately 50 locations within the service area of the transit system.

TABLE 3-2. OVERVIEW OF TRANSIT FARE PREPAYMENT DEMONSTRATIONS

	AUSTIN	PHOENIX	JACKSONVILLE	SACRAMENTO
TYPE OF AREA	medium size city	large city	large city	large city
POPULATION OF AREA (SMSA) 1970	323,000	969,000	622,000	804,000
MEDIAN FAMILY INCOME (1969)	$9,288	$9,800	$8,671	$10,362
PERCENT POPULATION WITHIN TRANSIT SERVICE AREA	65%	40%	70%	73%
REVENUE PASSENGERS PER SERVICE AREA POPULATION	20.7	12.7	35.5	19.3
ROUTE MILES (2-WAY)	279	760	827	602
SYSTEM BUS MILES (ANNUAL)	2,237,000	4,514,214	5,900,700	9,100,000
AVERAGE HEADWAY				
Peak Period	30 min.	30 min.	24 min.	
Off Peak Period	30 min.	1 hr.	40 min.	
FARE STRUCTURE				
Zoned Fare		X	X	
Fare (Base Zone)				
Peak Period	30¢	35¢	25¢	35¢
Off-Peak Period	15¢	35¢	25¢	35¢
Discounts for Special User Groups				
Elderly and Handicapped	X	X	X	X
Low-Income Persons	X	X		
Youth		X	X	X
Transfers	free in any direction with time limit	free	full fare	full fare
TRANSIT FARE PREPAYMENT				
Tokens or single tickets			X	X
10-Trip Tickets		X		
20-Trip Tickets	X	X		
Daily Unlimited Pass				X
Weekly Unlimited Pass			X	
Peak Period Monthly Pass	X			
Off-Peak Period Monthly Pass	X			
Monthly Unlimited Pass	X	X		X
Restricted Monthly Pass			X	
TYPE OF DEMONSTRATION	TFP promotion	TFP promotion	employer sponsored TFP promotion	employer sponsored TFP promotion
ELIGIBILITY REQUIREMENTS	none	none	employees of participating employers	employees of participating employers
LENGTH OF DISCOUNT PERIOD	two 1 month sales	two 1 month sales	1 month*	3 month
DEMONSTRATION DISCOUNT	40%, 20%	20%, 40%	25%*	25%
DISCOUNTED INSTRUMENTS	all TFP except student pass	all TFP except student pass	restricted monthly pass	monthly pass
AVAILABILITY OF DISCOUNTED INSTRUMENTS	45 outlets	100 outlets	workplace	workplace

*Tentative

Data are being collected to evaluate the demonstration's impact on pass buying, on ridership (immediate and long term), on operator revenues, and on administrative costs. Results from the first discount period have been partially analyzed at the time of this writing. The reduced-price promotion has resulted in a dramatic increase in pass sales; the October sales volume was nearly six times that of previous months and of October, the year before. However, preliminary analysis indicated that the impact on non-transit users is small, possibly negligible.

In interpreting these and succeeding results, it is important to understand that Austin has a high level of ridership and a seemingly positive orientation toward transit. Early survey results indicate that about 30 percent of Austinites use the bus at least occasionally. About half understand their bus system well enough to use it, one-third know of the existence of TFP (although few know where to buy them), and only 15 percent give the bus service a poor rating. The system enjoys an average of just over 30 riders per vehicle hour, one of the highest in the nation.

Thus, although there has been a strong positive response to the first discount period in Austin, it is the response of a very transit-oriented group whose members are probably quite astute in capitalizing on an opportunity to lower their urban travel costs. Such positive results might not be realized in another setting. Also the long-term response to a temporary price discount might be quite different from response during the discount. Future data will reveal the extent of the difference.

In Phoenix, the first discount period is scheduled for February, 1978, and will offer price reductions of approximately 20% on monthly passes, 20-trip punch cards, and 10-trip tear-off tickets, which have recently been introduced. The second discount period, featuring 40% price reductions, will follow in October or November 1978. Intensive marketing campaigns similar to Austin's will precede the discount periods; outlet expansion had occurred prior to the demonstration. Prepaid tickets and passes will be sold at approximately 100 locations within the service area of the transit system.

As in Austin, the Phoenix evaluation will be directed at determining the potential benefits, both to the transit system and to the rider, of promoting transit fare prepayment. The evaluation will investigate the impact of intensive promotion of reduced-price passes on the level of

Take the Phoenix Bus for a ride.

We're going to let you take advantage of us.

From January 30 until February 25, you can save 20% on our 20-ride passes. And our monthly passes. Even on our new Big 10 ticket books.

Why are we being so easy?

Because we'd really like you to try riding the bus.

And if you take us up on it, you'll find a lot of nice things happening.

You'll say goodbye to those mornings of warming up your car. You'll save money on gas.

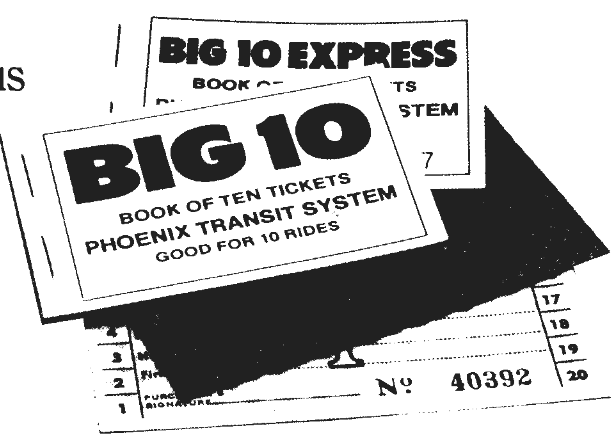
You'll be able to read the paper while you ride. You can make some new friends. Or just enjoy seeing our beautiful city.

And you just might notice that you're a lot more relaxed when you don't have to battle the traffic.

Go ahead. Take us for a ride while we're 20% cheaper.

You might like it.

Ticket books and passes 20% off.



Brochure To Be Used In Promoting the February 1978
Prepaid Ticket and Pass Sale In Phoenix, Arizona

transit ridership and TFP sales, identify the characteristics of pass ridership, and determine the impact of increased utilization of fare prepayment on the revenues and costs of the transit operator. Each site provides a setting in which to study the effect of a temporary price reduction on long run purchase choice and aggregate sales.

In Phoenix, however, characteristics of the site may produce results which are markedly different from those observed in Austin. The region is one of the most rapidly growing areas of the country; during the 1960's the city expanded outward, rather than upward, as population grew. This pattern of growth has resulted in low population density throughout the urban area, and extreme dispersion of employment sites. Only 10% of the city's workers are employed in the central business district, and 40% of the land within the city limits is undeveloped. The road system is extremely efficient and congestion is confined to short morning and evening peak periods.

Low population density, coupled with the dispersion of employment sites, residences, and the retail sector, has resulted in a transit system which offers a relatively low level of service. Ridership is low and the general public's knowledge of the transit system is even lower. Only 5% of the population knows enough about the system to be able to use it.

Phoenix, then, offers the opportunity to study the promotion of transit fare prepayment in an auto-oriented, low transit knowledge, urban area. The differences which are inherent in the two sites will be considered when comparing and cross-analyzing demonstration results.

Employer-Sponsored Prepayment Projects

The promotion of prepayment through employers is a technique to increase the levels of transit ridership and TFP sales while reducing some of the administrative burden for the transit operator. Employer sponsored prepayment programs have varied in detail, but the unifying concept is that employees are able to purchase prepayment instruments - be they passes, multiple-ride tickets, or tokens - at their place of work, with a minimum of personal inconvenience. By purchasing prepayment instruments in bulk and bearing responsibility for their final distribution, the employer absorbs a large portion of the administrative costs of a TFP program.

These schemes have a number of potential advantages for the people and agencies involved. Employees can pay for their transit rides with a minimum of inconvenience, and possibly at a reduced price. Employers may find that the demand for parking at their facilities is lessened, and they may reduce their subsidization of parking. In addition, they may find that transit fare prepayment subsidies are one of their most popular (and least expensive) fringe benefits. Finally, the transit operating agency may reduce administrative expenses, attract more riders, protect a greater proportion of operating income from seasonal or weather variations in patronage, and, by increasing the proportion of income which is prepaid, improve its cash flow position. Offsetting these potential advantages, there is also the possibility of increased expenses for the employer in administering the scheme, and for the transit agency in selling the idea to businesses.

In Jacksonville, Florida and Sacramento, California demonstration projects which will assess the potential benefits of promoting fare prepayment through employers, are currently underway. In Table 3-2, characteristics of the sites are presented and compared. At both localities, a sales campaign aimed at enlisting a range of major employers who will agree to make prepayment instruments available at the workplace will be planned and implemented. To gain a maximum amount of information concerning employee response to the promotion under alternative circumstances, an effort is being made to solicit employers who will offer TFP instruments under a variety of conditions: payroll deduction, payment by cash, partial subsidy, full subsidy, no subsidy, passes only, etc. The employer solicitation phase of the demonstrations is scheduled to last from 4-6 months, and TFP instruments will be distributed through approximately thirty selected employers for 12 months. Toward the end of the distribution phase, a one or two month UMTA-sponsored 25% sale will be conducted. During this period, the transit operator will sell passes at a discount to employers, and this cost saving will be passed on to employees.

In Jacksonville, a consultant will be employed to conduct the marketing phase of the demonstration. Three sets of promotional materials will be developed: the first aimed at inducing employers to participate in the demonstration, the second designed to encourage employees to purchase TFP, and the third designed to communicate information about the project to the general public. The materials designed for employers and employees will comprise the major part of this effort.

The employer market in Jacksonville is easily identified; thirty percent of the city's labor force is employed in forty large firms. However, many of the firms have headquarters outside of Jacksonville, and it is anticipated that they may be reluctant to shoulder the administrative burdens associated with the promotion. For this reason, a marketing promotion which relies on personal contact rather than advertising, and which stresses the potential benefits of the UMTA-sponsored TFP sale, will be used.

Once the participating employers have been selected, the focus of the marketing campaign will shift. An effort will be made - through seminars, advertising, and announcements - to encourage employees to experiment with TFP and the transit system. Presently, 2000 weekly passes and only a few monthly passes are sold in Jacksonville. Because monthly pass sales are so low, a TFP pricing study is being conducted as a precursor to the demonstration. The price design of the passes is being reviewed and redesigned. Passes which are likely to attract a larger market, will be introduced. Presently, TFP's are available at only a few locations, and agressive marketing has not been pursued. Hence, one aspect of the employee marketing promotion must be informational; acquainting employees with both the transit system and alternative payment methods. Another aspect of the campaign will be persuasive; to sell employees on the convenience and cost-attractiveness of TFP.

In Sacramento, the marketing phase of the demonstration is also being developed. An effort will be made to solicit a representative cross-section of both private and public sector employers. Transit usage in Sacramento is low; only 2.7% of the city's workers use transit to travel to work, compared to a national average of 7.8%. Hence, an integral element of the marketing design must be the dissemination of information about transit services. TFP use in Sacramento is very high; about 50% of all transit riders use daily passes which are priced at one round trip, and 15-20% of all riders purchase monthly passes which represent a 12-14% discount for the daily user.

The issues to be examined in evaluation of the Jacksonville and Sacramento demonstrations occur on three levels. First, the responses of the solicited employers will be investigated in detail. The level of commitment across firms may vary as to form of distribution, degree of subsidization, and limitations on sale by such factors as the type, location, and size of the workplace, the availability of transit service and parking at the work site, and upper management's attitude toward transit. In addition, the administrative costs borne by employers and changes in other fringe benefits which result from the promotions will be documented. Second, employee response to the demonstration will be monitored and explained. In particular, socio-economic and travel characteristics will be studied. Changes in trip-making behavior and payment method, as well as time of day and mode shifts which result from the demonstration will be noted. Third, demonstration impact on the revenues and costs of the transit operator will be studied. The promotion of prepayment through employers is likely to generate increased ridership on routes which are heavily utilized, during the peak hours. If service must be increased in order to accomodate higher levels of demand, the costs to the transit operator may be very high. In addition, the administrative and marketing costs of the promotion will be documented, and the cash flow savings realized by prepayment will be analyzed.

Fare-Free Transit

Overview

Recent interest in the use of fare-free transit to produce a wide range of potential benefits has resulted in a number of demonstration projects which will test the feasibility of the concept in achieving stated objectives. In broad overview, the arguments in support of fare-free transit can be grouped into three categories.

First, it is argued that the abolition of fares will help to divert people out of private cars and onto transit. Each passenger-mile on a transit vehicle typically consumes less energy, causes less air pollution, requires less parking space provision, and (under congested conditions) contributes less to traffic congestion than does a passenger-mile by private automobile. It is consequently argued that, given a fixed capacity transportation system and a pattern of travel demands to be satisfied, the higher the proportion of journeys made by transit in preference to the private car, the lower will be the total costs to the community and the greater will be the net benefits. Thus, fare-free transit would help the urban transportation system as a whole to function more efficiently.

Second, the abolition of fares would abrogate the costs which are involved in collecting, handling, counting, and guarding farebox revenues. Since there would no longer be a need to collect money from boarding passengers, boarding times would be reduced, leading to faster average vehicle speeds and perhaps more frequent and reliable service.

Vehicles and stations could be redesigned to permit more efficient passenger movement. Overall, it is argued, fare abolition should lead to lower total costs to society in providing the same, or even an enhanced, level of transit service.

Third, it is claimed that fare-free transit can achieve or reinforce other, non-transportation objectives felt to be socially desirable. In particular, assistance to two groups of the population is usually mentioned in this regard. The first group comprises the poor and unemployed. The second group is the downtown business community - it is argued that fare-free transit service will help to revitalize deteriorating central city areas.

These three broad arguments underlie most of the advocacy of fare-free transit. However, many of the above statements about benefits are open to considerable contention, and the gaps in current understanding about the costs and benefits of fare-free public transport service argue strongly that any demonstrations of the concept should be regarded as experimental rather than exemplary - one is trying to learn rather than to promote an idea of proven value. Two types of demonstration projects in this area are currently being planned and implemented: systemwide offpeak fare-free transit, and downtown fare-free transit.

Offpeak Fare-Free Transit Projects

Offpeak fare-free transit may be a viable means by which shoppers and others on personal trips, who make up as many as 20% of rush hour riders, can be diverted to offpeak travel. This diversion of riders would have the double effect of reducing crowding at rush hour and increasing ridership at offpeak times when excess capacity exists in transit vehicles, and additional riders can be carried at very little cost. In addition, new riders may be attracted to transit, thereby contributing to increased ridership. Demonstration projects currently in the planning or implementation phases in Mercer County, New Jersey, Salt Lake City, Utah, and Denver, Colorado, will demonstrate the effectiveness of offpeak fare-free transit service in achieving stated objectives.

In Mercer County, New Jersey, a one year demonstration of free transit service in offpeak hours will begin in January of 1978. Sponsored jointly by UMTA and the New Jersey Department of Transportation, the demonstration site will include the City of Trenton and the remainder of Mercer County, almost the entire service area of the Mercer-Metro

Transit Authority. At present, a peak period fare of 30¢ and a 15¢ offpeak fare are in effect, with slightly higher fares for the longest suburban trips. The 15¢ fare will be eliminated for all riders during the normal offpeak hours: 10:00a.m. to 2:00p.m. and after 6:00p.m. Monday through Saturday, and all day on Sunday and holidays.

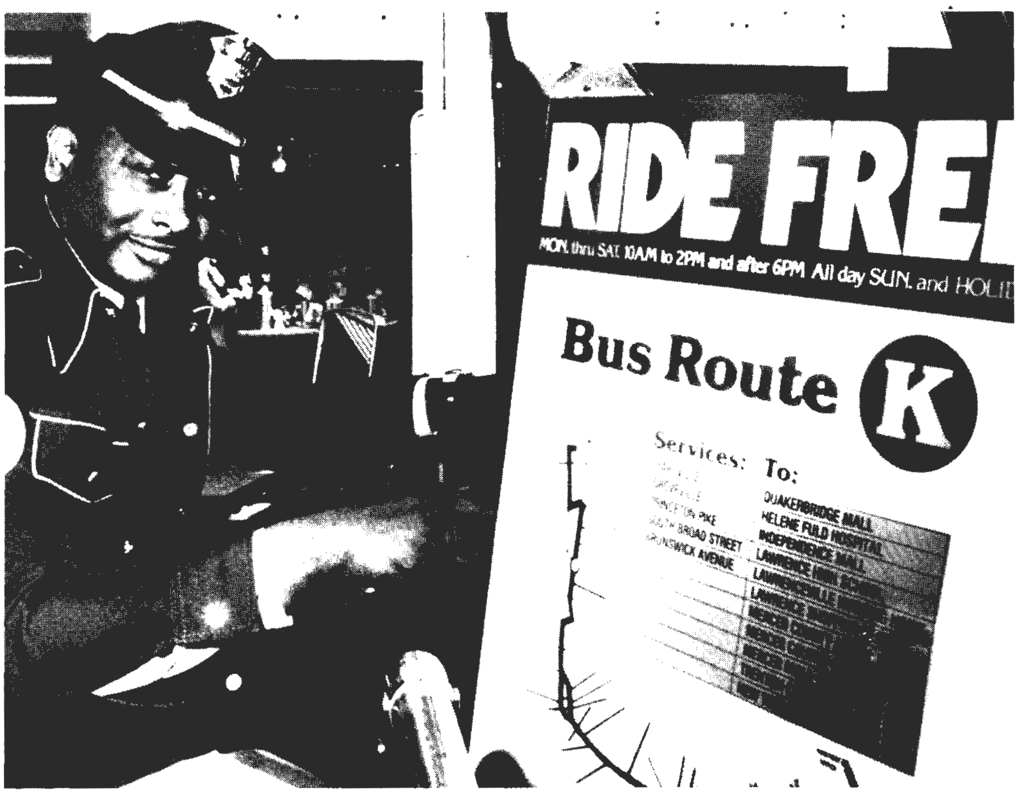
Trenton, the major city in the project area, has a population of approximately 105,000 persons, and is experiencing many of the traditional problems of older, northeastern cities. The more affluent population has moved from the city to the county, and retail activity and jobs are following. As a result, almost 13% of Trenton's residents are below the poverty level, just over 12% of the population is classified as senior citizens, and 35% of Trenton's households lack an automobile.

This demonstration, the SMD program's first large-scale fare-free experiment, will provide an opportunity to evaluate the impact of free-fare with regard to travel behavior (demand) changes, level-of-service (supply) changes, transit operator cost and efficiency changes, and other effects such as retail activity shifts. It is intended that the demonstration will serve to augment an ailing central business district; for example, workers may remain downtown for an hour after work to shop, and then ride home for zero fare after 6:00. In additon, fare-free transit may improve the mobility of Trenton's large transit dependent population. Lastly, it is anticipated that the transit operator will realize an improvement in the peak to base service ratio through reduction in peak demand and higher load factors during offpeak service hours.

As part of the evaluation of this demonstration, an extensive data collection and analysis effort will be undertaken. Particular emphasis will be placed on the use of field observations, surveys, and transit operator records to address level-of-service, travel behavior, and operator impacts. A less extensive effort, relying primarily on interviews with merchants and local officials will be undertaken to assess economic and CBD viability impacts.

A second off-peak, fare-free demonstration is being conducted in Denver, Colorado. This demonstration is actually a continuation of a locally funded project entitled "Transit Awareness Month" which featured free transit fares in the offpeak period. Fare-free service was initiated on February 1, 1978 and, under the terms of a demonstration grant agreement will continue through January 31, 1979. Zero fares are in effect for all services between the hours

Transit Fare Prepayment Sales Outlet in
Austin, Texas



On Board A Fare-Free Bus in
Trenton, New Jersey

of 8:00a.m. and 4:00p.m. Monday though Friday, and all day on Saturday, Sunday, and holidays.

The Denver Regional Tranportation District provides fixed-route bus service to the 1,500,000 residents of a special transportation district which encompasses portions of six counties surrounding the Denver, Colorado metropolitan area. Regular offpeak fares are 25¢ for local service, 75¢ for express service and $1.00 and $1.25 for medium and long distance regional service.

Only 4% of all person trips in the Denver region are made by transit, but the transit mode share for work trips to the CBD is 30%. During the offpeak hours there is excess capacity on most buses, but during the peak commuting hours the system operates at or above capacity. Therefore, two primary objectives of the demonstration are: (1) to divert some peak hour travel to the offpeak; and (2) to improve the performance of the existing bus fleet. It is anticipated that a planned marketing and information campaign will increase public awarenesss of the transit system and consequently increase ridership during the offpeak hours.

Data collection is of primary importance in the evaluation of this demonstration and will be grouped into five categories: patronage, attitudinal, financial, traffic, and institutional. The evaluation effort will emphasize the measurement of changes in travel patterns and travel behavior of individuals over the course of the project. Offpeak fares will be reinstated after January 31, 1979 and the resulting impacts on ridership will be estimated through analysis of data collected through June 30, 1979.

In order to offset the high costs inherent in implementation of systemwide fare-free demonstration in large cities with a high base fare, additional options have been considered. For example, it may be desirable to implement fare-free transit in just one part of an urban area. The site conditions for such a partial demonstration would need either to include some clearly identifiable transportation disadvantaged group (in order to provide political justification) or to be a multi-jurisdictional region in which only one jurisdiction would participate in the costs and receive the fare-free service.

Central Business District (CBD) offpeak (or all day) fare-free systems fall into the partial demonstration category. The goal of this strategy is associated promotion of CBD retail activity. The CBD fare-free transit concept, and demonstration projects which will test the scheme, is discussed in the following section.

Downtown Area Fare-Free Transit Projects

Central area fare-free transit has been viewed as a mechanism by which the central business district may be revitalized. The implementation of fare-free zones should provide a stimulating effect on fare-paying passenger traffic outside the demonstration zone by acquainting non-users and infrequent transit users with the availability of transit service. In addition, traffic volumes in the downtown areas may be reduced and traffic speeds might be increased. In effect, CBD fare-free zones should improve the overall public image of public transportation and CBD activities and improve mobility in the downtown area. Demonstration projects in Albany, New York and Knoxville, Tennessee will assess the performance of central area fare-free zones in achieving these stated objectives.

In Albany, a fare-free zone will be in effect from 9:00a.m. - 3:00p.m. Monday through Friday with fare-free operation on Saturday from 9:00a.m. to the close of business activities. The free zone will apply to all 19 routes which enter or leave the downtown Albany area during the mid-day. The fare collection method for the first 18 months of project implementation will be based on a strategy of monitoring fare-paying passengers (for trips outside the zone) by an accounting system -- for example, pay enter/pay exit with the driver monitoring fare receipts. However, during the latter six months of project implementation an honor system will be tested; individual riders will self-identify their origin and destination pair - thus, fare receipts will not be required.

Albany is characterized by a clearly decaying downtown area. Between 1967 and 1972, retail sales declined 33%, and current observations suggest that the trend has continued. Public investments have been made that offer some incentive for a reversal of the decline, and it is anticipated that the downtown fare-free demonstration project could contribute to whatever momentum might be generated for an improvement of downtown. As an example of potential support which might be garnered, the City of Albany and the downtown merchants have each agreed to share the local support of the project.

In the evaluation of the Albany demonstration, the data collection and analysis plan will focus on stated objectives. To assess demonstration impact on downtown revitalization, information on retail sales volumes and pedestrian volumes will be analyzed, and interviews will be conducted with retail managers and members of the business community. Traffic volumes on major links in the downtown area will be monitored and data will be collected to determine the extent of cross zonal trips, short-hop trips, and increased utilzation of CBD activities by fare-free zone residents for the purpose of determining project impact on mobility within downtown. Changes in fare-paying passenger volume will be accounted for by measurements of revenue increase and passenger counts as well as increased transit utilization for work trip commuting by downtown employees. Lastly, an attitudinal survey will be administered to the general population to assess any change in the public's image of transit.

As part of the Knoxville, Tennessee, CBD demonstration project, a fare-free zone was introduced in November 1977. Those persons who board and alight within the CBD must request a special card from the driver and remain near the front of the bus; the card is to be surrendered upon alighting. This system was chosen to avoid the confusion of switching to one involving payment on entrance inbound and on exit outbound.

As in Albany, the principal objective of the Knoxville fare-free zone is to improve the mobility of downtown workers, shoppers, and residents, and to enhance the economic vitality of CBD activities and merchants. The impact of the fare-free zone on downtown revitalization and mobility may not be fully understood, however, apart from the context of the totality of changes which are occurring at the site. The fare-free zone is only one element of a multifaceted demonstration project which is underway in Knoxville. Chapter 4 contains a complete discussion of the Knoxville demonstration.

Projects Demonstrating Methods for Transit Performance Improvement

Within the transit management program of UMTA, there has been increasing demand for more sharply defined measures of the deployment of urban transit resources and of the resulting usage and benefits of offered services to the general public. The key to effective urban mobility is the efficient utilization and management of transit resources-labor, equipment, consumables, and route network.

Since the inception of urban passenger transport services, transit operators have attempted to gauge the passenger revenues of each service against the cost of providing it. Until very recently, operators have relied on labor-intensive spot surveys of patrons and have used total system costs for the comparison of revenues and costs. After evaluation of various management and transit service studies which indicated both increases and decreases in ridership, it was determined that more reliable measures must be used to assess the benefits of operation on a line-by-line basis. With the advent of special tariffs for the elderly and other transportation-disadvantaged persons, operators have a stronger need for specific information on the characteristics of transit riders. If an area of the community has a high proportion of elderly citizens or other captives to transit use, then service changes in that locality have a large impact on that section of the city, and service should not be reduced or altered on the basis of making an equal ratio of service alteration everywhere. However, the cost of monitoring urban ridership has escalated so sharply that new methods of passenger traffic enumeration must be adopted. It seems feasible to consider the use of computerization.

During 1975-1977, UMTA has sponsored a project in the San Fernando Valley portion of Southern California Rapid Transit District (SCRTD), to develop a low cost, effective method of collecting socio-economic data and presenting it in a way that will improve mangement's awareness of the utilization of transit services. Two major accomplishments resulted from this project. First, a lower-cost, comprehensive method of gauging the potential ridership as compared to the actual patronage, within a specific area, was obtained. Second, a software package with conversational computer programs which will permit local transit authorities to use reliable statistical techniques to pinpoint potential markets for transit, was developed.

In demonstration projects which are currently in the planning stage, these existing software tools will be adapted for practical, cost-effective use. The primary goal of the project is to give both the operating and policy-making levels of tansit management much improved tools for assuring that available resources will be employed to meet the adopted transit service objectives in the most efficient manner. The second goal of the project is to introduce new, inexpensive, techniques and procedures for collecting and analyzing data regarding ridership and operating costs for each transit route. This will be done for the purpose of serving the primary goal as well as the immediate management needs for control and innovation of existing services. At the present time, the following cities are being considered as potential demonstration sites: (1) Omaha, Nebraska; (2)

Louisville, Kentucky; and (3) San Diego, California. UMTA regards these demonstrations as experimental; they will assess the usefulness of this method for measuring resource performance. The demonstrations will be conducted in a carefully controlled manner to facilitate the systematic monitoring of the outcome in order to interpret and identify all impacts.

In particular, the following tasks will be performed during the demonstrations.

- Review of locally selected public transportation service goals and objectives for use as route criteria or standards.
- Definition of transportation services provided and measurement of vehicle operations.
- Estimation of operating expenses by route, service area, and operating period.
- Measurement of the level of demand for each route and service type and study of the socioeconomic and travel characeristics of current riders.
- Preparation of productivity and financial analyses of the defined transportation services on each route for each operating period.
- Development of local data processing and retrieval capabilities.
- Identification of the travel requirements and residential location of potential transit riders.
- Measurement and analysis of the short and medium term results of implementing various change factors.
- Extension of resource management analysis to transportation systems management
- Development of a continuing staff training program.

See Figure 3-1 for a work flow diagram showing the relationships of the tasks.

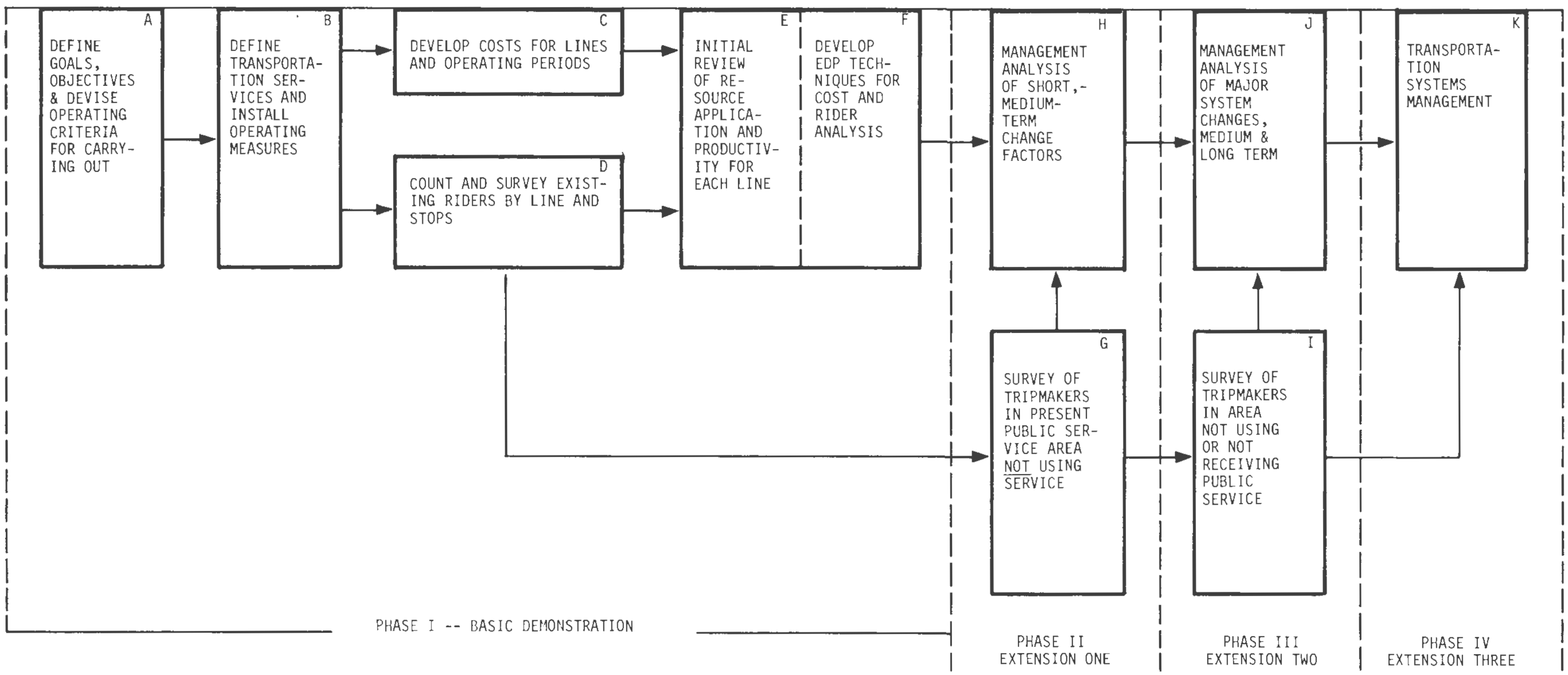


FIGURE 3-1. WORK FLOW OF TRANSIT MANAGEMENT DEMONSTRATION TASKS

PRICING DISINCENTIVE DEMONSTRATIONS

Overview

In recent years pricing disincentives have been considered a potentially effective approach for improving urban transportation in congested areas. The concepts are based on the philosophy that transit incentives by themselves may not be fully effective in obtaining significant mode shifts from the automobile to the transit option and other ridesharing arrangements. Only by the application of specific disincentives to the low occupancy automobile and the introduction of tangible and visible transportation improvements, can significant increases in transit ridership be obtained. Charges applied to parking or auto use are an essential element of programs to expand transit and para-transit service because they generate the space needed by high occupancy vehicles for efficient operation and the revenues needed for service expansion.

Pre-implementation planning and site selection procedures have begun for a number of pricing disincentive demonstrations. In the area of road pricing, the background planning and implementation information required to demonstrate the concept was completed in fiscal year 1977. Road pricing involves charging vehicles for the use of streets in congested areas, thereby encouraging the use of transit in those areas. The site selection process for the concept was completed in 1977 with: (1) Berkeley, California; (2) Boston, Massachusetts; (3) Madison, Wisconsin; and (4) Honolulu, Hawaii, expressing interest in examining the impacts of implementing the concept.

Corridor and spot pricing are two variants of road pricing. They are used in a restricted area to test the ability to divert travel to high occupancy modes. Because their effects are focused on a geographically limited area, these concepts are usually more politically acceptable and, therefore, easier to implement than roadway pricing.

The corridor pricing concept is very similar to areawide road user charges except that its target is a congested urban corridor rather than a downtown area. A demonstration of this concept would provide information on how motorists might shift travel times, modes, or routes when confronted with a priced corridor. As with other pricing schemes, this concept would be augmented by mass transportation improvements along the affected corridor.

Spot pricing, which is even more localized in its impact than corridor pricing, involves pricing the use of congested or trouble spots such as expressway entrance and exit ramps, major intersections in central cities, or access points to major activity centers such as stadiums or entertainment complexes. Spot pricing can be used to encourage the use of existing park and ride services from strategically located satellite parking lots of sport arenas and civic activity centers.

In the area of parking pricing, a site selection process was initiated to locate candidate cities willing to test a variety of concepts. Four strategies have been identified that appear particularly suited to relieving urban congestion and generating revenue for transit improvements: (1) parking license; (2) morning peak surcharge; (3) parking space tax; and (4) revenue tax. Madison, Wisconsin, has begun preliminary planning for a demonstration to test pricing schemes that will involve a surcharge for vehicles parking at city owned spaces in the morning peak, increase patron rates for long term parking, validate shopper parking by merchants, and reduce parking rates for shoppers. Additional sites will also be identified to assess the effectiveness of other parking pricing strategies. In the discussion which follows, the concepts embodied in each of the proposed pricing disincentive demonstrations, will be outlined.

Road Pricing Demonstrations

The transportation system in congested cities cannot be substantially improved unless it has more street space with which to improve service speeds, reliability, and productivity in terms of person movement. Congestion pricing, which levies special charges on vehicles using crowded streets, is a potentially effective means of providing this space. Because it can be focused on the congested area, it is likely to be more effective than other more general changes in prices or taxes, such as increasing the price of gasoline or reducing transit fares. The advantages of congestion pricing lie largely in making highway capacity available for high occupancy transportation modes, including not only conventional transit, but also various forms of paratransit - all modes, in fact, which use street space economically. Congestion pricing is thus a leading element in what must be a package of prospective improvements.

Congestion pricing can take many forms: for example, supplementary licenses to enter a congested zone, surcharges on parking, or metering of vehicles. Conceptually, one of the most attractive alternatives is the area use charge, or, in other words, a license to use a specified zone. Such a scheme can be designed to affect the principal factors important in controlling congestion, namely peak period traffic and vehicle occupancies. Compared to the alternative forms of congestion pricing, the area use charge appears to be easier and less expensive to implement.

In a demonstration approach, the congested area of the city would be designated as the "priced area" during certain hours of heavy travel. Private automobile drivers desiring to travel in the designated area during the congested periods would be required to purchase a special license and display it prominently. At the same time, changes in public transportation, broadly defined, will be initiated. The primary objective will be to increase vehicle occupancy. Current automobile users have varied trip origins, destinations, and service needs. Thus a wide range of specific measures will be appropriate; e.g., encouragement of carpooling, vanpooling, shared taxi; and other para-transit forms as well as expansion of bus service. The entire range of innovations would be implemented as a complementary set.

During the past fiscal year, feasibility studies were initiated for the implementation of road pricing demonstrations in Berkeley, California, Boston, Massachusetts, and Honolulu, Hawaii. The purpose of the studies was to design a licensing scheme, determine the level of charge, develop the transportation improvement plan, and estimate the impacts of implementing the package of innovations. These analyses were to provide each locality with the information necessary to judge the merits of the approach and provide guidance toward the institutional changes that will be necessary for successful implementation of the package.

In Berkeley, the road pricing study was terminated by action of the City Council in November of 1976 after a newspaper article aroused citizen misperception and opposition. Subsequently, an attempt was made to uncover the reasons behind the demise of the study; interviews were conducted with 23 individuals who are active in Berkeley politics, community transportation, and citizen issues. It is hoped that the information gained from these interviews will aid in implementation of the concept in other sites.

The pricing study lay fairly dormant in Berkeley until a pejorative newspaper article was published. This article omitted some of the details and alternatives of the study and was written with a suggestion of mockery. The general public learned of the study from the article and, perhaps due more to the tone than the content, conjured up visions of toll booths scattered throughout the city and assumed citywide pricing 24-hours a day. It is still unclear whether the general public understood that the study would not automatically mean implementation; but this fact would have been difficult to get across, since most people believe studies are done only for the purpose of implementation.

Within days of the article's appearance, City Council members began to receive phone calls from people adamantly opposed to the study. The fears expressed by many of the callers were not over issues of regressivity or business impacts, but rather sheer anger at the idea of losing a basic freedom. Among business interests it was felt that any form of pricing (even if applied to one road during the peak period with city residents exempt and free transit provided) would give Berkeley an "armed camp" image and discourage shoppers from outside the city.

The study probably would have continued in the absence of general public knowledge and opposition. This opposition would have been postponed until the longer, second phase of the study, where efforts to devise more specific, acceptable alternatives would have been made. The presentation of alternatives might have attracted some community support and may have mollified some public fears and opposition. However, it is still not clear whether the community would have agreed upon implementation of one of the final plans.

At present, a road pricing study is being conducted in Boston to investigate possible implementation of the concept. Alternatives with respect to: (1) the spatial extent of the priced area, (2) the temporal extent of the pricing restrictions, and (3) the price of the license, are being examined. When the study is completed, recommendations for a specific demonstration will be made. As has been the case with other road pricing proposals, political acceptance of the concept may be difficult to obtain.

With regard to the spatial extent of the project, two alternatives are being studied. The City of Boston has considered the Boston Proper, a 3.4 square mile area which includes the central business district, as one of the road pricing alternatives to be studied. In addition, a .4 square mile "core" area where the levels of congestion, quality of transit service, and concentrations of non-residential activity are higher than in Boston Proper as a whole, will be considered.

With regard to the temporal extent of the pricing restrictions, two alternatives are being studied. In Boston Proper, there is relatively little peaking of traffic congestion. Traffic is very heavy throughout the day, and volumes fall off significantly only after 7PM. Hence, road pricing during a full 12-hour period is being considered. If an attempt is made to limit the impact of the program to work trips, however, a morning peak period restriction would be optimal.

In regard to the license fee, two alternatives are being examined. The 1972 Parking Study for downtown Boston indicated that the average worker paid approximately $2.30 per day for parking. In a large majority of cases, reimbursement was complete, so that parking awas effectively free. Hence, a license fee of $2 per day would almost double the out-of-pocket cost of driving downtown to work. A higher price would probably be excessive. The possibility of a lower fee is also under examination.

In order to determine which set of pricing alternatives holds the most promise for implementation in Boston, a review of existing work-trip, mode-split models is underway. The use of an appropriately selected model will enable quick analysis of a large number of pricing alternatives. An application at the aggregate level will also serve to evaluate the effectiveness of the chosen model. In addition, the question of how to estimate the effect on travel times of the reduction in traffic brought about by the pricing program, is being investigated.

In Honolulu, the state and local transportation authorities are developing a proposal for the pricing strategies and parking policies which are considered desirable for testing at the site. The objective of the Honolulu demonstration will be to limit auto usage through the mechanisms of corridor and spot pricing, as well as parking strategies. Concurrently, mass transportation improvements will be effected, and it is expected that many persons will abandon the high-priced auto mode for relatively inexpensive, convenient, transit.

Parking Pricing Strategies

As discussed above, economic disincentives to auto use (congestion pricing) may provide localities with one of the most effective ways to improve traffic conditions and transportation systems in general. Not only can economic disincentives be aimed directly at the auto driver who contributes most to congestion and air quality problems, but such a program would generate substantial local revenues to be used for upgrading other components of the transportation system and would produce improved traffic flow conditions needed for efficient transit operations. This latter aspect sets the pricing solutions apart from physical restrictions such as preferential parking for some groups, and blanket prohibitions.

In a study of pricing strategies applied to parking which was completed this year, it was concluded that pricing of automobile use in an area, rather than auto parking, is the most effective way to deal with auto-related problems. The main advantage of an area licensing scheme over the application of charges to parking is that through traffic would not escape the license requirement. A major effort has been made during the past year to interest a city in a detailed study of an area licensing requirement. The major obstacle to implementation of a project has been political oposition often stemming from a fear of "radical" departure to more standard solutions.

Since many localities already tax parking, a parking pricing scheme might be more easily implemented than area licenses. The typically congested downtown core would be an obvious candidate for the application of parking charges, but many other types of areas could benefit from the pricing of parking. Some communities have attempted to discourage commuter traffic in selected neighborhoods by issuing special parking permits to residents and restricting all others to short-term parking on the street. Parking pricing could be used in many situations, and at least four strategies are commonly recognized.

<u>Strategy 1:</u> <u>Revenue</u> <u>Tax</u>: A flat tax rate of, say 25 to 100 percent, would be levied against all revenue from municipal, commercial, and private operations. Long-term municipal on-street parking rates would also be increased.

<u>Strategy 2:</u> <u>Parking</u> <u>Space</u> <u>Tax</u>: Operators would be charged an annual fee for every space they provide regardless of who uses it, when it is used, or for how long. The spaces in each municipal, commercial, and private facility would be inventoried, and all owners would be assessed each year for each space. The city would be divided into zones according to the severity of congestion in different areas. Rates would be the highest in areas experiencing the most congestion, with perhaps two or three other zone-types and tax rates.

Strategy 3: Morning Peak Surcharge: Providers of municipal, commercial, and private parking would be required to make a record of the number of cars parked in their facilities during the morning peak period, and would be assessed an annual fee for each of these automobiles. As in strategy 2, surcharges would be applied according to the distribution of congestion throughout the city.

Strategy 4: Parking License: During the two or three peak morning hours on weekdays, all cars parked anywhere within zones designated by the city, would be required to display permits which would be sold for a fee. Daily, weekly, and monthly stickers would be available at a number of convenient locations such as municipal parking lots, service stations, banks and post offices.

Demonstration-design studies are currently underway for projects which will test the array of pricing strategies in a variety of localities. A site selection process will commence in the near future for potential demonstration sites. The city of Madison, Wisconsin, which was formerly under consideration for a road pricing demonstration, has abandoned that concept and expressed interest in a parking pricing study.

The political opposition to all forms of pricing disincentives for the relief of traffic congestion has prompted policy makers to consider the more publicly acceptable alternative of price incentives to accomplish the same goals. Reducing the price of parking for carpools, for example, could be a less painful way to encourage higher automobile occupancy than, say, levying a hefty tax on all parking. However, the impact of such an incentive could be quite different from that of a tax since it would offer advantages to the general public (including transit riders and those already carpooling) while the burden of a tax would be aimed more exclusively at single-occupant autos.

The value of price incentives in discouraging low occupancy auto use has yet to be evaluated empirically since there are few situations where such incentives have been offered to the general public. The carpool incentive program in Seattle is the only one known to exist in the United States. A small scale survey which was administered to 150 users of two public parking facilities in downtown Seattle where reduced parking rates are offered to carpoolers, provides the sole source of data in this area.

The carpool incentive program in Seattle is administered by a municipal agency, Commuter Pool, which offers reduced-rate parking to carpools in two municipally-owned facilities located at the periphery of the central business district. The normal municipal parking rate of $25 per month has been completely eliminated for carpools at one facility, and reduced to $5 per month at the second (the Freeway Garage).

Of the sample of carpoolers interviewed, 62% were new to carpooling. While this result indicates that parking incentives may have a significant impact upon carpool formation, the results also show the influence exerted by factors of time and convenience. As many as one quarter of those changing from single-occupant auto to carpool may have been influenced by these factors alone (or factors other than parking price) since they were parking for free before changing modes. Since the simultaneous effects of parking and operating costs, time, convenience, and other aspects of carpooling were not examined, it cannot be determined which of these factors is the most important.

While the parking incentives in Seattle appeared to stimulate new carpool formation, the survey results indicate that increasing the number of carpools may not necessarily lead to significant reductions in congestion or other traffic related problems in downtown areas. Reductions in congestion will only be effected if relatively large numbers of people change from single-occupant automobiles. In Seattle, only 22% of the carpoolers previously drove to work alone, while the remainder were almost evenly split between transit and carpool. The large proportion (40%) of those drawn from transit may have served to add cars to the street. However, if this effect were to relieve pressure from an overcrowded transit system during the peak hours, this impact could be considered beneficial by a city pondering implementation of the concept.

The usefulness of parking price incentives for solving urban traffic-related problems needs further empirical study before firm conclusions can be drawn. The response in Seattle suggests a number of hypotheses which should be tested:

(1) Parking price reductions alone will encourage a relatively small number of single occupant auto drivers to form carpools:

(2) Price reductions will encourage a substantial number of transit riders to form carpools;

(3) A significant number of people changing from transit will form new carpools among themselves rather than join existing carpools:

(4) Price reductions will attract cars into the priced area which had previously been parked in less expensive locations; and

(5) Price reductions will induce those living relatively close to the priced area to carpool.

FUTURE PROJECTS IN THE DEVELOPMENT STAGE

During this fiscal year, several activities were initiated to develop new demonstration concepts for implementation in fiscal year 1979. These activities included design work, candidate site selection, and the preparation of research studies and feasibility reports. In the discussion which follows, the price/service variation concepts which have been proposed for demonstration in fiscal year 1979, will be described.

Self-Service Fare Collection System

Flexible pricing is an important element in programs to improve the effectiveness and efficiency of transit service. The ability to increase ridership, and, at the same time, maximize net revenue from each market segment through various pricing schemes is of great interest to transit operators. However, the implementation of flexible pricing schemes (peak/offpeak differentials, zoned fares, short/long term passes, etc.) imposes complications in fare collection. The objective of demonstrations in this area will be to evaluate the effectiveness of self service and automated billing fare systems in implementing flexible fare structures. In addition, the improved operating efficiency resulting from the use of these systems will be examined, and the public response to each of these systems will be established.

As part of the demonstration design effort, the self-service fare collection systems which are currently in use in Europe and the United States, will be analyzed. The concepts employed in each of these systems will be examined, and their potential transferability to the American transit environment will be evaluated. System requirements which are necessary for self-service fare collection, such as operating procedures, support services, marketing, and hardware will be developed. The above system requirements, institutional recommendations, and functional specifications will be documented for UMTA approval so that alternative self-service fare collection demonstration design packages can be presented to candidate cities.

Credit Card Fare Post Payment System

At present, the technology for using a combination of credit cards and automated fare collection equipment in transit operations has been sufficiently developed to become economically feasible. Basically, the system employs a magnetically coded or otherwise machine-readable credit card and automated recording equipment at the transit stop or in the vehicle, which can read the credit card and store information about the trip. This process may involve insertion of the card at the beginning and at the end of each trip.

Some small-scale field trials of the concept have been conducted, and some are still in process. However, these trials have been largely restricted to special situations, such as subscription and dial-a-ride service. Consequently, very little is known about the operational feasibility of using credit cards on a broader scale in transit operations. The purpose of this demonstration concept is to assess the potential of using credit card payment on a systemwide basis in public transportation.

There are a number of potential benefits which might result from implementation of such a system. They may be grouped into major major categories:

- improved record keeping and information management through timely ridership and revenue information which can be used in management decisions relating to service policies and patterns;
- increased flexibility with respect to fare policies; fare adjustments and service subsidies can be implemented quite easily by changing certain parameters in the relevant software;
- increased patronage, since the credit card would eliminate the need for change and would introduce an incentive to use transit more frequently because of deferred payment.

Fare Prepayment

Transit-fare prepayment has been broadly defined as any method of fare payment other than paying cash at the time a transit trip is taken; thus, the action of prepayment consists in the purchase of evidence that can later be verified as a substitute for cash in payment for transit rides. Prepayment methods include tokens, tickets, passes, punch cards, permits, and even credit cards. These payment types vary according to differences in boarding procedures, duration, number of times they may be used, and client population which may use them.

While numerous transit agencies have or are planning to implement prepayment plans, very little is known about the prepayment methods preferred by different sectors of the transportation market. In addition, evidence of the impact of prepayment plans on the revenue and costs of the transit operator has been murky at best. There are also no available guidelines for selecting the optimal discount strategy or distribution method. The objective of an ongoing SMD-sponsored study is to develop demonstration plans for two fare prepayment concepts of multi-city application. The demonstration plans will be developed for two sites (i.e., one site per concept).

In designing the demonstration plans, a variety of different prepayment systems, discount levels, and distribution methods will be considered. A mix of city environments will be analyzed when developing site selection criteria. However, selection of the prepayment concept will be made on the basis of the concepts which have the best possible application to a variety of city scenarios; that is, to permit a multi-city oriented demonstration.

Parking Pricing

Two additional parking pricing projects are planned for implementation in FY 1979 to encourage the use of high occupancy vehicles. These concepts are an answer to the re-emerging interest in the application of parking strategies to control the heavy volume of single occupancy inbound traffic. These demonstrations will not only consider the application of pricing disincentives to discourage auto use but will also recommend specific incentives to encourage high occupancy auto and transit use.

Four parking strategies have been selected for possible consideration for demonstrations. These are: (1) the revenue tax; (2) the parking space tax; (3) the morning peak surcharge; and (4) the parking license. These schemes are described in detail in the Pricing Disincentives section of this chapter.

The site-selection process for implementation of parking pricing strategies is currently underway. The four cities which have been selected for further consideration are: (1) Madison, Wisconsin; (2) Boston, Massachusetts; (3) Honolulu, Hawaii; and (4) Berkeley, California. Site specific studies in several of these cities will begin in the near future.

Integrated Fare Demonstration

The purpose of this project is to augment efforts underway in the paratransit program area by testing specific pricing arrangements for the various services which are being developed. The experiments will provide empirical data on the price and service elasticities of paratransit characteristics, and it is expected that the information obtained from these pricing studies will aid in the development of guidelines for implementing a comprehensive pricing program on a multi-modal basis. For the fare integration, different fare structures will be examined to determine those that maximize the convenience of using different modes for the total trip. Variations in flat fares may provide estimates of demand elasticities for the individual and combined modes. Institutional and financial circumstances will be examined to develop fare policies at the transportation broker level that would aid in balancing the transportation demand with the most efficient supply of transportation service.

Demonstration projects which test the integrated fare concept will provide an opportunity to evaluate the effectiveness of existing pricing strategies within the paratransit industry. They will also begin to identify further pricing innovations between paratransit and conventional transit which will more accurately balance supply and demand. Currently, an integrated fare demonstration is being designed for implementation in Nassau County, New York.

Fare Incentives as a Promotional Basis

Transit fare incentives have been used as a habit-breaker to entice auto users onto transit by a temporary low or no fare. Three general types of promotional schemes of this nature have been tried in recent years by several transit operations: free ride coupons, free ride days, and the free bus.

Free-ride coupons are distributed either by printing them in a newspaper or by direct mail. These coupons are exactly analogous to the "cents off" coupons for food items and other convenience goods that are commonly distributed in the same way. The advantages of this type of promotion are that, by using direct mail, one can promote specific routes selectively (perhaps a new route or a route that has been losing ridership at a greater than average rate), and from an experimental point of view, one has the luxury of examining treated and control groups. Direct mail distribution also allows one to target the promotion to particular types of households.

The most common form of promotion appears to be free-ride days; the systemwide abolition of fares for just one or two days is often linked with some other event such as a local sale or the acquisiton of new buses. In some cases, the fare elimination is restricted to the offpeak hours.

The free bus is a third type of promotion in which one free-ride vehicle is switched from route to route so that passengers cannot anticipate where it will be at any one time. In these cases, boarding passengers simply find the fare box covered up and learn that no fares are required.

While "casual empiricism" suggests that such measures have the potential for inducing a permanent increase in ridership, very little analysis of the overall benefits of this activity has been undertaken. A primary objective of projects in this area will be to determine whether the benefits of such programs justify their costs.

At the outset, the experience gained to date with these types of programs will be surveyed. This review will aid in the employment of local initiative and experience to define promising fare promotional concepts for implementation in two cities in FY 1979.

Fare and Service Variations to Improve Route Performance

This project is one of a series of price- and service-variation demonstrations that are designed to develop credible guidelines for the transit industry regarding the costs and benefits of making service, as opposed to fare, changes. This demonstration is designed specifically to study and devise alternative measures to improve the performance of transit vehicles on particular routes - their travel time, productivity, and cost of operations. Route performance measures will also be developed to give estimates of service elasticities for comparison with price elasticities which have been developed in other price related demonstrations.

The concept involves the selection of a set of transit lines that are known to vary in several characteristics: their length, time of service, area served, socio-economic characteristics of users, etc. A set of comprehensive analyses will then be performed to determine the performance characteristics of the lines, including areas of high and low-demand, variability throughout the day and week, specific sections with delays, and reasons for those delays.

After problem areas within the line segments have been identified, specific action will be taken to improve productivity, reliability, and travel time. Some of the techniques which may be employed are:

a) the application of skip-stop operations;

b) increase in transit vehicle supply for line segments; and

c) action to eliminate delays at boarding points, traffic lights, etc.

A demonstration design study has been initiated to examine the transit service changes and pricing policies to be considered. The study will review the structure of pricing and service improvements and provide an analysis of the existing state-of-the-art experience. Experimentation demonstration designs will then be developed for single-city and multi-city applications.

Graduated Fares by Level of Conventional Transit Service

In formulating an overall fare policy, a transit operator may employ a variety of criteria. A particular fare policy may be adopted to achieve any of the following objectives:

- proper allocation of resources to transit service through marginal cost pricing;

- maximization of fare box revenues; and

- maximization of social benefits derived from increased transit use.

In practice, maximization of both fare box revenues and of social benefits tend to play a role in setting fares. With respect to the former, the strategy for achieving the maximization of revenues is to offer different transit services to different market segments at differentiated fares based on the value users place on the services. This is essentially the point of market segmentation: to determine the transit services users or potential users in different markets want and are willing to pay for, and to provide those services at fares that are equal to the valuation users place on them.

Typically, service differential has been interpreted as the provision of special services for particular groups, such as express or subscription buses for commuters, downtown shuttles for shoppers, or dial-a-ride or feeder services for the elderly and handicapped. Each one of these services is clearly distinct from basic transit services. Setting differentiated fares, therefore, can be accomplished by considering each special service separately.

However, there has also been some consideration of service differentiation within the basic transit services. The most obvious differentiating criterion is the length of the trip, but others, such as frequency and seat availability, could be considered. Existing fare structures most often are differentiated with respect to distance in the form of surcharges once a trip goes outside a defined zone. It is possible to introduce additional criteria relating to the value of the transit service provided to obtain a graduated fare structure that more adequately reflects the different levels of services. For example, express service might be priced above local service. The basic objective of a demonstration of this concept would be to demonstrate the feasibility of designing and implementing a fare structure that covers different levels of service quality within the basic transit system.

The benefits of such a pricing scheme are obvious. A differentiated fare structure would be more equitable, since it would avoid situations in which a short trip costs as much as a crosstown trip. It could be structured to encourage use of the most economical service from an operational viewpoint. The structure could take advantage of variations in fare elasticities and cost/service trade-offs among various market segments to increase fare box revenues. Recent refinements in market research for public transit systems can provide a better basis for formulating a graduated fare structure.

Even so, there are problems in the implementation of this demonstration concept. They include the achievement of a political agreement on service differentiation criteria, the design and implementation of an appropriate market segmentation study, and, perhaps most importantly, the administration of a fare structure that is almost by definition more complex than existing ones. Difficulties in the administration of this type of fare structure may also result in certain operational problems, such as delays that are due to increased boarding times, barriers to the user of simple types of passes, and lost revenues and enforcement problems arising from fraudulent usage. Because of these problems, it is likely that a demonstration of fare differentiation by level/value of service would require some form of specially designed pre- or post-payment agreement.

Transfer Cost Elimination and Network Simplification

Depending on the urban area and trip purposes, it has been found that ten to fifty percent of all transit trips involve transfers for reaching final destinations. Most transit systems require an additional fare for transferring among vehicles, when the inconvenience and the waiting time associated with the transfer is already a sufficient disincentive for making the trip by transit.

The objective of this demonstration is to evaluate and study the effect of transit transfer fares on transit usage and to develop means for eliminating transfers and simplifying network routes. Initially, a detailed study will be undertaken, and a planning manual produced, to describe the various transfer schemes in existence, the extent of the transfer problem, its disadvantages to the user, and possible benefits that it provides to the transit operator. Some of the questions to be addressed will include: which transit trips are most accountable for transfers? Which market segments are more prone to transfer? How does the marginal cost of transfer charges as compared to the originating fare, affect transfer usage? How do transfer revenues affect total operating costs? How does the disincentive of transfer charges compare to the disincentive of transfer waiting time? Specific reommendations will be made for demonstrations that should be undertaken to test the impact of eliminating transfer fares and performing network route simplifications.

Token Reinforcement Procedures for Increasing Offpeak Ridership

The concept of token reinforcement as applied to transit systems involves rewarding, both psychologically and materialistically, individuals who use the transit system. This reward process helps to place transit on a more competitive basis with the automobile. It provides financial and social advantages to the users and attracts attention to transit by associating it with other desirable activities such as dining out, shopping, sports, etc.

Two applications of the token reinforcement concept have been tested in a limited environment witn promising results. One application aims at increasing offpeak ridership by distributing tokens that have numerous face values and may be exchanged for various goods and services at retail outlets. The possible arrangements that can be made by merchants and transit operators in providing ridership incentives that may benefit the merchants, operators and users, are of interest. Merchants who are willing to subsidize the cost of the token reinforcement will be solicited, and, in return, they may realize increased patronage from bargain seeking consumers. Token reinforcement is also a potentialy effective distribution method for reduced or fare-free transit.

A demonstration is being planned to provide empirical information on the effectiveness of token reinforcement procedures in increasing offpeak ridership and in providing free transit which maximizes ridership increases and cost decreases. The reinforcement procedure will be studied in terms of the user market groups it attracts, the transit trips taken, and the administrative/financial impacts to the transit operator. Since the token refinforcement procedure constitutes a form of transit fare prepayment, it will be interesting to examine how the principle of token reinforcement can be administratively incorporated into existing transit fare prepayment distribution and usage procedures.

Transportation Pricing Management through Selected Households

The concept of managing the travel behavior of selected households requires the solicitation of a group of individuals who agree to face a carefully structured schedule of transportation prices which are designed to test their transportation behavior. The participating households would be given in advance, a yearly transportation budget (say, $500.00) to use as they please - with the intention of allocating this sum to appropriate purchases which satisfy their travel needs. A demonstration of this type would provide empirical information on the travel decision-making of individuals who must allocate a fixed travel budget for transportation modes which have different pricing policies. A similar experiment is in the final planning stages in the Netherlands.

An experiment of this type would present an opportunity to obtain a sound body of data on consumer response to pricing changes. The results could provide a basis for using future policies to achieve stated objectives. The experiment would also provide information on the technical and political feasibility of innovative pricing schemes such as areawide congestion pricing, corridor pricing, and spot pricing.

Bus Transit Cost Study Design

The efficient management of any business must be based on an effective costing system. The objective of this study is to develop a system capable of identifying the detailed breakdown of a transit systems costs at every phase of operation.

A state-of-the-art review will investigate current costing practices in the transit industry through research and actual case studies. Methods of listing and categorizing the costs associated with all phases of transit service and how they vary with changes in service levels will be examined. Case study evaluations of specific transit agencies may aid in the understanding of the relationship between the cost of providing service and revenues generated as well as the proportional share of each cost element and their interrelationship. Information will be generated to enable the development of mathematical models. These models would be capable of allocating individual costs to specific transit lines and identifying whether specific services cover their direct cost of operation or contribute more than their proportional share to fixed costs, etc.

DEMONSTRATION CONCEPT SUPPORT

Technical and research activities in support of demonstration concepts have included the preparation of technical support studies, demonstration design work, and the development of a research conference on transit pricing and service improvements. These activities have aided in the implementation of new demonstration innovations, which are identical in detail, in a consistent framework across varied sites. This procedure will enable comparison of the impacts of a single demonstration concept in dissimilar locales - making the best use of information gained from the experiments. In the section which follows, the various technical and research activities which have been pursued in support of demonstration concepts, will be outlined.

Demonstration Design

When a decision has been made by UMTA to support one or more demonstrations of a particular type, detailed demonstration design work has been performed. The scope of this work is broad; the concept is refined, demonstration details are developed, a site selection process is completed, and a site specific demonstration implementation plan is presented. Typically, the process includes some or all of the following activities:

- Refinement of the basic demonstration concept, specifying operational and experimental details which may be critical to the value or the practicalities of carrying out the demonstration;
- Recommendation of the proposed details of the demonstration for approval, modification, or rejection;
- The specification of criteria for site selection;
- The development of a short list of potential sites, using information at hand or personal contacts with local government officials;
- The preparation of documents which summarize the objectives and operational details of the demonstration (insofar as they are determined at that stage), to be used in explaining the concept to potential sites and ascertaining interest;
- Site visits to a small number of potential sites;

- On the basis of site visits and analysis of available data, the recommendation of an agreed number of potential sites per demonstration to be funded;

- The provision of assistance to potential grantees (where necessary) in the preparation of a grant application;

- The preparation of a demonstration implementation plan for the specific site, detailing such matters as the objectives, the overall experimental design, the operational changes to be made and their timing, the monitoring activities to be carried out over the course of the demonstration, and the methods of evaluation. Such a plan may also include some administrative details relating to the reporting obligations of the grantee and the evaluation contractor; and

- Further liaison among UMTA, the grantee, and the evaluation contractor during the course of the demonstration, as may be necessary or advantageous to facilitate the progress of the demonstration.

During fiscal year 1977, site specific demonstration implementation plans were developed for the projects concerning transit fare prepayment (in Austin, Jacksonville, Phoenix, and Sacramento) and offpeak fare-free services (in Trenton and Salt Lake City). In addition, a preliminary design study has been initiated for the central business district fare-free experiments.

Review of European Experience in Fare Innovations

It is believed that the experience of European transit operators with regard to service provision and fare policies may be of considerable relevance to the United States, and in particular, may provide information about promising concepts which may be explored through the SMD program. For this reason, information is being assembled about relevant activities by European transit authorities, in a form most likely to suggest ways in which UMTA's program of demonstration projects would be aided. This implies, among other things, an emphasis on ideas which are transferable to U.S. conditions, and on those which promise to be testable in the field.

Price and Service Variations: A Work Plan

Research in the area of price and service innovations has demonstrated the need to study the impacts of independent fare and service changes as well as a combination of both. Experiments of this type would enable the analyst to obtain estimates of disaggregate demand elasticities by user group, geograhical area, time of day, type of service provided, etc. This work will also provide information on the impacts of fare increases, fare decreases, and the effect of the base fare from which the change is made. Variables for measuring the level of service will be selected, and service elasticities will be computed. Attention will also be focused on the relative importance of price versus service changes and the possible development of equivalency measures. With the increasing cost of automobile travel, an attempt will also be made to obtain cross elasticities to determine the effect of changes in auto travel cost on transit ridership, and vice versa.

The data required to obtain these estimates of elasticities will be obtained from a series of carefully designed demonstrations, monitoring and analysis of ongoing or planned demonstrations in other areas outside the Pricing Division of SMD, and compilation of existing results from research and analytical studies.

Research Conference on Pricing and Selected Service Improvements

The development of this conference was initiated for the purpose of bringing together the transportation community (officials from the transit industry, federal, state, and local governments, and private concerns) to discuss the key issues regarding pricing policies and related service improvements. The ultimate objective is to identify areas of most needed research and demonstration that may be directly implemented by the Pricing Division of the Office of Service and Methods Demonstrations.

The program will include workshop sessions with and without resource papers and formal sessions with paper presentations.

While a Transportation Research Board steering committee will be established to advise on the contents of the conference, some of the topics that may be included are:

- The transit industry's point of view on fare-free transit;

- The government's point of view on the same topic;
- Promotional fare policies;
- Demand and service elasticities;
- Flat fare system vs. charge for service provided;
- Merchant's role in mass transit provision;
- Pricing strategies for the offpeak periods;
- Impacts of fare increases;
- Fare integration; and
- Prepayment mechanisms.

<u>Transit Service Development Study</u>

This is one of the efforts to develop price and service variation experiments. The purpose is to study the policies and procedures presently employed by major operators for developing routes, schedules, and fare structures, and to identify specific research or demonstration projects which will advance the state-of-the-art in this area.

Four major tasks will be performed in this study:

a) Personal contacts with leaders of the transit industry. Discussion will be held with numerous officials of transit agencies, committees of APTA, and officials of transit management companies, regarding the scope and contents of the study. These contacts will also help in properly documenting task b.

b) A review of current policies. What are some of the market research and demand analysis techniques presently being used? How are route changes and schedules implemented? How is service evaluated and what performance measures are being used?

c) Analysis and critique of current practices. How effective are the demand analyses? Are routes, schedules, and fares tailored closely to demand? How meaningful are the system and route productivity and performance measures?

d) Recommendations for research and demonstration projects. Which areas of transit service development are most in need of additional research and demonstration projects? Demand? Costs? Route and schedule development? Runcutting? Information?

Road Pricing and Parking Strategies Information Booklet

A major effort has been initiated to expose a large number of cities to the pricing disincentive concept so that they will express their interest in implementation of a demonstration. As part of this effort, an information booklet has been developed which defines, in simple and clear steps, the major aspects of road pricing. The booklet directly addresses the basic issues and concerns regarding the impacts of various pricing schemes. Several scenarios of road and parking pricing applications are illustrated; the transportation problems which may be alleviated in each scenario are enumerated.

The road pricing and parking strategies information booklet will be distributed to a large number of cities. Those localities which express interest in implementation of the concept will subsequently be subject to a detailed feasibility study and candidate selection process.

ANALYTICAL STUDIES

In addition to demonstration implementation and concept development activities, a number of analytical studies have been undertaken which are characterized by the dual objectives of supporting various elements of the SMD Program and contributing to the advancement of the state-of-the-art in transit fare and service variations. These studies play an important role in the SMD Program activities of concept identification and demonstration planning and design. Typically, the studies also result in the generation of new insights and analytical techniques which are useful to transit planners and decision-makers across the nation.

Washington, DC, Elasticity Study

This study quantifies the reactions of commuters living in the Northern Virginia suburbs who use bus service on Shirley Highway or Lee Highway, when confronted with an increase in peak period fares. Observing and analyzing patronage on these lines permits a comparison of fare elasticities for two levels of bus service; on the Shirley Highway, an exclusive lane serves bus vehicles as well as car pools of four or more persons, while traditional service is provided on the Lee Highway.

Analysis of data collected before and after the fare increase indicates that the demand for service on the Shirley Highway Express buses is less elastic (-.27 to -.22) than that for the traditional Lee Highway bus service (-.53 to -.27). There was little evidence of passengers on either service shifting travel outside the peak periods to avoid higher fares. No noticeable impact of the transit fare increase on auto person travel was observed.

The study concluded that the differences in elasticities exhibited by the two types of bus service tend to confirm that different segments of the public transit market have different demand elasticities. Translating this into rudimentary pricing policy, one might consider raising fares more on premium transportation services than on traditional services. Such a policy would place user charges more in conformance with the services obtained. As long as the aggregate transit demand elasticity with respect to fare stays within the range 0 to -1.0, the net increase in revenue due to higher fares will exceed the net loss in revenues attributable to loss of patronage.

Fare Reduction Case Studies

Fare-free experiences in central business districts are currrently being investigated in case studies of up to four cities which have implemented zero fare policies. In addition, several case studies will be performed on other fare experiments such as systemwide fare-free, fare reduction, and offpeak fare-free. Each case study will include: (1) a description of the CBD area and transit service; (2) a description of the pricing and service innovations; (3) an analysis of changes in trip-making and mode split by different socioeconomic groups; (4) an analysis of changes in costs and revenues to the transit operator; (5) an economic impact analysis of the business community; and (6) an analysis of impacts on traffic congestion. The fare reduction studies will include planning advice to provide implementation guidelines for cities planning such experiments.

San Diego Analysis

Experience in San Diego from January, 1973 through April, 1975 is being used to formulate and estimate a model which can be used to identify ridership changes due to cost and service modifications. Data taken from monthly ridership, service, and financial reports and disaggregated by route provide a rich information base. To date, several reports have been produced which pertain to various aspects of the study.

The San Diego model is policy-oriented. By focusing the analysis on basic variables such as fare, speed, frequency, comfort and reliability, all of which are of major importance to the decision process of potential riders, the model will be capable of providing guidance as to the relative efficiency of policies aimed at changing system service characteristics. At the same time, it is designed to account for simultaneity among service variables. Demand is hypothesized to depend on a set of endogenous service variables which include frequency, speed, and comfort and on a set of exogenous service variables plus socioeconomic and other factors. Supply depends on demand, availability of buses and drivers, and cost and revenue factors. Speed depends on the age of the bus, number of bus stops, and average passenger per seat.

Preliminary results indicate that, over the system as a whole, the patronage response was similar to that which might have been expected from previous independent work. The responses were such as to increase deficits when fares were lowered and service levels were substantially improved. However, the greater numbers of passengers were carried at a cost per passenger which, over the period studied, did not increase in real terms. San Diego's experience of an expanding system at an approximately constant real cost per passenger was very unusual among transit operators in this period, and this phenomenon is to be addressed in detail in a forthcoming paper.

An important theme of the present findings is the diversity contained within a single bus system such as that in San Diego. Different markets are served under different conditions. It was found that what was typical behavior at the systemwide level became much less typical when relatively homogenous but separate parts were considered. Policy-making for transit systems, must of course, recognize this diversity, which implies that the instruments used to stimulate ridership should be used selectively. Measures of consumer response are difficult to translate into practical advice because of interactions between serice conditions, fares, and other factors affecting choices. System costs have similar complexities. For these reasons, the future work of this study will concentrate on the additional information which data at the individual route level can contribute. The San Diego bus system provides a unique data base for this work.

Refinement and Extension of the Fully Competitive Mode Choice Model

Research on the Shirley Highway Demonstration Project developed a new class of transportation policy planning tools that offer promise for the analysis of similar systems in other urban areas. The initial application of the tools was restricted to the binary mode case (transit vs. auto) to permit comparison with the conventional binary techniques and to the Shirley Highway data. The study had two objectives. The first was to determine and isolate those factors which influence mode choice, and determine how those factors combine to produce the bus market share. The second objective was to model in a fashion that would allow the results to be transferred and applied to other areas.

Using the 1971 Shirely Highway data and the 1974 Minneapolis I-35W data, several calibrations were performed with varying model specifications. The analysis involved comparisons among alternative mode choices which are influenced by the other alternatives available. Price and time elasticities for several of the models were computed. The calibration phase provided some empirical support to the intuitive expectations that mode choice is related to auto and bus costs and travel times.

Application of Competitive Choice model to Trenton, New Jersey

A fully competitive mode choice model is being tested as a forecasting tool to predict the impact of offpeak fare elimination on current transit riders using data from Trenton, New Jersey. If the model is found to be effective in forecasting impacts of transit system changes upon current tripmakers, then a tool is available for testing and fine-tuning system alternatives without the need for costly and time-consuming field trials. If existing tripmakers' reactions can be predicted by use of this model, and other econometric techniques can be assimilated to account for shifts in origin/destination patterns, induced travel, and to give some indication of regional impacts, then a significant advance will have been achieved towards the UMTA goal of developing a methodology for determining fare policy.

The Fully Competitive Mode Choice Model, developed under UMTA sponsorship, is particularly suitable for this application. The model is sensitive to changes in travel times and out-of-pocket travel costs, and is modally interactive, having both definable elasticities within modes and cross elasticities between modes. In addition, earlier applications in other locations indicate that it can be effectively applied to account for travel decisions of people traveling together as a group. This characteristic is of particular importance in the prediction of mode choice for offpeak travelers.

The work plan for applying the model to the Offpeak Fare Elimination Demonstration Project in Trenton, contains the following elements: a preliminary prediction of the impact of offpeak fare reduction on existing travelers; the establishment of data requirements and coordination of data preparation; the application of the model to predict the outcome of the demonstration project; and preparation of a final report including detailed comparisons of observed versus predicted transit line volumes.

Impacts of Section 5 Half-Fare Program

Information is being compiled to determine the impact of the half-fare program on the operations and costs of various transit agencies. The revenue loss due to the fare reduction will be evaluated in terms of the fraction of Section 5 funding affected. The study will also yield data on increased ridership by elderly and handicapped persons and evaluate the extent to which the program has aided these target populations.

Information gained regarding the price elasticity of ridership by the elderly and handicapped will be of value to transit properties which are planning new services. Furthermore, it will provide an opportunity to review price elasticity measures for a distinct market segment as compared to price elasticities for the general population. The development of market specific price elasticities will aid in the extrapolation of pricing policies to transit markets which have a potential for improving transit productivity.

A comprehensive report will be written which details the findings. The report will document the impact on operations, costs, and revenue for all sites which received

Section 5 funds, quantify the gain in ridership by the elderly and handicapped, discuss the findings concerning the price elasticity of ridership by those individuals, and identify other factors which influence ridership.

Effects of Fare Increases

The object of this study is to prepare a national summary of the aggregate impacts of transit fare increases in American cities with populations greater than 50,000. The study will provide a state-of-the-art review which includes descriptions of proposals for premium fares and for reducing deficits through increased transit fares. A select sample of transit operators will be interviewed regarding the distribution and observed impacts of recent fare increases on ridership. Local objectives for the fare increases will also be identified. The final report will summarize the findings and will be directed toward providing guidance to transit companies which are considering fare increases.

Multi-Modal Pricing Strategies

This exploratory study of multi-modal pricing policies will develop a strategy designed to promote and enhance relationships among system users and the system's financial supporters. The price related parameters include tolls, parking fees, and area or zone entry charges as a function of vehicle occupancy, tolls related to time of usage, fares collected at time of system usage (fare box charges), prepaid fares, and fares billed subsequent to usage. The modes under consideration include auto, fixed rail, buses, and paratransit. Topics being explored include: (1) fare differentials among modes, (2) out-of-pocket charges versus total charges; (3) "package fare" options that include one price for multi-modal trips and special transit discounts within the central area for persons who commute by "efficient" modes; (4) fare differentials among modes according to the level of service provided; (5) cost differentials among the various transit modes oprating in a similar environment, and (6) identification of various modes and of revenue sources.

This research will commence with a short but concentrated review of the literature to determine the state-of-the-art. A paper will be produced suggesting potential opportunities to explore cross modal pricing usage relationships in the real world. Concepts and brief descriptions will be developed for experiments and demonstrations which will lead to a more comprehensive understanding of multi-modal pricing relationships.

SUMMARY

The demonstration concepts and research projects which have been discussed in this chapter are designed to develop and test a wide range of transportation pricing and service innovations. The primary objective of these innovations is to promote efficiency in the allocation and use of society's transportation resources. In order to attain this objective, it is necessary to rationalize the pricing system; stimulating passenger demand for the most efficient, high occupancy modes. On the supply side, SMD's Pricing Policy Division is developing procedures to aid transit operators in efficiently and effectively managing the deployment of urban transit resources. Although many of these efforts are in the planning or pre-implementation phase, some significant findings may be cited at this time:

- Major fare reductions increase ridership, but not at sufficient levels to offset revenue losses; fare increases lead to ridership decreases with an increase in revenue.

- Systemwide offpeak fare reductions: (1) increase transit usage; (2) require little increase in transit capacity; (3) induce a shift in unnecessary peak travel to the offpeak period; (4) encourage the staggering of work hours; (5) provide increased mobility for the poor, the elderly, and the handicapped, and (6) may cause a small revenue loss.

- Downtown fare-free zones may increase ridership, improve the public image of transit, stimulate retail sales, reduce congestion, and act as a catalyst for urban redevelopment.

- Localized or promotional fare and service changes that acquaint existing and new transit riders with specific attributes of a transit system, result in ridership increases outside the affected zone.

- Certain markets for public transportation are under-priced; a fare increase for premium service on the Shirely and Lee Highways in Washington, DC did not produce a large decline in ridership.

- Periodic price discounts of transit fare prepayment (TFP) instruments result in increased usage of TFP and transit, and increased awar eness of transit service. In Austin, Texas, sales of TFP instruments increased 600% during a one month (40%) discount promotion.

- Employer promotion and distribution of fare prepayment instruments offers a convenience and potential price reduction to employees, a fringe benefit package for employers, and a reduction in administrative costs for the transit operator.

- Parking bans and increased parking charges promote significant mode shifts to transit and carpooling.

- Financial disincentives for low occupancy modes, coupled with public transportation improvements, increase transit usage and carpooling and reduces congestion, pollution, and energy consumption.

As the pricing and service concepts which are currently in the development stages evolve into operational demonstrations, our knowledge of the application of fare innovations in real world settings will be enhanced. In order to ensure that the maximum amount of information is gained from these experiments, the Pricing Policy Division of SMD is expending considerable effort in the areas of demonstration design, concept development, and technical research. Future findings from the various activities which have been described in this chapter will comprise a significant contribution to the state-of-the-art in the area of transportation pricing policy.

REFERENCES

1. DeLeuw Cather and Company, "Evaluation Plan for the Trenton Free-Fare Demonstration Project," February 1978.

2. DTM, Inc., "Refinement and Extension of the Fully Competitive Mode Choice Model-Task 2 Report," May 1976.

3. DTM, Inc., "Refinement and Extension of the Fully Competitive Mode Choice Model-Task 5 Report," July 1976.

4. DTM, Inc., "The Refinement and Extension of the Fully Competitive Mode Choice Model-Final Report," July 1976.

5. Ecosometrics, "Recommendations for Transit Fare Prepayment Demonstrations," Research Report RR-125-2, January 23, 1978.

6. Ecosometrics, "Transit Fare Prepayment Summary Guidelines," Research Paper RR-125-1, November 20, 1977.

7. Goodman, Keith and Melinda Green, "Low Fare and Fare-Free Transit: Some Recent Applications by U.S. Transit Systems," Urban Institute WP 5050-5-4, 153 pp., August 1976.

8. Green, Melinda A., "The San Diego Transit Study Data Base: Reference Manual" WP 5066-5-2, June 1977.

9. The Huron River Group, Inc., "Transit Fare Prepayment - Final Report," UMTA-MA-06-0049-76-3, August 1976.

10. Kemp, Michael and Rebecca Rea, "The Consequences of Transit Fare and Service Policies: A Classified Bibliography," Urban Institute WP 5050-1-2, 36 pp., April 1976.

11. Kemp, Michael, "Policies to Increase Transit Ridership: A Review of Experience and Research," Urban Institute WP 5032-1-3, 71 pp., December 1975.

12. Kemp, Michael A., "The San Diego Transit Study Data Base: Tape-User's Guide," WP 5066-5-4, September 1977.

13. National Bureau of Standards, "Elasticity of Transit Demand with Respect to Price: A Case Study in the Suburban Washington, DC Area of Northern Virginia," October 1977.

14. The Urban Institute, "Comparing Strategies for Reducing Traffic Related Problems: The Case for Road Pricing," Working Paper 5050-3-5, September 1976.

15. The Urban Institute, "The Consequences of Short-Range Transit Improvements: An Overview of a Research Program," Working Paper 5050-5-1, November 1976.

16. The Urban Institute, "An Econometric Model of Bus Transit Demand and Supply," Working Paper 5032-1-4.

17. The Urban Institute, "Implementation Procedures for Pricing Congested Roads," Working Paper 5032-3-3(2), February 1976.

18. The Urban Institute, "Plan for a Demonstration of Offpeak Fare-Free Bus Service in Mercer County, New Jersey," Working Paper 5066-8-1, February 1977.

19. The Urban Institute, "Plan for Demonstration of Transit Fare Prepayment Promoted by Employers in Sacramento," Working Paper 5066-6-1, February 1977.

20. The Urban Institute, "Plan for Reduced-Price Promotion of Transit Fare Prepayment in Phoenix," Working Paper 5066-6-3, October 1977.

21. The Urban Institute, "Planning and Implementing a Congestion Pricing and Transportation Improvement Package," Working Paper 5050-3-1(3), February 1976.

22. The Urban Institute, "The San Diego Transit Corporation: The Impacts of Fare and Service Changes on Ridership and Deficits," Working Paper 5066-5-1, May 1977.

23. The Urban Institute, "Transportation Improvement Programs Using Road Pricing: A Preliminary Analysis for Berkeley, California," Working Paper 5050-3-6.

24. The Urban Institute, "Transportation Improvement Programs Using Road Pricing: A Preliminary Analysis for Madison, Wisconsin," Working Paper 5050-3-7, October 1976.

25. The Urban Institute, "Utah Transit Authority Off-Peak Fare-Fare Demonstration Plan", Working Paper 5066-08-02, July 1977.

26. Urban Mass Transportation Administration, "An Invitation to Local Communities to Submit Statements of Interest in Participating in Experiments with Transit Service Level and Fare Policies," March 1976.

27. Urban Mass Transportation Administration, "Second Annual Report to Congress Concerning the Demonstration of Fare-Free Mass Transportation," September 1976.

CHAPTER 4

PARATRANSIT SERVICES

INTRODUCTION

Paratransit service refers to that group of transportation services that fall between the single occupant automobile on one hand and the fixed-route, fixed schedule bus or train on the other. Common forms of paratransit are taxis, jitneys, dial-a-ride, rental cars, carpools, vanpools, and buspools. For purposes of the SMD program, only those services which can be offered to the public on a shared ride basis are being demonstrated. This excludes exclusive ride taxi service and rental cars but includes the other commonly recognized forms of paratransit.

A major reason for developing paratransit service is to make better use of existing transportation resources in the public and private sector. There are thousands of taxis, social service agency vehicles, school buses, limousines, commuter cars and vans that can be utilized more efficiently to complement existing transit operations. We are developing service models to show how these resources can be used in a coordinated fashion to serve markets more effectively than possible by fixed-route transit. The approach includes market segmentation to identify the transportation needs of particular groups, design of services to meet the needs of the market segments and coordination of service to avoid overlap of service and destructive competition.

During the past year, paratransit services have been receiving slow but steady and significant acceptance around the country. In addition to actual service implementation, paratransit has received a good deal of attention in conferences and publications. The most encouraging aspect of the growing interest in paratransit is the tendency on the part of the planners and operators to maximize the utilization of existing transportation resources rather than create new and perhaps overlapping services to meet identified transportation needs.

Although a good deal has been accomplished, progress has been slow. This is not considered unusual and is typical of the nature of change in a complex society. One of the factors that is impeding change is a lack of knowledge on the effects of providing a new service. The results of the demonstration program will not only show that positive changes can be made in our approach to transportation problems, but will produce essential data and analytical results to assist others in planning similar operations.

The paratransit program has been working on two fronts to develop new service concepts. Some of the projects, termed component demonstrations, have a limited scope and address the development of a particular service technique, such as vanpooling, look in detail at the operational features, economics and public acceptance. Other projects, referred to as institutional demonstrations, have a broader scope and include such projects as the Knoxville Transportation Broker, which emphasizes the development of a new institutional framework in which a greater variety of transportation services may be offered to the public. As the individual techniques are developed through the component demonstrations, models for the management structure to accommodate these services should also become available through institutional demonstrations.

Thus far, most of the projects have been in the category of component demonstrations. Since paratransit concepts are relatively new, there is a variety of techniques to test. Also, most urban areas are hesitant to try too much at once. Therefore, the projects tend to be small and are in smaller or lower density urban environments. After the introduction of one innovation, however, there is a tendency on the part of the test area to think about attempting other innovations as well. Also, once a concept has been successfully tested in a small demonstration, larger urban areas show more willingness to attempt similar projects. Larger urban areas are more difficult to work in, not only because of the more complex institutional arrangements but also because of the greater number of public and private transportation providers that must be considered. Therefore, one direction of the program is to go from small, single service projects to more complex service demonstrations in larger urban areas. This does not mean that certain city sizes will drop out of consideration for demonstrations. Small, medium, and large urban areas each have different institutional situations and transportation demands. In addition, local goals are different and a service arrangement which is acceptable to one city may be rejected by another. There are usually some modifications required for the general service model developed, even for cities of the same size. Fiscal constraints, the availability of transportation resources (transit, taxi, social service agency), the ability of local managers, the willingness of local citizens to support transportation, and the availability of state and local funds are all factors which affect the final specifications of the transportation system that may be developed.

Therefore, demonstrations must be conducted in various types of urban areas to develop relevant information on the service models for a mix of different size and types of urban areas.

The following sections describe the current areas of interest and contain a description of active projects. Progress has not been even in each of the areas. It has been difficult to develop projects which include taxi operators in a meaningful way. However, this situation is being rectified in projects currently under development. On the basis of the progress to date, we expect several of these "innovative ideas" to become accepted practice within the next few years.

AREAWIDE INTEGRATED TRANSIT

Overview

Areawide transit service is a means of increasing transit coverage by providing demand-responsive service in low-density areas and integrating this service with fixed-route operations serving higher density parts of the urban area. The demand-responsive service is offered in well defined modules that encompass a coherent community. The local service feeds fixed-routes for those passengers wishing to make longer trips outside of the demand-responsive module. Dispatching for the demand-responsive service can be provided by a computer system which automatically communicates origins and destinations to the vehicles.

The aim is to move toward a situation where an entire urban area is covered, and the full effects of an areawide system can be measured. Not only will it be of interest to measure the impact on patronage of this integrated approach, but it will be important to determine whether a computer can control such a system at an acceptable level of service. The cost of computer dispatching will also be determined.

The development of the coordinated service will also involve private operators to the maximum extent possible. The use of private operators in the demand-responsive mode has cost advantages, thereby bringing the cost per trip down to acceptable levels in many communities. Also it provides the opportunity to make better use of existing operations many of which have served their community for years.

The cost per trip for demand-responsive transportation often appears to be high because it is usually compared with the average cost of a transit trip. This comparison may not take into account such things as density of the area being served and nature of demand (peak or off-peak). In the areas being served by demand-responsive transportation, the cost of providing any type of public transportation will typically be high due to the low-demand density; and fixed-route transit would often be prohibitively expensive in low-density areas if reasonable service in terms of time between vehicles and area coverage were offered. Therefore, the choice is more likely not between demand-responsive and fixed-route, but between demand-responsive and no service at all.

We are hopeful that a full areawide system can be implemented in FY 1979, although the increased complexity of such an approach may take implementation into 1980.

Current Projects

Areawide DRT/integrated transit services are summarized in this section, with emphasis given to the manner in which the different service modes are coordinated to give areawide coverage. An overview of characteristics and features of current projects providing integrated services is provided in Table 4-1. A summary of results for these projects is given in Table 4-2.

The four projects reviewed in this section are all aimed at increasing transit coverage through the use of areawide demand-responsive services (integrated fixed-route and DRT). Nevertheless, there are some major differences among the projects regarding the types of trips being served, the types of integration attempted, and the modes being coordinated.

An integrated areawide transit system is made up of component and/or complementary services. Component services, such as demand-responsive feeders to fixed-routes, are provided in three of the four projects discussed. In addition to feeding fixed-routes, the demand-responsive component may be used for travel to a destination within a low-density area. With complementary services, the user can travel by either fixed-route or demand-responsive modes, trading off the fares and levels of service. Thus, with complementary service, no DRT fixed-route transit coordination is required, although transfers from one bus route to another may be necessary for some trips.

So, while component integration can be achieved without duplication of services, transfer-coordination strategies

TABLE 4-1. OVERVIEW OF AREAWIDE DRT/INTEGRATED TRANSIT DEMONSTRATION PROJECTS

	ROCHESTER (GREECE)[1]	ROCHESTER (IRONDEQUOIT)	WESTPORT	ANN ARBOR[2]	ST. BERNARD PARISH
SITE CHARACTERISTICS					
Site	Greece, NY (suburb of Rochester)	Irondequoit, NY (suburb of Rochester)	Town of Westport, CT	City of Ann Arbor, MI	Most of the developed portion of St. Bernard Parish, LA
Location	Central NY state on Lake Ontario	Central NY state on Lake Ontario	50 mi NE of downtown NYC	40 mi west of Detroit	contiguous to City of New Orleans on east
Service Area (sq. mi.)	15	15	22	23.5	20
Population	68,000	56,400	28,700	106,000	57,000
Density(per/sq. mi.)	4530	3710	1300	4510	2900
Average Income	13,600	14,800	26,000	12,800[3]	13,500
Average auto ownership(autos/hr)	1.3	1.4	2.2	1.2	1.8
% Elderly (over 65)	8	11	8	5	-

[1]Description of service characteristics in Greece are as they were around September-October 1975, a temporary period of steady state six months after the demonstration project officially began.

[2]Not an SMD project. Data reflects operations in 1976.

[3]Median income.

Abbreviations

FR = fixed route
DAR = dial-a-ride
SRT = shared ride taxi
FRS = fixed route supplemental (Westport only)

TABLE 4-1. OVERVIEW OF AREAWIDE DRT/INTEGRATED TRANSIT DEMONSTRATION PROJECTS (CONT'D)

SERVICE CHARACTERISTICS	ROCHESTER (GREECE)	ROCHESTER (IRONDEQUOIT)	WESTPORT	ANN ARBOR	ST. BERNARD PARISH
New Services	DAR advanced reservation or immediate service; limited transfer coordination between FR and DAR; home/work/school subscription service; 24 hr. advanced reservation handicapped service; prearranged group trips; coordinated fares vary by service, user type; group fares; computerized dispatching	DAR advanced reservation or immediate service; home/work subscription service; 24 hr. advanced reservation handicapped service; FR loop bus; route deviation services; FR mini-bus service; coordinated fares vary by service, user type; computerized dispatching	SRT, including subscription service; package delivery; information broker; 24-hr. advanced reservation; handicapped service, new fares for new services	Integrated DAR/FR; immediate, advance reservation, or subscription service; zonal DAR, with prescheduled transfer points between DAR and FR. At night and weekends essentially DAR/DAR service with some FR and route deviation.	Subscription taxi feeder services to express buses; special subscription fares
Modification to existing services	Route rationalization on two of the pre-project FR lines	Route rationalization on one of the pre-project FR lines; replacement of FR services with route deviation services	Expanded FR hours of operation; modified fare system	Rerouting and rescheduling of existing FR lines	Expanded SRT feeder service to FR; FR headways decreased; taxi fleet upgraded; fares changed;
Service Hours	DAR: 7:30 am-10:15 pm M-F 8:45 am- 7:15 pm Sa FR: 4 routes operate in peak period at 8-30 min. headways; 2 of the routes operate off-peak at 20-45 min. headways	DAR: 8:00 am-7:00 pm M-F 8:45 am-7:45 pm Sa Summerville Shuttle: 9:30 am-3:00 pm M-F 7:00 am-10:00pm M-F 7:00 am-10:00pm Sa Loop Bus: 10:00 am-4:00 pm M-F Urban PERT: 9:00 pm-1:00 am M-Sa	Daytime FR: 7 routes 7:45 am-5:05 pm weekdays and Sat., 35 min. headways Commuter FR: 10 routes two morning and three evening commuter trains served SRT and handicapped service: 6:00 am-1:00 am M-Th 6:00 am-2:00 am F-Sa FRS: Daytime FR service after 5:05 pm; Commuter FR service to two additional morning commuter trains	6:30 am -12:00 pm M-F 8:00 am - 6:00 pm Sa and Su no. of DAR zones and FR lines vary by time of day FR headways: 15 min. peak 30 min. off-peak	Local Routes: 6:00 am - 6:00 pm M-F headways 30-60 min. (to be decreased to 20-30 min.) Limited express bus service. SRT and subscription taxi feeder service during hours of FR operation

TABLE 4-1. OVERVIEW OF AREAWIDE DRT/INTEGRATED TRANSIT DEMONSTRATION PROJECTS (CONT'D)

	ROCHESTER (GREECE)	ROCHESTER (IRONDEQUOIT)	WESTPORT	ANN ARBOR	ST. BERNARD PARISH
Coverage	DAR and handicapped service: 100% coverage within service area Work/School subscription: 100% residential coverage within service area; Kodak Park, and other selected work sites and schools covered DAR provides 100% coverage to FR buses to Rochester CBD	DAR: 100% coverage within 60% of service area Work Subscription: 100% residential coverage within service area; Kodak Park and other selected work sites covered Handicapped service: 100% coverage within service area FR, DAR, and Urban PERT together provide 100% coverage to Rochester CBD	FR: service within 3/8 mi. of nearly all residents SRT and handicapped service: 100% coverage	100% coverage is provided between any two points in Ann Arbor;	SRT feeder: 95% coverage to local FR buses; subscription taxi feeder; about 50% coverage to the express bus service to downtown New Orleans (others must use local FR to get to express buses)
Fare Structure	\$1.00 - basic DAR (30¢ for each additional person) 40¢ - 85¢ work & school subscription 50¢ - fixed route other fares from 50¢-\$2.00	\$1.00 - basic DAR (30¢ for each additional person) 30¢ - loop bus, Summerville Shuttle, and Urban PERT \$5 - \$8 per week - subscription	50¢ - FR \$1.00 - \$3.25 SRT 25¢ - advanced reservation service for handicapped Annual passes for FR available Integrated fares at certain times	25¢ - first fare (free transfers); monthly passes available	60¢ - \$1.85 peak period zonal fares for combined FR-taxicab trip within Parish (10¢ less during off-peak) \$10/week or \$30/month for combined express bus-subscription taxi trip
Service Provider	RTS (Regional Transit Service),the existing local public transit authority	RTS (Regional Transit Service), the existing local public transit authority	WTD (Westport Transit District), the existing local public transit district, coordinates entire system operation and directly operates the FR mini-bus system; WTC (Westport Transport Corp.), a private transportation company owned by a local taxi operator, operates the SRT and FRS services	AATA (Ann Arbor Transportation Authority), the existing local public transit authotiry	Existing private provider who owns and operates the taxis and fixed route buses in Parish

TABLE 4-1. OVERVIEW OF AREAWIDE DRT/INTEGRATED TRANSIT DEMONSTRATION PROJECTS (CONT'D)

	ROCHESTER (GREECE)	ROCHESTER (IRONDEQUOIT)	WESTPORT	ANN ARBOR	ST. BERNARD PARISH
Vehicle types and fleet syze	For demand responsive services: 7 Twin Coach mini-buses 12 GMC small buses 9 assorted vehicles (4 w. wheelchair lifts)	Entry for Greece applies	For FR mini-bus service: 11 Mercedes mini-buses and 3 Twin Coach buses for SRT, FRS, and special market services: 11 modified Dodge maxi-vans (2 w. wheelchair lifts)	For DAR service: 48 12-pax Dodge Vans (4 w. wheelchair lifts) For FR service: 32 GMC transit buses	For FR service: 5 full size buses For taxi service: up to 25 sedans
Current Status of System	New recently approved UMTA demonstration will provide for dial-a-ride service in four areas of Rochester including Greece and Irondequoit; centralized computer dispatching will control operations in all four areas	Entry for Greece applies	Fully operational except for carpool and vanpool matching	Fully operational	Expansion of taxi feeder service area is just beginning; full planned expansion of area and decrease in headways to be completed March 1, 1978 at earliest; implementation of subscription feeder service is farther off in the future

TABLE 4-2. RESULTS OF AREAWIDE DRT/INTEGRATED TRANSIT DEMONSTRATION PROJECTS

	ROCHESTER (GREECE)[1]	ROCHESTER (IRONDEQUOIT)[1]	WESTPORT	ANN ARBOR[2]	ST. BERNARD PARISH[3]
DEMAND UTILIZATION					
Pax/week	DAR 2,600 Subscription 1,000 Handicapped & Groups 200 PERT Total 3,800	DAR 630 Subscription 500 FR and route deviation services 2,560 Handicapped 40 PERT Total 3,730	FR (incl. transfers) 12,400 SRT 2,200 FRS 800 Total 15,400	Ann Arbor FR (incl. transfers) 28,500 DAR (incl. transfers) 13,700 Handicapped 160 Total (1st fare basis) 34,300	Taxi (incl. feeder ridership) 2,500 Bus 2,200 Taxi feeder 230
Extent of transferring	30% of DAR and 6% of subscription riders transferred to/from FR	16% of DAR and 81% of Summerville Shuttle riders transferred to FR	21% of daytime FR riders transferred	18% of FR riders and 23% of DAR riders transferred from FR or DAR	-
Pax/veh hr.	DAR 4.7 Work Subscription 6.6 School Subscription 13.5 Handicapped 2.7 Group 22.0 PERT Total 5.4	DAR 3.3 Subscription 8.3 FR and route deation services 11.8 PERT Total 7.7	FR 24.0 SRT 4.0 FRS 8.5 Westport average 15.0	FR (incl. transfers) 35.2 DAR (incl. transfers) 6.0	-
Pax/trip (applicable only for demand responsive services)	PERT Total 1.15	-	SRT 1.18	-	-

1 Operational results for Greece covers a period from March to October 1975, and for Irondequoit from September to Decmeber 1976, a temporary period of steady state.

2 Not an SMD project. Data reflects operations in 1976.

3 Pre-demonstration figures, where available.

Abbreviations
FR = fixed route
DAR = dial-a-ride
SRT = shared ride taxi
FRS = fixed route supplemental (Westport only)

TABLE 4-2. RESULTS OF AREAWIDE DRT/INTEGRATED TRANSIT DEMONSTRATION PROJECTS (CONT'D)

	ROCHESTER (GREECE)		ROCHESTER (IRONDEQUOIT)	WESTPORT		ANN ARBOR		ST. BERNARD PARISH
ECONOMICS (cont'd)								
Operating cost/ veh. hr. ($)	PERT total	17.60	21.70	FR SRT FRS	15.40 9.40 9.40	Teltran total	19.85	-
Operating cost/ veh. mi. ($)	PERT total	1.64	1.90	FR SRT FRS	0.94 0.70 0.70	Teltran total	1.58	-
Operating cost/ pax ($)	PERT total	3.25	2.81	FR (incl. transfers) SRT FRS Westport average	0.71 2.45 0.89 0.97	DAR (incl. transfers) FR (incl. transfers Teltran total (first fare basis)	3.31 0.56 1.89	-
Revenue/cost	PERT total	0.20	0.09	FR SRT FRS	0.27 0.48 0.14	Teltran total	0.12	-
Operating subsidy/ capita ($)	PERT total	5.50	8.50	FR SRT FRS Total	15.90 5.10 1.70 22.70	Teltran total	28.50	-
Labor:								
Driver ($/hr)		6.10	6.60		4.15		5.40	2-5
Dispatcher ($/hr)		-	-		4.75		5.40	-
Direct labor as a percent of operating cost(%)[4]		68	62		60		60	-

[4] Driver and dispatcher wages and fringe benefits.

TABLE 4-2. RESULTS OF AREAWIDE DRT/INTEGRATED TRANSIT DEMONSTRATION PROJECTS (CONT'D)

	ROCHESTER (GREECE)	ROCHESTER (IRONDEQUOIT)	WESTPORT	ANN ARBOR	ST. BERNARD PARISH
LEVEL OF SERVICE (demand responsive services only)					
Avg. wait time components (min.)	DAR (immediate requests): response time = 25 pickup deviation = 5 DAR (advanced requests): pickup deviation = 7 DAR (transfers): wait time (DAR to fixed route) = 6 wait time (fixed route to DAR) = 12	DAR (immediate requests): response time = 25 pickup deviation= 3 DAR (advanced requests): pickup deviation= 6	SRT: (immediate requests): response time = 6	DAR (immediate requests): response time = 23 DAR (immediate and advanced requests): pickup deviation= 12 DAR (transfers): wait time (DAR to line bus or other DAR)= 4 wait time (line bus to DAR) = 4 DAR (standing orders): variation in pick-up time = 2	Taxi: response time =11
Avg. ride time (min.)	DAR = 16 Work subscription = 23 School subscription = 18	DAR = 10	SRT = 12	DAR (daytime) = 10 DAR (evening) = 14	-
Avg. pax trip length (min.)	DAR = 2.8 Work subscription = 3.4 School subscription = 1.1	DAR = 2.0	SRT = 3.6	DAR (daytime) =2.3	Taxi =2.5
ECONOMICS					
Veh./hr. (total for year)	PERT total 27,400	24,600	FR 40,500 SRT 29,100 FPS 6,300	Teltran total 173,000	
Avg. revenue/pax ($)	PERT total 0.66	0.31	FR (incl. transfers) 0.20 SRT 1.15 FPS -	Teltran total 0.23 (first fare basis)	-

must be developed that minimize the wait time involved in transferring between DRT and fixed-route modes. Complementary services, such as fixed-route and shared-ride taxis, require an extensive fixed-route network and pricing policy which discourages use of doorstep service by those who are conveniently served by the fixed-route network in order to achieve high levels of productivity and cost-effectiveness.

Rochester Integrated Transit Demonstration

The Rochester Integrated Transit Demonstration (RITD) was designed to assess the role of demand-responsive transit services in a regionwide transit system that includes an extensive fixed-route bus network. The Regional Transit Service (RTS, an operating subsidiary of RGRTA, the regional transit authority) implemented dial-a-bus (DAB) and subscription services in the suburb of Greece in 1973. The new services were called PERT, for PERsonal Transit. To expand services in Greece and introduce demand-responsive service to the neighboring community of Irondequoit, UMTA Service and Methods Demonstration (SMD) funding was granted, and the two and one-half year demonstration program began in April 1975. PERT services were subsequently introduced in the suburb of Irondequoit in April 1976.

Demographically, Greece and Irondequoit are quite similar. They consist of predominantly single-family, owner-occupied housing, with automobile ownership and income above the SMSA and national averages.

The demonstration included the planning and operation of many-to-many dial-a-bus (DAB) services, route and point deviation services, doorstop and checkpoint subscription services, special services for the transit-dependent, and fixed-route services. Each service was designed to provide effective and efficient service to a market that was not well served by the existing fixed-route system.

Dial-a-bus service in Greece was initiated in a 9.6 square mile service area, which was subsequently expanded to 15.2 square miles by 1975. Daytime and evening service was offered during the weekdays, with evening service curtailed on Saturday. Irondequoit DAB service was offered in a 8.6 square mile area. Operating hours were similar to those of Greece DAB, although all evening service was curtailed due to low evening demand. DAB fares in both Greece and Irondequoit were $1.00 (one-way), and $0.50 for the elderly during the off-peak period. Additional passengers were charged $0.25, and transfer to a fixed-route bus was $0.05.

Computerized Control Center, PERT Dial-A-Bus
Rochester, New York

PERT Dial-A-Bus Vehicle, Rochester, New York

Route-and point-deviation services were implemented in both Greece and Irondequoit. In Greece, a fixed-route/point deviation shuttle was instituted. In Irondequoit, two deviation services were implemented. In addition, a fixed-route loop bus which connected most of the activity centers in Irondequoit was introduced.

Greece offered three types of subscription service. Home-to-work subscription service was offered to two major employers. Feed-a-bus subscription service took peak period passengers to and from a transfer point with an RTS fixed-route bus. The transfer point was located near a number of major employers, so feed-a-bus was combined with work subscription service to that area. School subscription service was also offered. All subscription services required a reservation by 2:00 p.m. on the day preceding the trip.

Two subscription routes were operated in Irondequoit. Both routes used a system of designated stops for picking up and dropping off passengers, rather than providing every home with door-step service.

Special services for the transit dependent were also offered. Special group service began in Greece in 1974 as a once-per-week shopping service and later expanded to ten to fifteen trips per week. In 1975, a bus equipped with a wheelchair lift was placed in service, which enabled persons confined to wheelchairs to use regular dial-a-bus service in Greece. Starting in June 1975, "Special Handicapped Service" began, and disabled passengers from the Greece service area and from Irondequoit could travel to any of a dozen locations in the Rochester CBD.

Coordination of the demonstration services with each other and with the existing fixed-route network was an important facet of the demonstration. This included the coordination of transfers, and the replacement of selected fixed-route services with demand-responsive service -- a policy that was known as "route rationalization."

Route rationalization was introduced in both Greece and Irondequoit. In Greece, cutbacks were made on two routes in stages between June 1974 and January 1975, when most mid-day fixed-route service was eliminated in the service area. In Irondequoit, additional fixed-route service (such as the loop bus and one of the route deviation services) provided fixed-route alternatives to the services that were cut back. Thus, there was not a simple replacement of service in Irondequoit, but rather the fixed-route services were consolidated and dial-a-bus was offered to supplement the fixed-route system.

Transfer coordination between fixed-route and DAB in Greece was introduced by selecting a transfer point at the intersection of two major arterials. At this point, efforts to improve transferring included the meeting of every other fixed-route bus by a DAB vehicle, and the construction of a transfer facility. In addition, minimum transfer fares encouraged the combined use of DAB and fixed-route bus in order to travel to the Rochester CBD.

Equipment innovations were a significant part of the demonstration. This included vehicles, communications hardware, and computerized dispatching. PERT service in Greece initially began with several small Twin Coach buses. Since then, 21 buses made by six other manufacturers were added to the fleet, including four vehicles with wheelchair lifts. Thus, the Rochester demonstration provided a unique opportunity for comparing buses made by various manufacturers regarding performance and user preference within the same environment.

In September 1975, phase-in of the scheduling of passengers and the dispatching of buses in Greece began using a computerized algorithm rather than manual scheduling and dispatching. Drivers received pick-up and drop-off instructions individually from the computer. Once computerized scheduling and dispatching was made fully operational in Greece, it was instituted in Irondequoit. The intent of computerized scheduling and dispatching was to improve reliability and productivity, reduce travel time, and increase the system's effective capacity beyond that experienced with manual scheduling and dispatching. Computerized operation was also expected to provide additional information for system planning and management.

The Rochester demonstration constituted a totally integrated system. Service was designed to be cost-effective while providing good coverage to all market groups. Fares and transfers were coordinated and the fleet was assigned according to service demand and availability. Finally, all operations were coordinated through a single control room.

Results

The following results have been reported in the evaluation of the PERT operations:

- PERT services have provided comprehensive transit coverage to all residents of Greece and Irondequoit and eliminated the need to make transfers for trips within the Greece and Irondequoit communities.

- Ridership in Greece peaked at 500 passengers per day in 1975 and dropped in 1976 to around 378 as a result of severe vehicle breakdown problems. Irondequoit ridership peaked at 105 passengers per day.

- Vehicle utilization in Greece was 5.5 pax/vehicle hour and increased in 1977 due to high productivity on the point deviation service. Vehicle utilization on the Irondequoit DAR service did not exceed 3.5 pax/vehicle-hour.

- Operating cost for the PERT system in 1975 was $17.60 per vehicle hour, which is comparable to that of the RTS fixed-route system. About two-thirds of the PERT operating costs were attributed to driver and dispatching labor costs. The operating cost per passenger for PERT trips was $3.25.

- DAB levels of service were lowest during the winter of 1976, when vehicle breakdowns were excessive and reached their highest levels the following year. During the winter of 1976, the vehicles were out of service, on the average, over a third of the time. In 1977, immediate request trips on DAB averaged 29 minutes, of which 17 minutes was response time; advanced request trips took 21 minutes. (An equivalent auto trip was calculated to require 8.4 minutes.) Irondequoit DAB average system response time was 25 minutes initially, during the period of frequent vehicle breakdowns and shortages, and 17 minutes in 1977 when vehicle reliability improved.

The coordination of transfers between dial-a-bus and fixed-route vehicles was not successful. For example, in 1975 and 1976, transfer times from dial-a-bus to one fixed-route were longer than half the fixed-route headway, an indication that "coordination" was inferior to random arrrival at the transfer point (assuming fixed-route headways were uniform). Transfer times from fixed-route to dial-a-bus averaged 12-16 minutes, which were shorter than response times for immediate request DAB users, partially due to the advanced notice RTS drivers could give to the PERT control room.

A major problem with DAB was service reliability. During 1976, when there was a constant shortage of vehicles and problems with the implementation of computerized dispatching, the level of service provided generally declined. The actual pick-up times varied widely around the promised times, making it difficult for users to plan their travel schedules. Fifteen percent of passengers attempting to transfer from fixed-route buses to DAB reported waiting times of at least 30 minutes. A survey in the spring of 1977 suggested that the expected waiting time had decreased markedly by that time, coinciding with the general improvement of DAB reliability.

Route rationalization in Greece does not appear to have been very successful. Best estimates are that PERT failed to capture 67% of the former off-peak, fixed-route riders. These riders either used the fixed-route buses during the peak period or changed their tripmaking pattern significantly by either foregoing trips or using alternative modes. Surveys of DAB users showed that most former fixed-route riders judged the fixed-route buses to be faster, more reliable, and more convenient than PERT with a transfer to fixed-route buses. Also, the fixed-route bus-fares were less than half of DAB fares, although this difference was somethwat mitigated by a reduced mid-day feeder fare introduced in January 1975. Moreover, the additional DAB vehicle-hours required because of route rationalization slightly exceeded the number of RTS vehicle-hours eliminated, resulting in a net increase in total operating costs.

It is difficult to draw any conclusions about the effectiveness of computerized dispatching. During the early months of computerized operation, network coding errors, system response time delays and hardware failures resulted in poor levels of service. A full evaluation of the impacts of computerized dispatching was hindered by vehicle unreliability and a drastic reduction of DAB demand caused by service cutbacks. By February 1977, when vehicle reliability had improved substantially, DAB was operating in a reduced service area, carrying less than one-third of the demand carried in 1975 under manual dispatching and operating at lower vehicle productivity levels. The computerized dispatching performed well; however, because of low-demand density conditions, its effectiveness in large-scale or high demand situations was not demonstrated. Any advantages over manual dispatching would be most apparent at such high demand conditions, when the capabilities of manual dispatchers might be exceeded.

PERT operations were hindered somewhat by the organizational structure that was instituted for the demonstration. Basic disagreements existed between the regional transit authority, RGRTA, and RTS upper management over the potential of PERT. While RGRTA viewed PERT as a cost-effective method for expanding coverage, RTS viewed it as a potential drain on the fixed-route system's resources. Because PERT was being managed by consultants from MIT, important decisions were made by personnel far from the site with no actual control over RTS. The resignation of the RGRTA executive director during the demonstration contributed to the management problems.

In summary, the Rochester demonstration tested a number of service concepts and technological innovations. Although a number of exogenous factors impacted the results, many important lessons were learned regarding the concepts tested and the issues involved in the integration of demand-responsive and fixed-route services.

Westport Integrated Transit Services Demonstration Project

The Westport Integrated Transit Services Demonstration Project, which began in April 1977, is intended to establish a wide range of integrated transit services under the jurisdiction of the Westport Transit District (WTD). The WTD, a public authority, currently operates the fixed-route bus system, and has contracted with a local taxi operator to provide shared-ride and demand-responsive services. Integrated services are provided by a fleet of eleven mini-buses, three small transit coaches and eleven new vans, coordinated through a central dispatch office that is staffed and operated under contract to the WTD.

The demonstration proposes to: (1) provide integrated transit coverage through expanded service hours, and the addition of new routes, (2) increase transit productivity through increased ridership on both the fixed-route and shared-ride taxi services, and by decreasing operating costs as a result of fleet utilization and consolidating dispatching of all services into a single control room, and (3) expand its services to the very young, the elderly, and the phyically handicapped through the efficient provision of door-to-door service and through spatial and temporal expansion of fixed-route services.

Westport is situated on Long Island Sound, about one hour's drive from New York City. The town encompasses roughly 22 square miles, and has a population of 28,000 people resulting in a relatively low population density of 1,300 persons per square mile. The average income of Westport residents is over $21,000 (after taxes), and the average auto ownership is well over two cars per household. About 8 percent of the community's residents are over 65 years of age.

The current route structure, adopted when transit service was initiated in Westport in 1974, is a series of seven fixed-route loops which meet at a common transfer point near the center of town. Each route has a run time of 30-35 minutes, and a timed transfer is coordinated in the center of town. This service is offered continuously from 7:45 a.m. to 5:30 p.m. Commuter service, provided from 6:30 a.m. to 7:30 a.m. and 5:50 p.m. to 7:30 p.m., consists of ten routes converging on the commuter stations. Vehicles can be hailed anywhere along the routes, as there are no designated bus stops. This fixed-route system had reached capacity, particularly for commuter service and during the mid-afternoon period. A need to serve increased demands, new markets, and a desire to expand temporal and spatial elements of service prompted design of the demonstration project.

The most important feature of the Westport demonstration is the integration of conventional transit services provided by the District and new paratransit services provided by a private operator. It brings a range of services under a single management system. The District has contracted with one of the Westport taxi operators to provide paratransit services using vehicles owned by the District. The company provides personnel, supervisory, and management functions. All revenues generated by the service belong to the Westport Transit District.

A crucial element in this integration is the implementation of a single control center to dispatch and monitor the operation of all transportation services. The new services of the demonstration project are:

1. Shared-Ride Taxi Service

   An integrated taxi service offers shared-ride as well as small package delivery. Fares, based on a zonal system, are at least 20% lower than in current private taxi operations, and a goal has been set of doubling pre-demonstration productivities. The service is provided through a single dispatch center and utilizes vans (called Maxytaxys) purchased as part of the demonstration.

A Maxytaxy will pick up and deliver any small package within the town's boundaries. The individual requesting service is required to call the merchant involved to arrange payment for the goods. The cost for this service is the regular Maxytaxy fare plus a $0.50 surcharge if the driver must leave the vehicle to make the pickup.

2. Supplementary Fixed-Route Service

Greatly increased commuter service has enabled the District to serve twice as many commuter trains. The new van fleet serves late morning trains while minibuses are providing daytime service. Daytime service was expanded through the addition of an eighth bus route. The vans are also used to provide additional hours of fixed-route service from the downtown area during the early evening. On Friday and Saturday nights, fixed-route service pass holders can use the shared-ride taxi at reduced rates.

3. Special Market Services

Advance request demand-responsive service is available for special user groups such as the elderly and handicapped and for organizations such as day care centers who wish to subscribe for special services. Two vans are equipped with lifts to serve handicapped persons.

Vans are used for shared-ride and demand-responsive services, while minibuses and coaches are used for fixed-route service. Vans are used on fixed-routes at times of low-demand or as a supplement to minibuses and coaches at times of high demand. Vans, minibuses, and coaches are used for subscription service, depending upon the level of demand. The efficient utilization of the available vehicle fleet for appropriate services is intended to reduce the cost of operations.

The pricing policy and integrated fare structure are key elements in the integration of services. Users have the opportunity to purchase an annual pass which entitles the passholders to unlimited trips on the fixed-route system for an entire year. The annual passes are priced modestly, with discounts for family plans and transit captive groups (young, elderly). Daytime and commuter passholders are entitled up to half-fare on shared-ride taxis at specified times. A single bus-fare and transfer can be purchased for 50 cents, and the handicapped and elderly are charged only 25 cents. Scrip, sold at a reduced rate, is available for use on the shared-ride taxis.

In Westport, shared-ride taxi and fixed-route bus services are offered by the WTD as complementary services. Residents do not need to use both services for a single trip and thus, no transfer coordination is required. This is possible because of the coverage and timed transfer structure of the fixed-route system.

Results

All components of the WTD system have exhibited ridership growth since demonstration services began. Part of this increase is undoubtedly due to expanded coverage. Shared ride taxi productivities have grown to over four passengers per vehicle hour, serving a market comprised mostly of new users and some former private taxi users (a detailed discussion of the results of the shared-ride taxi operations are contained in the shared-ride taxi section of this chapter). In its fixed-route supplementary service capacity, the Maxytaxy vans have been carrying 8.5 passengers per vehicle hour. Total system fixed-route ridership has increased by 14% over a year ago, and productivities have also increased slightly.

The Westport project, still in its first year, is demonstrating that an integrated system with coordinated services and fares can be an effective way to provide a family of services tailored to different segments of the community. Although the annual pass program is priced low and discount fares are available for shared-ride taxi service, the demand has been sufficient enough to maintain a 35% system-wide recovery ratio. A new market has been developed for the Maxytaxy which does not draw heavily from taxi or fixed-route users.

Ann Arbor, Michigan - Integrated Dial-A-Ride and Fixed-Route Transit

Since the conclusion of a dial-a-ride pilot project in the fall of 1972, the Ann Arbor Transporation Authority (AATA), the public transportation authority in Ann Arbor, has developed and implemented an integrated dial-a-ride and conventional fixed-route bus transit system (Teltran), utilizing a computer assisted reservation system; Teltran

Coordinated Transfer Between Dial-A-Ride Van
and Fixed-Route Bus, Ann Arbor, Michigan

provides the city with 100% geographic coverage during all hours of operation.

While neither the Teltran system nor the other transit services provided by the AATA were sponsored by the Urban Mass Transportation Administration's (UMTA) Service and Methods Demonstration (SMD) Program, UMTA sponsored an evaluation of transit in Ann Arbor under the aegis of the SMD program. The decision to include an assessment of transit in Ann Arbor within the SMD program reflected the continuing national attention being given to this innovative transit system. Project services described below refer to operations as of May 1976.

The Teltran system employs dial-a-ride service within specific geographic zones (the number of which varies by time period) and connects the zones with fixed-routes serving the downtown area and other major activity centers. Thus, a rider may be picked up at his door by a dial-a-ride vehicle, transfer to a fixed-route bus for a trip downtown, and may transfer there to another vehicle for doorstep delivery, if necessary. Transfer between dial-a-ride vans and fixed-route buses are coordinated to minimize wait time.

Passengers pay a 25¢ fare upon boarding either type of vehicle and all transfers are free. Special half-price fares are available to low income, handicapped and elderly citizens; reduced price monthly passes are available to the general public.

Since fixed-route bus headways during peak periods are 15 minutes, several dial-a-ride vans must operate in each zone to permit coordinated transfer with each fixed-route bus. The city is presently divided into 14 zones for weekday service, 7 zones for weekday evening service, and 9 zones on weekends. Four (4) fixed-routes are operated and serve the 7 dial-a-ride transfer points. Teltran also includes a city-wide dial-a-ride service for the handicapped using a special vans equipped with wheelchair lifts. Five fixed-route bus lines in neighboring Ypsilanti are also operated by AATA.

A computer assisted system allows three dispatchers to handle the AATA fleet of 32 full-size transit buses and 48 dial-a-ride vans. In addition, a varying number of call takers answer questions and log in telephoned requests for service. Riders may telephone to request immediate or future pickups or place a "standing order" to reserve the same trip on a subscription basis. The computer acts primarily as a bookkeeper, keeping track of reservations, displaying them to call takers and dispatchers, and facilitating editing. The assignment of individual service requests to particular zones and vehicle tours is performed manually.

The Teltran system got underway in April 1973 when the voters approved a 2.5 mill increase in the property tax. In the summer of 1973 implementation began. A phased implementation strategy was adopted to permit adequate time to develop the staff necessary for full scale operation. As of June 1976, all zones had received integrated service, and annual ridership was estimated at 1.8 million for the 1975-1976 fiscal year.

Results

While it is too early to judge the long term impact of the Teltran system, the feasibility of the concept of zonal dial-a-ride connecting to fixed-route transit at prescheduled points has been demonstrated. A system thus configured can provide 100% coverage between any two points in a service area, with a fairly high level of service. High ridership levels can be developed, including a significant number of previous auto users. Level of service and ridership data are summarized in Table 4.2. It appears that a computer assisted system such as that used in Ann Arbor can increase the efficiency and reliability of reservations and dispatching. Also, incremental implementation of a Teltran-like service may be advisable.

Providing 100% coverage implies serving some areas where the demand is low. Costs could be reduced by decreasing or eliminating service to these areas, but at the expense of providing lesser coverage. A summary of cost data appears in Table 4.2. Level of service provided many users could be improved by orienting the service more to fixed route and less to dial-a-ride, again, at the expense of coverage. Nonetheless, Ann Arbor is committed to 100% coverage, and in this context, the Teltran system appears to be successful.

St. Bernard Parish, Louisiana - Taxicab Feeder to Bus Services

This project is the first in the U.S. to involve shared-ride taxicab service as feeders to bus services, with convenient transfer mechanisms such as coordinated transfers, joint fares and sheltered bus stops. This concept of integrating taxicabs with conventional and subscription bus service is being tested in St. Bernard

Transferring from Fixed-Route Bus to Shared-Ride Taxi, St. Bernard Parish, Louisiana

Parish (population 57,000), a low-density suburban area of New Orleans, Louisiana.

The two-year demonstration project, which began in June 1976, is supporting the expansion of a pilot taxi-feeder service which has been operating in a portion of the area since 1974. During the demonstration period, bus service is being improved, and feeder service will be introduced throughout the entire bus service area. The project is being managed by the St. Bernard Parish Planning Commission, and the service is being provided by two private companies, Arabi Cab and St. Bernard Bus, both owned by the same individuals.

St. Bernard Parish presently has two regularly scheduled bus routes that run parallel to the Mississippi River. One route runs about nine miles through suburban neighborhoods and scattered strip commercial areas with one bus providing service on one hour headways each weekday from 6AM to 6PM. The second route, on the St. Bernard Highway extends over ten miles toward the rural portion of the Parish with two buses operating on thirty minute headways Monday through Friday, and hourly on Saturday. There are eight bus-fare zones and the charges range from $0.35 to $1.50 for a one-way trip depending on the origin and destination zones (half fare for elderly and handicapped persons). During commute hours, express buses leave from the western edge of the Parish and travel non-stop to the CBD of New Orleans for a fare of $0.40.

The taxicab operator provides conventional taxi service within the Parish on a 24-hour 7-day basis using 21 radio-dispatched sedans. The fare is computed by a meter with an initial or flag drop of $1.00 and 10¢ for each additional 1/5 mile. Shared riding is attempted during heavy demand periods. Taxi feeder service to the two regularly scheduled bus routes is currently available from two bus-fare zone areas in the Parish. In this four-square-mile area, which contains almost half of the total parish population, taxis pick up persons who live more than 1/4 mile from the bus routes and telephone to request the cab-bus transfer. The cab pick-up time is coordinated by the dispatcher to minimize the passenger wait time at the designated transfer points. The fact that buses arrive at regularly scheduled times facilitates the matching of two or more riders for the same cab. On the return trip, the bus passengers tell the driver that they wish a bus-cab transfer, and the bus driver indicates to the dispatcher when and at which transfer point the passengers will be discharged. Available cabs then pick up the riders and deliver them home. The user pays a joint fare between $.50 and $1.50 depending on the length of the trip. Approximately $.50 of this covers the taxi portion of the trip. During offpeak times, the elderly and handicapped can ride for half fare.

The demonstration project will expand the taxi-feeder concept to a larger area, offer subscription taxi-feeder service, and upgrade the taxi and bus service with some new vehicles. There are three major phases planned for the project. During the first year, the existing bus service provided with three 40-passenger vehicles is being improved by adding three new buses. The existing 21-vehicle taxi fleet is being modernized by the taxi operator by leasing up to nine 7-passenger vehicles purchased by the Parish under the project. In the second phase, shared taxi-feeder service will be introduced to the remaining two bus-fare zone areas, and the fares for the current taxi transfers will be increased by up to 25¢. In the second year, a combination taxicab-feeder and express-bus service operated on a subscription basis is planned. Taxis will pick up regular commuters at specified times and deliver them to the express bus terminal for a direct trip to downtown New Orleans.

Implementation of demonstration project services has been delayed considerably. Fixed route services, which had been temporarily discontinued on the Judge Perez route and on the express-bus runs to New Orleans, are being restored. The taxi operator has obtained 7 new taxis. Expansion of the taxi-feeder service is just beginning with full expansion to be accomplished by June 1, 1978 at the earliest. Improvements in bus service, i.e., decreases in headways on the existing bus routes, will also not be made until May, when it is expected that five buses will be available. Implementation of subscription feeder service is farther off in the future.

There are no project results available as yet since delays have postponed implementation of project services. Site and project characteristics are included in Table 4-1.

Comparison of Findings Across Projects

The four projects -- in Rochester, Westport, Ann Arbor, and St. Bernard Parish -- demonstrate a set of distinctly different approaches to providing integrated transit/paratransit service. Comparison of the services presents a significant opportunity to gain insight into the general applicability of these approaches. In the discussions to follow, the four projects will be compared in terms of the techniques they use for providing areawide service, the level of service offered, the resulting demand for service, the operational and cost effectiveness, and institutional and labor issues.

Three of the projects -- in Rochester, Westport, and Ann Arbor -- are fully operational. Comparison of Westport and Ann Arbor results with Rochester results is complicated by equipment problems which occurred in Rochester during the winter of 1975-76, as well as several fare and service changes in the original service area (Greece, NY) during 1976 and 1977. Many of the cross comparisons will use results from Greece during the time interval of September through October 1975, a temporary period of steady state occurring six months after the demonstration officially began. Cross comparisons with the second Rochester service area, Irondequoit, will tend to be qualitative in nature since operational results are currently being analyzed for a detailed evaluation report on that service. Data for Westport represents the period through October 1977, six months after the demonstration project service became fully operational. Ann Arbor data represent the period up to the summer of 1976, before the final phase of the Teltran system was implemented. In St. Bernard Parish, implementation of demonstration project services is just beginning. Therefore, comparisons with St. Bernard Parish services, where possible, will tend to be more qualitative and conceptual. The characteristics and operational results of the four projects are compared in Table 4-1, (Overview of Areawide DRT/Integrated Transit Demonstration Projects), and Table 4-2, (Results of Areawide DRT/Integrated Transit Demonstration Projects).

Coverage and Other Level of Service Components

User level of service may be affected in a number of ways by the introduction of areawide integrated demand-responsive transit. The primary impact is coverage. Operators may find it economically feasible to provide demand-responsive service (DRT) in areas of low-demand density that could not be served feasibly by fixed bus routes.

While each project has achieved nearly 100% spacial coverage in the areas of service, the way in which this has been achieved and the resulting levels of service vary. In Westport, fixed-routes have been used extensively throughout the area, providing service within 3/8 of a mile to almost all residents. For those who are located at the fringe of the service area or otherwise choose to use doorstep service, shared-ride taxi is provided on an areawide basis.

Transfer between the two systems is not required (users must make transfers between fixed-routes for those trips not oriented along the route corridors). Thus most users can make use of lower cost fixed-route service regardless of geographical location.

The other projects have treated coverage in a different way. Specific areas do not receive fixed-route coverage, and DRT service must be used to access the line-haul system. Thus a transfer is required and less choice is available to the individual users in trading off various level of service components (e.g., cost, walk time, and other travel time components).

Fare structure differs significantly among projects. In Westport, users choose between low-fare fixed-route service and higher-fare, shared-ride taxi. In Ann Arbor, a single low fare allows users to use fixed-routes, dial-a-ride, or a combination of services. In Rochester (Greece), dial-a-bus users who transfer to fixed-route pay a 5¢ sucharge over fixed-route fares; many-to-many dial-a-bus service within Greece is more expensive. St. Bernard feeder service users pay very small surcharges. Thus in some projects, 100% coverage is offered at a single fare while in other projects coverage is extended with additional user costs.

All four projects have utilized doorstep DRT service, a high quality and expensive form of transit. This service is attractive since users may wait indoors and eliminate walk portions of the trip. Doorstep service does, however, significantly increase in-vehicle travel times, due to more circuitous routing.

Demand responsive service, by nature, requires input from the user in the form of a request for service, to which the system then responds. Thus an additional element, some form of wait time, is introduced into the user travel time. For immediate requests, the user must contend with a system response time, which is the time between the request for service and the actual pickup time. For advanced requests, the user must take into account the pickup deviation, which is the time between the promised pickup time and the actual pickup time (pickup deviation is also applicable for those requesting immediate service if a promised pickup time is given). Where transfers are required, the user will also be faced with a transfer wait time. While efforts have been made to coordinate transfers to minimize this effect, success has not always been achieved.

Finally, because the number and spatial location of requests for service varies considerably from day to day, both the response time pickup deviation, transfer time, and in-vehicle travel time for a particular trip can vary considerably from day to day. Thus, reliability on flexible demand-responsive services tends to be considerably more of a problem than on fixed-route services, which operate on a given route and given schedule.

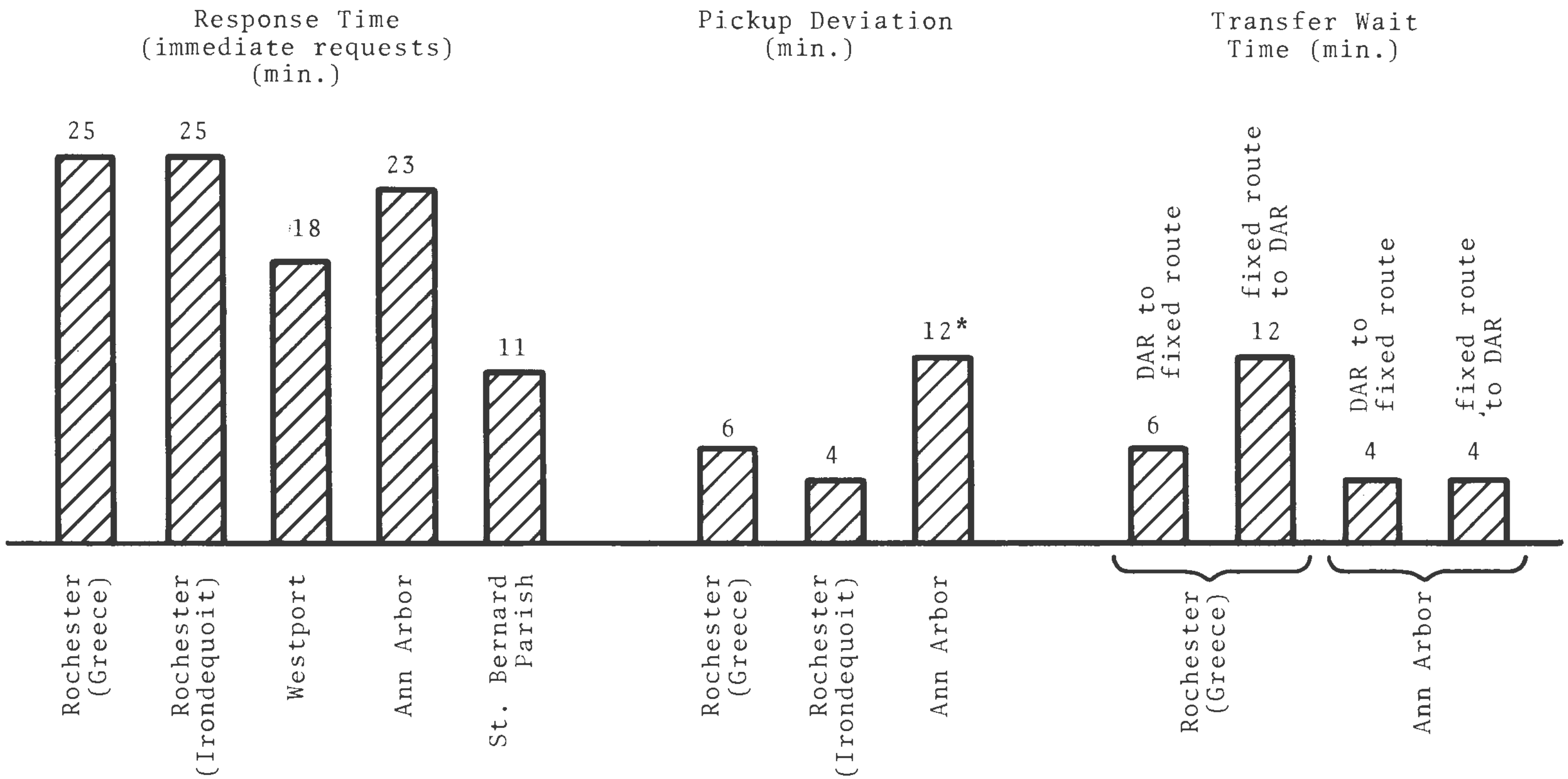
Specific level of service results of the four projects are summarized in Figure 4-1 and discussed further in the following paragraphs.

Response times for (immediate request) demand-responsive service were similar in Greece and Ann Arbor, but lower for the Westport shared-ride taxi service. Data available on pickup deviation in Greece and Ann Arbor show longer deviation in Ann Arbor. This is misleading, however, since in Ann Arbor users are promised pickup times in a range or "window" of 10-15 minutes, and pickup deviation is measured from the front of the window. Thus, while a user must be ready to leave for the total time between the beginning of this range and the actual vehicle arrival, lateness will not be perceived until after the end of the window. Shorter transfer times in Ann Arbor than in Greece resulted apparently from more successful coordination.

Reliability was a major problem with dial-a-bus in Greece. During the period of stable operation in 1975, approximately 70% of all requests resulted in the bus arriving at least 5 minutes early or late; 15% were twenty or more minutes early or late. In Ann Arbor, an on-board survey showed that 41% of customers were not served "on time," i.e., within the 10-15 minute window. One aspect of the Ann Arbor service that has considerable influence on reliability is the cycled nature of the service. Since vehicles are scheduled to arrive at the transfer points at fixed times, there is an upper bound on ride time and it is easier for the dispatchers to estimate expected pick-up time. The complete "many-to-many" service policy in Greece may have contributed to the system's reliability problems; without any schedule constraints, the service may experience inherent unreliability.

Computerized vs. Manual Dispatching

Rochester began its service using manual dispatching and then converted to fully computerized dispatching. Under computerized dispatching, an algorithm was utilized to assign trips to vehicle tours and to order these tours in



*Represents perceived average wait from start of ETA window to pickup.

FIGURE 4-1. COMPARISON OF AVERAGE WAIT TIME COMPONENTS ACROSS DEMAND RESPONSIVE SERVICES real time in order to achieve desired levels of service. By the end of the demonstration, automation had evolved to the point where drivers would directly input their status and receive instructions directly from the computer. Ann Arbor has utilized computer-aided dispatching to allow human decision-making with the data processing assistance of a computer. While the computer does not perform any decision-making functions, it facilitates dispatching by increasing the efficiency of a number of calltaker and dispatcher tasks, including the assignment of trip requests to tours, editing tour lists, and monitoring system conditions. In Westport, manual dispatching of shared-ride taxis and coordination of minibus operation is employed, from a single central control facility.

While each of the systems seems to be performing adequately, no conclusion can be drawn as to whether any of them is generally superior. Fully computerized dispatching is expected to be most valuable at high demand levels, which were not reached during the period of computerized dispatching in Rochester. Improved level of service in Greece may have resulted from computer dispatching and/or reduced demand levels and fewer vehicle breakdowns. The computer-aided dispatching system utilized in Ann Arbor was found to provide good service levels given that highly skilled dispatchers are utilized. Of course, at lower demand levels, such as in Westport, manual dispatching should be adequate.

Transfer Coordination

The very long times experienced by transferring passengers in Greece seem to indicate that the coordination procedure was a failure. Particularly poor was the transfer time for outbound riders transferring from fixed-route buses to dial-a-ride (12-16 minutes on the average). This was largely due to failures in communicating the requests of users for a transfer before they reached the transfer point. Greece was able to improve its transfer coordination later in the demonstration. Improved vehicle reliability and the radioing of outbound transfer requests directly from fixed-route bus drivers to dial-a-ride dispatchers (rather than via both fixed-route and dial-a-ride dispatchers) contributed to this improvement.

In Ann Arbor, the transfer coordination procedure achieved short transfer times with passengers reportedly satisfied with service levels despite the fact that 70% of dial-a-ride users relied on transfers to complete trips.

The success of Teltran's transfer coordination may be attributed to:

- The fact that it is a cycled service with a fixed schedule for arrival at transfer points.
- The fact that dial-a-ride and fixed-route vehicles will wait at rendezvous points.
- Special training of drivers and dispatchers.

Variation of Services Over the Day

In Rochester, Westport, and Ann Arbor, integrated service has made it possible for different services to be offered at different times of day. In Rochester, special work subscription services were offered at peak times, shopper services during the midday, and route deviation services at night. In Westport, service is oriented to the railroad station for commuters during early morning and early evening hours, while during the day, the service is oriented to the center of Westport. In Ann Arbor, dial-a-ride zones expand during evening hours when fewer vehicles are needed, trip patterns are more dispersed, and most fixed-routes do not operate. On weekends, a different configuration of dial-a-ride is employed.

While the tailoring of services to demand by time of day is a useful method for providing transit services efficiently, one drawback should be noted. A system which changes configuration a number of times over the course of the day or week can be very confusing to users. In Ann Arbor, for example, a given trip may have to use different vehicles and transfer points, depending on the time of day; inevitably, the service levels experienced each time will be different and the users will be unable to estimate travel times and plan trips properly. Variations in service levels (e.g., travel times) will be interpreted by the user as a failure in system reliability. In a system using demand-responsive service where the user is not provided schedules or routes, these variations may aggravate the system's inherent lack of comprehensibility to users (a problem evident in Ann Arbor from user complaints).

Ridership Characteristics:

The four projects were all implemented in service areas of between 15 and 25 square miles. As can be seen from Figure 4-2, there are significant variations in ridership

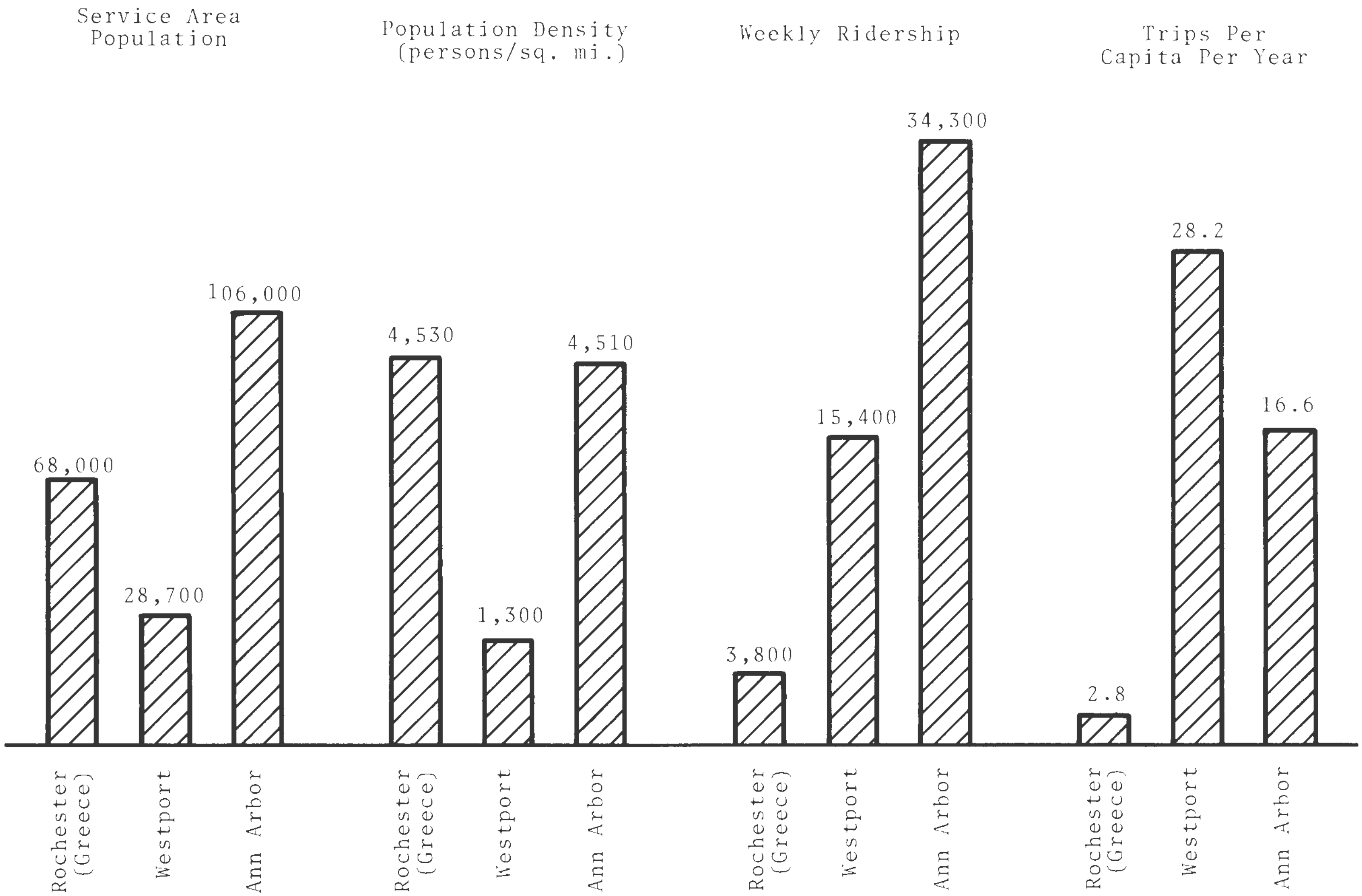


FIGURE 4-2. COMPARISON OF THE RELATIONSHIP BETWEEN RIDERSHIP AND POPULATION ACROSS INTEGRATED TRANSIT PROJECTS

between projects. This may be due in part to large differences in the service area population. While Westport and Ann Arbor have been successful in generating high ridership response, it is difficult to make any general statements about ridership levels in Greece. Unlike the other systems, the Greece results do not include any fixed-route totals. The most heavily utilized fixed-route in the entire Rochester system passes through the Greece-Rochester service area. Furthermore, the equipment problems which resulted in poor levels of service at some points during the demonstration drove away users who never returned and thus made it difficult to determine how effective different services were in attracting riders. This is an indication that such problems can have a long term negative impact on ridership regardless of whether they are eventually straightened out.

A comparison of rider characteristics among the three projects indicates that they are all attracting a diverse mix of riders. Westport's daytime ridership is highly transit dependent, with about three quarters of the riders between the ages of 12 and 19 and 67% without driver's licenses. In contrast, the commuter service, which accounts for one third of the daily ridership, is made up almost entirely of adults, who formerly drove or were driven to the train station. In Ann Arbor, a quarter of the respondents came from no-auto households, while nearly one-half had no driver's license. However, about 60% said their transit trip had replaced a trip by automobile. About 3% of the respondents indicated that they had sold, or not purchased, an automobile as a result of the Teltran system. In Greece, a quarter of the riders came from no-auto households and nearly two thirds had no driver's licenses. About 30% were from households with two or more cars. A variety of age groups were represented. Unlike DAB users, work subscriptions riders were predominantly middle-aged and affluent; a large majority (72%) never rode RTS buses.

In summary, demand-responsive services have demonstrated their appeal to a diverse market group. Significant numbers of persons with autos available have been attracted to paratransit. Moreover, Westport's commuter routes and Rochester's work subscription service provide evidence that tailoring services to particular commuting trips is an effective way of attracting auto users who may not ride conventional transit.

Productivity

The vehicle utilization for the various demand-responsive services varies greatly, both between projects and between different services of a single project. Differences may be due to mode of operation, vehicle density, level of service, demand, and trip patterns.

The Rochester project includes a number of different service types in a single location. These include special services for the handicapped, school subscription, work subscription, group charters, and route deviation as well as dial-a-bus. In Greece, the handicapped service exhibited the lowest vehicle utilization, or productivity, of 2.7 pax/veh.-hr., since trips are more dispersed and longer dwell times are incurred. Higher productivities on group and subscription services are due to the ability to prepare more efficient tours and the many-to-one or many-to-few nature of the services.

Greece dial-a-bus, Westport shared-ride taxi, and Ann Arbor dial-a-ride productivities can be compared since each serves many-to-many trips and both immediate and advance requests of about the same average trip lengths. Of the three, Ann Arbor's productivity is highest at 6.0 passengers per vehicle-hour, compared to 4.7 in Greece and 4.0 in Westport. This may be partially explained by the fact that Ann Arbor's service is largely oriented to trips bound for the transfer point. Thus, many passengers board and alight at a single stop, reducing total dwell time, and overall ride time may be shortened by the similar orientation of trips. In addition, dial-a-ride vehicles in Ann Arbor are constrained to fairly small sections of the service area, which means less time is spent making detours for pick-ups and drop-offs. Westport's shared-ride taxi service was implemented most recently and ridership is continuing to increase, so the productivity may increase further with time.

Vehicle productivity for the fixed-route service in Westport has averaged 24 pax/veh. hr., or 68% of the productivity of the fixed-route service in Ann Arbor. This difference is largely due to the much higher population density in Ann Arbor and the fact that only the highest density corridors are served in Ann Arbor, with feeder services offered in other areas.

Finally, overall system utilization varies. Greece's PERT system productivity has averaged 5.4, which includes all demand-responsive services in Greece but excludes the fixed-routes. Westport and Ann Arbor results are more comparable, with figures for the entire city-wide systems. Westport exhibits the higher productivity, 15.0, compared to 11.6 in Ann Arbor. The lower overall vehicle productivity in Ann Arbor may be explained by the fact that over 3/4 of total vehicle hours in Ann Arbor are devoted to demand-responsive services, while in Westport, vehicle hours are split about evenly between fixed-route and demand-responsive services. Thus, despite the fact that Westport has a lower population density and lower service fequencies, it has been able to achieve greater systemwide utilization of its vehicles.

Operating Costs

It is somewhat difficult to compare the operating costs since systemwide costs for each project include costs of components which are not analogous. Greece's PERT service includes all demand-responsive services (dial-a-bus, group subscription and handicapped services), but excludes fixed-routes; Teltran includes both fixed-route and demand-responsive (dial-a-ride) components. Thus, while all PERT services average a slightly lower cost per passenger ($3.25) than the Ann Arbor dial-a-ride service ($3.31), their cost per passenger is much higher than that of the total Ann Arbor Teltran service ($1.89). The Westport service has the lowest systemwide cost per passenger ($.97). Fixed route services in Westport are more costly than Ann Arbor's on a per passenger basis; however, the shared-ride taxi system, at $2.45 per passenger, is about 25% less expensive than demand-responsive services in either Rochester or Ann Arbor.

Aside from differences in service components among projects, differences in cost per passenger are in large part due to differences in operating costs per vehicle hour: $18.85 for Teltran, $17.60 for Greece PERT, and $15.40 and $9.40 for Westport minibus and shared-taxi services, respectively. Since driver wages comprise 60-70% of hourly operating costs, hourly wages are noteworthy. In Westport (which uses non-union labor), hourly wages are $4.15, compared to $5.40 in Ann Arbor and $6.10 in Rochester. Private operation of demand-responsive services in Westport has further reduced the systemwide operating costs, suggesting that there may be significant cost savings in contracting with private operators for demand-responsive services.

The projects differ with respect to average revenue collected per passenger as well as cost per passenger. Westport fares vary by type of service so that shared-ride taxi trips contribute $1.15 per passenger or 48% of their operating costs on average, while minibus users contribute an average of $0.20 or only 27% of their operating costs. In contrast, due to the single low Teltran fare, users average $0.23 per passenger trip or only 12% of their operating costs. With a higher fare and higher costs, the Greece system averages $0.66 per passenger in revenue, which amounts to 20% of the operating cost.

The low revenue-cost ratio in Greece was due to high operating costs, low utilization and the need to maintain previous fares for dial-a-bus transfer passengers who formerly rode fixed-route buses. The very low revenue-cost ratio in Ann Arbor was due to a conscious decision to keep fares low and is compensated for by a property tax which Ann Arbor voters approved in order to subsidize Teltran.

The higher fares and lower cost of the Westport shared-ride taxi service result in a much higher revenue-cost ratio than any of the other services. A fare differential between fixed-route and shared-ride taxi encourages maximum use of fixed-route service, which can accommodate larger numbers of passengers at little or no extra cost. However, the fact that many users buy annual passes limits the effect of the fixed-route's high vehicle utilization on the revenue-cost ratio.

It is apparent from the three ongoing projects that higher costs are associated with the provision of areawide integrated transit systems because of the higher cost per passenger of demand-responsive services. An example of a technique to reduce the cost of the demand-responsive component in an areawide system is being tested in the St. Bernard Parish project. While results are not yet available, it is hoped that feeder service to the bus routes can be provided at a marginal cost to the taxi operator because the regular taxi business operates in the area served by the fixed-routes.

Role of the Private Operator

Recently, there has been much interest in involving private operators in the provision of integrated demand-responsive transit services. This stems from the recognition that demand-responsive services are closely related to taxi services in many aspects of operation. Each of the projects being discussed has had a different experience in the extent to which private operators participated in the planning or operation of such services. In Rochester, private taxi operators did not oppose the service, which was originated by the transit operator in an area of negligible taxi patronage. More recently, as service is to be expanded to new service areas, competitive bidding by private operators will take place. In St. Bernard, the taxi operator (who also operates the bus service) initiated the service concept. In Westport and Ann Arbor, however, problems arose in taxi operator/transit operator relations.

In Ann Arbor in 1971, two taxi operators filed for an injunction against DRT implementation by the Ann Arbor Transportation Authority, after having been offered the opportunity to participate in the project. They alleged that the Authority would be taking their property without compensation, competing with them unfairly and violating taxi franchise guarantees against public competition. The local court dismissed the suit on all counts and the decision was appealed and affirmed the following year. This decision was based on the ruling that DRT service is distinct from taxi service as defined in the taxi ordinance (since individual passengers do not have control of the vehicle), that the taxi franchise provides no guarantee against public competition, that the loss of business is not compensable, and that public competition was not "unfair" within the legal definition.

In Westport, initial attempts to involve both taxi operators in a contractual arrangement failed and only one operator chose to participate through competitive bids. The other taxi operator sought a restraining order on the project. The request for an injunction was based, in part, on the argument that the proposed program violated Section 3(e) (1602 e) of the 1964 UMTA Act and constituted an unlawful taking of property without just compensation under the Fifth Amendment. This is the only litigation to date which directly addresses the application of Section 3(e) in a paratransit context. The case also examined the applicability of Section 3(d) (1602d), which sets procedural requirements for demonstration projects.

The District Court ruled that 3(d) and 3(e) did not apply to demonstration projects. The Court mentioned, however, that the plaintiffs may have a claim to compensation grounded in state law. The review of the case by the Circuit Court of Appeals led to a modification of the lower court ruling. The Appeals Court did not consider demonstration projects to be exempt from 3(d) and 3(e). The Appeals Court held that since a demonstration was an application under the UMTA Act that "substantially affect(s)" Westport and its mass transportation service, 3(d) requirements were appropriate, and a public hearing was required to comply with this section. The issue of the applicability of Section 3(e) protections was resolved by determining that the taxi company was not a mass transportation company and hence not eligible for 3(e) protections. This court decision was based on the fact that the taxi company allowed exclusive ride service, and thus was not considered a mass transportation company.

The Westport litigation establishes several important (Federal) precedents impacting private taxi operators as well as public agencies. Private taxi operators are not free from federally subsidized competing services and this competition per se does not constitute a taking in terms of federal law. Section 3e protections are not available to private taxi operators who offer a service which may be reserved for the exclusive use of particular individuals or groups. On the other hand, public agencies wishing to implement demand-responsive services should be aware of the statutory policy which encourages private participation. Selection of a contractor operator through an open competitive bidding process would certainly be consistent with this policy. "Losing " bidders may have no apparent protections requiring compensation under federal law, even if they are franchised to operate similar services. Procedural requirements of the UMTA Act now hinge on whether the impact of the project is "substantial" rather than the type of grant which funds the project. Demonstrations, per se, no longer enjoy procedural privileges.

In summary, although taxi operators have been afforded very limited protection from public competition under existing laws, litigation can impact DRT operations. In order to avoid such opposition, utilizing private operators to provide DRT or tailoring DRT service to minimize competition with taxi operators may be advantageous.

Labor Issues

Transit labor has generally supported paratransit where it was to be provided by union personnel under existing, prevailing working conditions. Nevertheless, as taxi labor and taxi operators have moved into areas which fall under the definition of "mass transit", an important confrontation with transit labor has been building. The battleground for this confrontation, where federal (UMTA) funds are involved, has been the negotiation of 13(c) agreements. Transit labor is highly unionized and well compensated (relative to other public sector employees). Taxi employees are significantly less well organized and compensated, on the average. The prospect of paratransit developing largely outside the domain of traditional transit operations, provided by the private taxi sector, implies using labor at significantly lower wage rates and less generous working conditions, and could be viewed as undermining existing labor standards.

Equally, or more important, both conventional transit operators and transit labor often view paratransit provided by the private sector as potential competition for (scarce) public subsidy resources and, therefore, as posing a threat to their long run growth and survival.

Recent experience of some of the demonstrations have broken new ground on labor-related issues of paratransit:

The Rochester demonstration called for DRT services to be operated by the conventional transit operator at the prevailing wage rates and work rules; minor work rule modifications were negotiated to accommodate DAR service requirements. The 13(c) agreement was negotiated with little difficulty, and the union support for the demonstration has been strong and cooperative.

In September 1977, the RGRTA sought to renegotiate the 13(c) agreement with the Amalgamated Transit Union (ATU) covering an extended SMD project in Greece, Irondequoit, and two new service areas in the Rochester metropolitan area. The Authority sought the ability to award contracts to operate in the new service areas based on a competitive bid between public and private providers. RGRTA offered an agreement which would have guaranteed that service in the existing service areas be provided by union labor and requested that a set of wage and work rules similar to those adopted in Cleveland be applicable.[1] The ATU national leadership eventually agreed to revise the 13(c) to allow the competitive bid to take place, but refused to modify existing wage rates or work rules. The revised 13(c) agreement (signed in late 1977) is particularly noteworthy because it represented the first and only time that the Department of Labor (DOL) has made a finding of compliance with 13(c) provisions without a signed agreement with the local organized labor bargaining unit. The certification by DOL was based on an agreement signed by the ATU national leadership, an agreement which was actually opposed by the local ATU leadership.

---

[1]Lower wages for union laborers operating paratransit vehicles.

The Westport demonstration called for a public transportation authority to provide directly fixed-route services as well as to contract for (privately operated) demand-responsive (shared-ride taxi) services, maintenance services, management, and marketing services. There is no existing transportation union in Westport; the transit authority has executed an "open" 13(c) agreement with standard protective 13(c) clauses. The Westport agreement represents a precedent for a context where there is no organized labor with whom protective arrangements can be negotiated.

SHARED-RIDE TAXI

Overview

Taxi companies possess a huge, under utilized resource that can provide certain services more efficiently and economically than fixed-route transit. These include feeder service to fixed-route transit in low-density areas, service for the elderly and handicapped, demand-responsive service in low-density areas and neighborhood circulation service. All of these services can be provided by taxi operators offering shared-ride service. Shared ride taxis (SRT), in contrast to conventional exclusive ride taxis, may be defined as service in which the operator is permitted to carry two or more passengers traveling to and from different points. By carrying more passengers per trip the operator can increase productivity which results in significantly lower per passenger costs.

Experiences with shared-ride taxi are quite limited. Two demonstrations are currently underway and two more are planned for FY 1979. The projects will involve an increasingly complex array of services moving from a single purpose such as taxi-feeder to multi-purpose service that could involve social service trips, subscription commuter service and user-side subsidies. We are also interested in removing legal and institutional barriers which prohibit private transportation companies from providing more flexible service.

The limited experience with SRT has been encouraging. Taxis can provide a more efficient operation and a generally higher level of service. The use of taxis will allow service to be provided to areas that cannot be efficiently served by fixed-route transit, particularly at times of low-demand.

Current Projects

Shared taxi project services are summarized in this section, together with a discussion of the important local issues related to involving private operators in a public transportation service. Because of the differences between public transit and privately operated SRT service, and the importance of reviewing SRT projects in the proper context, some comparisons with paratransit operations outside the SMD program are included to expand the perspective on the level of service, demand, and economic measures reported.

An overview of characteristics and features of current projects providing SRT service is provided in Table 4-3. A summary of results for these projects is given in Table 4-4.

As is evident, shared-ride service is frequently offered in conjunction with other forms of public transportation, including fixed-route, charter, and subscription service. For those demonstration projects offering integrated transit service, only the SRT component will be reported in this section.

Westport Shared Taxi Operations

Shared ride taxi service is a major component of the Westport Integrated Services demonstration described in the preceding section. The Westport Transit District (WTD) contracted with a local taxi operator to provide door-to-door service between the hours of 6:00a.m. to 1:00a.m., daily. In addition to the many-to-many operations, the taxi vans are used in supplemental fixed-route service, subscription service, and advanced request service for the handicapped and elderly. A package delivery service is also being provided.

Twelve passenger vans, named the "Maxytaxy" are used for this service. A zonal fare structure was established and all trips are coordinated through a dispatch center which also controls the fixed-route Minnybus operations. An annual pass may be purchased for $395 which enables the holder to the use the shared-ride service at one-half fare any time during service hours for one year. Another method of payment involves purchasing books of scrip, called "Maxymony", worth $25.00 for a price of $20.00.

A management contract with the local taxi operator calls for provision of paratransit services, supplementary fixed-route service, and control and dispatching service. WTD collects all revenues and is billed by the taxi operator

TABLE 4-3. OVERVIEW OF SHARED - RIDE TAXI DEMONSTRATION PROJECTS

	WESTPORT	XENIA	ST. BERNARD PARISH
SITE CHARACTERISTICS			
Service Area (sq. mi.)	22	9	20
Population	29000	28000	57000
Population Density (per sq. mi)	1300	3100	2900
Avg Income (Household)	$26000	$10800 (1970)	$13,500
Avg Auto Ownership (Household)	2+	--	1.8
SERVICES:			
Many-To-Many	Y	Y	N
Feeder or Fixed Route	Fixed Route	N	Feeder to Fixed Route
Subscription	Y	Y	Y (Future)
Advanced Reservation	Y(H&E)	Y	N
Other	Package Delivery	Charter Trips	-
Service Hours	6am-1am, 7 days	7am-7pm, 7 days	6am-7pm, 6 days
Percent Population Served	100	100	95
SRT Fleet Size	11 Vans	7 Sedans	18-22 Sedans
Subsidy Mechanism	CPFF Contract	CPFF with incentive	User-Side (Initial Phase)
Fare Structure	Zonal	Flat Fare	Zonal
Avg. Fare	$2.00	--	-
Fare Range	$1.-$3.25[1]	$.50-$1.00[1]	$.60-$1.85(Incl.Bus Xfr)
Discounts	Evening Rate,(H&E)	Off Peak,Adv.Res,H&E	H&E(Off-Peak Only)
Prepayment	Annual Passes&Scrip	Tickets & Coupons	Subscription Svc Only
Tipping	N	Y	Y
Service Contract	w/Transit District	w/City	N (Private Carrier)
Operator/Driver Incentives	Dispatcher, Driver, and Management Incentives	Management Incentive	

1 Range shown for SRT services only; different fares exist for charter & subscription rides

TABLE 4-4. OPERATIONAL DATA
SMD SHARED RIDE TAXI PROJECTS AND OTHER PARATRANSIT SYSTEMS

	SMD PROJECTS			SRT PRIVATE SECTOR			SUBSIDIZED PARATRANSIT SYSTEMS	
	WESTPORT, CT.	XENIA, OHIO (1)	ST. BERNARD PARISH, LA	HICKSVILLE, NY (3)	DAVENPORT IOWA (3)	LITTLE ROCK ARKANSAS(3)	Averages from 11 Paratransit Systems in California (4)	Averages from 31 Dial-A-Ride Systems in Michigan (5)
LEVEL OF SERVICE								
Pct of Population Served	100	100	95	100	100	100	NA	NA
Vehicles Per Square Mile (in service)	0.18	0.78	.09-1.1	3.3	1.0	.37		
Avg. Wait Time, Min	9.	15.	NA	NA	NA	NA		
Avg. Ride Time, Min.	12.	13.		18.	14.	15.		
Avg. Trip Length, Miles	2.6	3.1		NA	NA	NA		
DEMAND								
Weekday Ridership	360	259		924	1269	3500		190
Weekday Ridership per 100 population	1.24	0.93		1.92	1.27	1.4	0.1 to 1.1 (range)	1.1
Demands per sq. mile per day	16.4	28.7		13.6	64.	23.3	NA	NA
Passengers per Trip	1.2	1.1,21.4,7.1(2)		NA	NA	NA	NA	NA
Passengers per Vehicle Hour	4.0	3.8		2.7	4.1	8.	NA	5.0
ECONOMICS								
Avg. Fare per Passenger	$1.20	$0.88(SRT)		$2.15	$1.05	$1.70	$0.46(.15 to .75)	NA
Operating Cost per Passenger	2.45	2.89		NA	NA	NA	$1.93	
Operating Cost per Vehicle Mile	0.68	1.02					NA	
Operating Cost per Vehicle Hour	9.60	11.00						
Revenue to Cost Ratio	0.42	.53						
Annual Operating Subsidy per capita	5.10	7.00					2.06	
Labor Rate, $/hr								
Driver	4.15	2.80	$2-5				NA	
Dispatcher	4.75	3.00	NA				NA	

1 Results are computed average of shared taxi (56% of all trips), subscription service (29%), and charters (15%), unless otherwise noted.

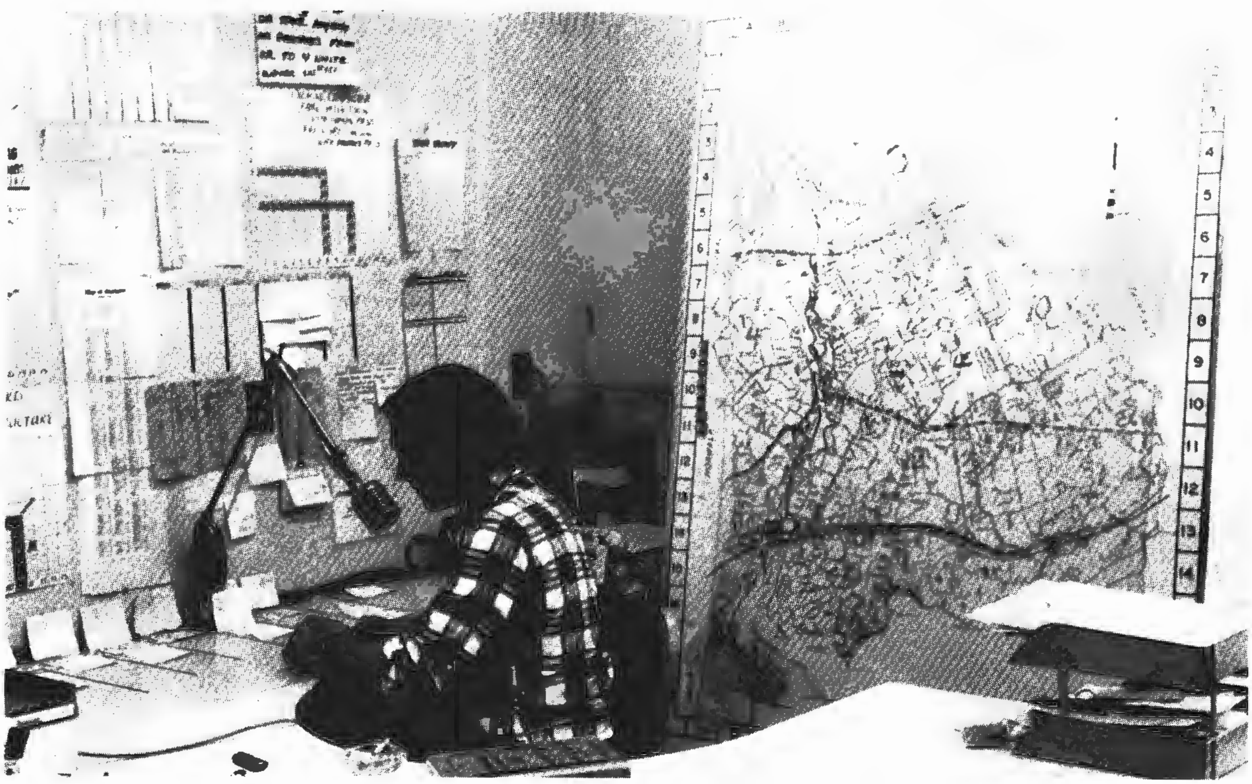
2 Shown for SRT, Charters, Subscription Service, respectively.

3 Source: Dave Systems & US DOT (TSC); Presentation at the California Conference on the Role of Taxis in Public Transportation, September, 1977.

4 Source: Gilbert,G., Establishing Innovative Taxicab Services: A Guidebook, UMTA-NC-11-0005, August, 1977.

5 Source: State of Michigan, Dept. of State Highways and Transportation, December, 1977.

Westport Shared Ride Taxi Vehicle "Maxytaxi", Westport, Conn.



Westport Integrated Services Dispatch Central, Westport, Conn.

for salaries and expenses plus a fixed annual management fee paid on a monthly basis. The contract also contains a profit incentive on a per passenger basis, with the rate per passenger increasing as the system productivity increases. Both drivers and dispatchers may receive a profit bonus based upon their performance.

Separate contracts have also been let to cover vehicle maintenance and system marketing. The maintenance contract, with the local school bus operator, provides for fuel, storage, parking facilities and some repairs on both the vans used in SRT service and the fixed-route minibuses.

Shared taxi ridership has been increasing steadily since the services began in April 1977. Taxis are currently carrying over 4 passengers per vehicle hour, and the demand for package-delivery service is increasing. Vehicle and service reliability has been good, as is evidenced by the 18 minutes average wait time from immediate service requests to pickup. An important indication from results to date is that the SRT operations are complementing and not competing with the fixed-route service. Shared taxi users are new transit customers and are not drawn significantly from bus or conventional taxi service.

Operating cost per vehicle hour, currently $9.60, has risen slightly and the cost per passenger has fluctuated between $2.30 and $3.00. The current average cost per passenger is $2.45, and the average fare per passenger is $1.20. Fares were expected to average $2.00 per trip; however, trip lengths are shorter than anticipated, and the original goal of a breakeven operation will not be realized.

Xenia

The Xenia, Ohio, transit demonstration began over three years ago and will terminate in mid 1978. An UMTA Service and Methods grant, awarded July 1974, enabled the City of Xenia to continue operating a fixed-route bus system introduced as an emergency service shortly after a tornado struck the city on April 6, 1974. In the course of the demonstration the system has evolved in stages from the original fixed-route bus system to its present form, which consists of a mix of differentially priced paratransit service including immediate and advanced request shared-ride taxi, exclusive-ride taxi, subscription and charter service.

The current mix of paratransit services, in operation since May 1976, is provided by a private operator under contract to the city. The city is billed on a monthly basis for the amount of operating costs less 30 percent of total revenues. The remainder of revenues go to pay driver commissions and management fees. The vehicle fleet consists of 7 taxi sedans and 5 minibuses. Minibuses are deployed on advanced reservation (charter) trips and subscription trips for students and workers. One of the minibuses is equipped with a lift for transporting handicapped passengers on an advanced reservation basis.

Taxi sedans are equipped with meters for charging fares for exclusive ride taxi trips. Flat fare established for SRT trips range from $1.00 per passenger for immediate requests to $.50 per passenger for off-peak trips scheduled more than 2 hours in advance.

The evaluation of the Xenia demonstration includes analyses of the feasibility of several types of transit service in a small city setting; one aspect of this study is examination of the effectiveness of public transportation as an aid in city redevelopment. The various changes in service which have occurred since initiation of the system in April 1974 should permit comparisons of several specific service features, with regard to their impacts on cost-effectiveness, ridership and coverage. Chief in importance is the comparison of fixed-route and paratransit operating characteristics. Other studies based on comparative analyses include the following: demand with respect to fare: cost-effectiveness of public versus city management; variations in quality of service over time and by service management; variations in quality of service over time and by service type: maintenance costs and productivity of taxi-type vehicles versus mini-buses in paratransit operations; relative impact on ridership of service levels and cost.

Average monthly ridership has dropped to about one-half the level of the fixed-route service at the time it was replaced by paratransit services. This drop is an indicator of the elasticity effects of increasing average fare per passenger from $.25 (fixed-route) to about $.90 for shared-ride taxi service. Monthly operating cost has dropped from about $30,000 to $20,000. Operating cost per vehicle mile is about the same as it was for publicly operated fixed-route service; however, the cost per passenger is considerably higher ($2.88/pax compared to 1.28/pax) because the operating costs are spread over fewer total riders. With the SRT service, a higher level of service is currently available at higher fares. The ratio of revenue to cost has increased from .10 to .53, which means the current service would impose less of a financial burden upon the community after the demonstration funding is terminated. the annual subsidy on a per capita basis is $7.00, or only about 60 percent of the subsidy required for the previous fixed-route operation.

A home interview survey is being analyzed to provide comparative data on users versus non-users of the transit system, including their opinions of the service and their perceptions of the tradeoff between fare and levels of service. Another focus of the home-interview survey is examination of auto ownership patterns since the tornado, particularly the effects of the transit service on re-acquisition of automobiles. Conversely, trends in auto ownership may explain part of the drop in ridership during the project. Estimates in the early stages of the demonstration indicated that a substantial percentage of individuals who had lost automobiles in the tornado had not acquired replacements for these vehicles. The survey will provide more conclusive, longer range data on the subject. An on-board survey will probe user's reasons for using the system and their assessments of service quality. The results of both surveys are expected to have implications for other small cities.

St. Bernard Parish Taxi Feeder Service

The objective of this demonstration is to investigate the extent to which public transportate coverage in a sururban area can be increased efficiently by using shared-ride taxicabs to provide feeder service to line-haul bus transit and to commuter subscription bus service.

Because the SRT service is a component of an integrated areawide transit system, it has already been described in the preceding section. In constrast to Westport SRT operations, shared-ride taxis in St. Bernard Parish are restricted to feeding the bus routes and do not provide many-to-many service. Although not comparable in scope to the Westport and Xenia systems, it is included in Tables 4-3 and 4-4 for the sake of comparing specific attributes, such as vehicle supply and fare structure with those of other SRT services.

Scottsdale

Another example of shared taxi-service for the general public will be introduced in a demonstration project in Scottsdale, AZ. Taxis will provide both ERT and SRT service, including SRT feeder service to and from three local bus routes. In addition, a user-side subsidized demand-responsive service for elderly and handicapped persons will be implemented. The project is currently in the final grant approval stages and operations should begin in FY79.

Comparison of Findings Across Projects

In Table 4-4, operating results for the three demonstration projects are shown. The interim nature of two of these projects must be stressed. Operations in Westport are still in the early growth phase. Trends in data indicate demand, service levels, and costs have not yet stabilized. Demonstration services have just begun in St. Bernard Parish. Therefore, no results are available as yet.

Where possible, comparative data are shown for other shared taxi projects outside the SMD Program. Some averages of operational data for eleven paratransit systems in California[2] and public dial-a-ride services in 31 communities in Michigan are included in Table 4-4. Some of the Michigan systems are operated by taxi companies, so the averages include both public and private operations. The eleven California paratransit systems are all privately operated under contract to the city. They charge low fares, from 15¢ to 75¢ and receive subsidies on a per mile or vehicle hour basis. The Hicksville, NY, Davenport, Iowa, and Little Rock, Arkansas examples are established SRT companies that operate entirely with the private sector and are sustained solely by fares collected from riders.[3] Not all of these findings are as recent as the demonstration projects results, however, and the economic results especially may not reflect current levels due to rapidly rising costs.

The transportation supply, as characterized by the number of vehicles per sq. mile, is lower for Westport than the other demonstration projects, primarily because of the lower population density. The taxi supply data plotted in Figure 4-3 shows how the number of taxis in service increases with population density, from 0.2 to over 3 taxis per square mile. In general, these sites provided better vehicle coverage than most public dial-a-ride systems, which usually have one bus in service per 2 to 5 square miles in

----

[2]Gilbert, G., et.al., Establishing Innovative Taxicab Services: A Guidebook, UMTA-NC-11-0005, 8/77.
[3]TSC and Dave Systems, data presented at the California conference on the role of Taxis in Public Transportation, September 7-9, 1977.

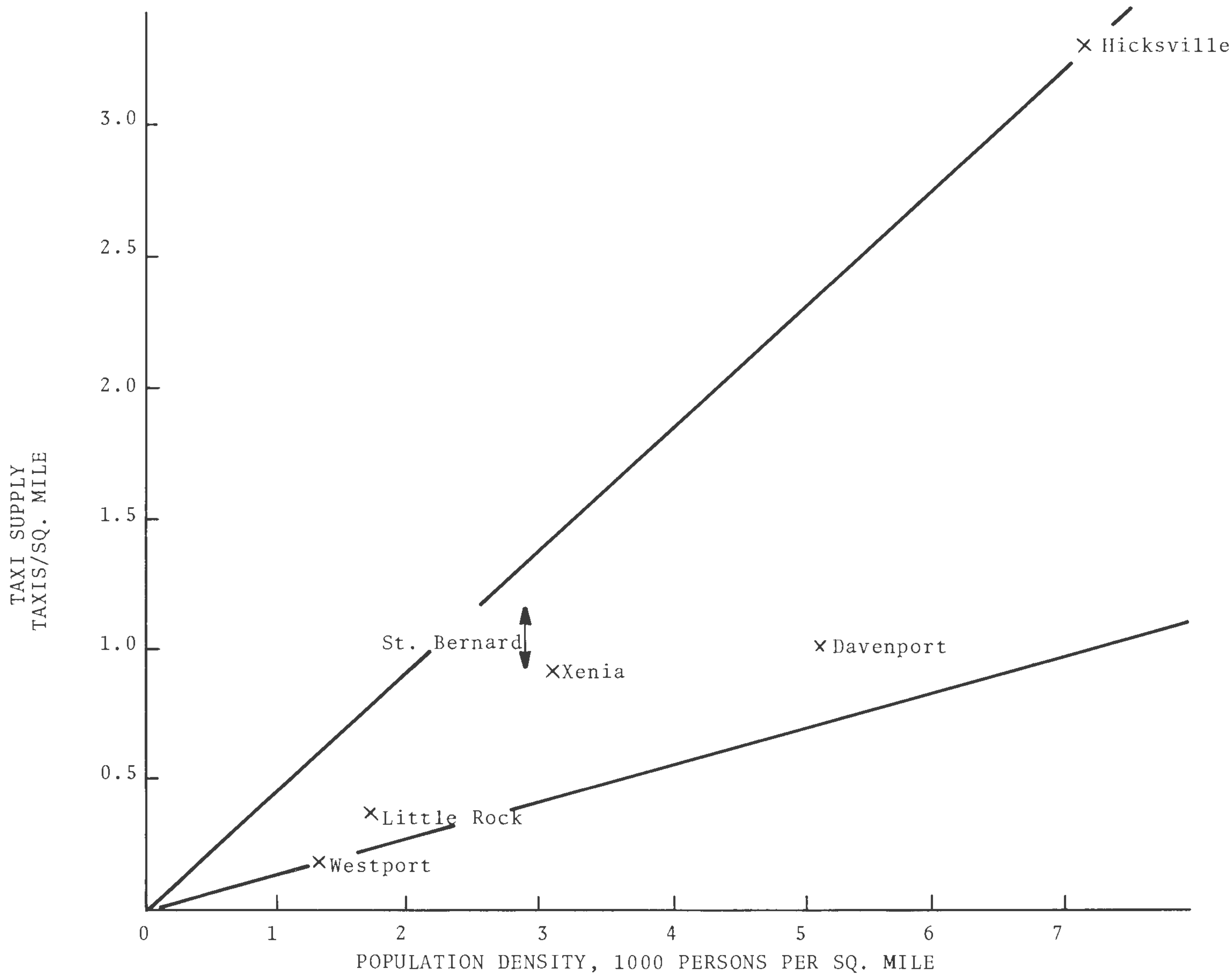


FIGURE 4-3. SHARED TAXI SUPPLY VS. POPULATION DENSITY

areas with population densities greater than 3000 persons per square mile. A varying supply rather than a fixed number of vehicles is a key feature which enables paratransit systems to economically adapt to changing demand levels during a day or for different days of the week.

Another measure of level of service is the average waiting time for a taxi to arrive. Wait time can reflect capacity constraints, and the relatively low value (6.2 minutes) for Westport, indicates that there is an adequate supply of vehicles. The average wait time for immediate service requests in Westport is 18 minutes and the standard deviation of the wait time is 7.6 minutes. For the Xenia operations, the average wait time is 15 minutes and the standard deviation is 16.6 minutes. These large standard deviations, relative to the mean, are typical of immediate request demand-responsive service. In terms of the total travel and wait time, both projects appear to be providing a high level of service.

Weekday demand levels for Westport and Xenia are both about .8 weekday passengers per 100 population. Xenia has stabilized at this level and the demand in Westport, still in the first year of operation, is increasing. For comparison, the three private SRT systems shown in Table 4-4, which have been in operation much longer, are serving 1.3-1.9 passengers/100 population. The eleven paratransit systems in California, which began operating more recently, range from .1 to 1.1. Vehicle utilization for the Westport and Xenia projects is about 4 passengers per vehicle hour compared with a range of from 2.7 to 8 for the three non-SMD SRT operations.

Operating costs are shown in the table as cost per passenger, per vehicle mile, and per vehicle hour. The cost per vehicle hour is around $11.00 for both Xenia and Westport. A management fee, which includes productivity incentives in the Westport contract, is included in the vehicle hour rate. This rate is substantially lower than the cost of public bus service, which usually ranges between $15-20/per hour. Lower labor rates and overhead for SRT account for a large share of the difference. Driver salaries for the SRT demonstration projects range from $2-5/hour and fluctuate due to commissions and demand.

Revenue-to-cost ratios are around 0.5; therefore, even though the cost per passenger is higher ($2.90 and $2.45 for Xenia and Westport, respectively), so are the fares charged for this higher level of service. Thus, the operating ratio is still favorable compared to most public bus systems. In Xenia, where SRT replaced fixed-route bus service, the annual subsidy is only about 60 percent of that required to sustain the fixed-route operation.

Legal and Institutional Issues

Taxi ordinance changes were not required for implementation of the three SRT demonstration projects. In Xenia, the flat fares eliminated the need for revising or adapating the meter-based pricing system. St. Bernard Parish was already providing zone-fare shared-ride feeder trips prior to the expanded demonstration. Westport Transit District, which has the authority to regulate taxi service and fares, established a new zonal fare system for the shared-taxi service.

Contractual service agreements may be made with one or more local taxi operators. In Xenia the only local taxi company in operation was interested in providing services to the city and a contract was negotiated without any major difficulties. However, in Westport, the most difficult and complex element of the project-implementation process involved the negotiations with two local taxi operators. Initially, WTD was proposing that the two operators combine some of their activities to form a private transportation company solely for the purpose of managing and providing the shared-ride taxi service. Each company would still operate premium ride and other services as desired. Because of irreconcilable differences and intense competition between the two firms, no such agreement could be reached. Consequently, interested providers in the area were invited to submit bids for the service. A joint bid was received from one of the taxi firms and the local school bus operator. However, the other taxi company elected not to bid and instead contested the demonstration on legal grounds in Federal court.

As discussed earlier in this chapter (Comparison of Findings of Areawide Integrated Transit), the Westport rulings at the District and Appellate Court levels establish important Federal precedents: private taxi operators which offer exclusive ride service are not entitled to Section 3e protections nor are they free from federally subsidized competing services; public agencies, on the other hand, should act in accordance with the statutory policy of encouraging private participation, and must also comply with the procedural requirements of the UMTA Act based on the impact of the project.

The complaint filed by the taxi operator alleged that: (1) the project would unconstitutionally curtail and compete with the plaintiffs publicly licensed taxi franchise, (2) WTD had not complied with UMTA regulations requiring public hearings, environmental impact, and providing for maximum feasible participation of private operations, and (3) the plaintiff was entitled to protections in the UMTA Act regarding compensation for damages to their franchise. The U.S. District Court ruled that the demonstration could proceed, and that Section 6 demonstration grants were exempt from the above requirements of the UMTA Act. The Appellate Court partially reversed the lower Court decision in ruling that the procedural requirements of the UMTA Act applied to any application under the Act with the critera for compliance being whether the impact of the project was substantial.

The review of the Section 3e issue produced the same result but for different reasons. The District Court held that the demonstration project was not subject to the provisions of Section 3e; however, the District Court noted the Transit District's compliance with the statutory policy of encouraging private participation. This compliance was reflected in the negotiation process, the competitive bidding process, and in the unofficial public hearing that was held. The Appeals Court held that Section 3e protections apply to all financial assistance under the Act (i.e., to demonstrations as well) but that only a mass transportation company may claim the protection of Section 3e. The criteria for decision was whether the service offered could be reserved for the exclusive use of individuals or private groups either by the operator or the first patron's refusal to permit others to be picked up. The taxi service fell in this category and hence was not entitled to Section 3e protections.

The Appellate Court enjoined funding of the demonstration until the WTD complied with the procedural requirements of Section 1602d involving an official public hearing. The federal legal process has been exhausted in the Westport case; the outcome of potential state litigation is uncertain.

TRANSPORTATION BROKERAGE

Overview

The Transportation Broker concept is a technique for managing existing transportation resources in a more efficient manner. The function of the broker is to identify the transportation needs of various market segments in an urban area and then match these needs with the most appropriate transportation resources available. The broker may modify existing transit service, coordinate social service agency transportation, contract with private bus, taxi or limousine operators, or arrange carpools, vanpools or buspools. The broker will act in a coordinating role as far as providing service is concerned but will take an active role in removing barriers to the more efficient use of existing vehicles. It appears that the main barriers to increased efficiency are not operational but legal and institutional. By clearing away the barriers the way will be open to providing improved transportation to the public and better use of community resources at minimum cost to the public.

Because of the great differences that exist between urban areas in this country, it will not be possible to develop a definitive model of a transportation broker that will be applicable to every urban area. However, the work to date has shown that barriers can be overcome, brokerage can be accomplished and efficiency of the transportation system can be increased.

Some of the measurable results of a brokerage function include:

1. Reduced cost for commuters
2. Better utilization of highways and deferral of highway construction
3. Less demand for parking space
4. Local traffic congestion relief
5. Better utilization of social agency funds
6. More efficient transit system
7. Healthier private sector transportation services
8. Less demand for public subsidies for transportation
9. Positive impact on energy consumption and air pollution

There has been a large and growing interest in Transportation Brokerage. The concept has a lot of promise and should be applicable in some form to every urban area around the country.

Current Projects

The Service and Methods Demonstration Program is currently sponsoring three demonstration projects involving the use of a transportation broker. The grantees for these brokerage projects are the Westport Transit District, Westport, Connecticut; the Metropolitan Transit Commission, Minneapolis-St. Paul, Minnesota; and the City of Knoxville, Tennessee. Information on these projects is presented in Table 4-5 and discussed in more detail in the following sections.

Knoxville

The Knoxville demonstration constituted the first implementation of the transportation brokerage concept on a region-wide basis. The Knoxville brokerage service has established and institutionalized a mechanism for coordinating a wide range of public and private transportation modes, including vanpooling and carpooling, into an efficient, integrated regional network. In addition to these functions, the Knoxville broker also provides information on available transportation services as well as information on costs, insurance, and regulatory requirements for ridesharing. This project differs from the Westport and Minneapolis projects (to be discussed) in that the city, as opposed to the transit authority, performs the brokerage functions.

In June 1975, the City contracted with the University of Tennessee Transportation Center for the initial planning, operations, and managerial activities for the project. As of July 1977 the City had assumed all responsibility for the brokerage operations.

The functions of the transportation broker include identifying and coordinating transportation needs and available services (on an individual traveler basis) across a broad range of users, providers, and modes. Needs are identified through general public marketing techniques and by working through employers, social service agencies, and other organizations to survey individuals within those organizations with peak and/or off-peak travel requirements. The broker also seeks to identify specific transportation service suppliers to fill these needs. Suppliers may be either existing public or private providers, such as the Knoxville Transit Corporation or charter bus companies, or new suppliers, particularly individual entrepreneurs with vans or cars. The overall objective of the broker's effort is to make better use of existing transportation resources,

TABLE 4-5. DESCRIPTION OF BROKERAGE PROJECTS

	Westport	Minneapolis	Knoxville
Grantee:	Westport Transit District	Metropolitan Transit Commission	City of Knoxville
Funding	$610,000	$335,000 UMTA 560,000 FAUS	$997,959
Schedule	April 1977-February 1979	April 1977-April 1979	October 1975 - December 1978
Management of Brokerage Operations	By Grantee	Jointly by grantee and private consultant	University of Tennessee then grantee after July, 1977
Demonstration Area	Town of Westport	Three multiemployer work sites in South Hennepin County Area of Minn. excluding CBD.	Primarily entire Knoxville SMSA (Regional), although 16 county East Tennessee Development District is actual service area.
Primary Brokerage Function	Promote shared ride taxi service. Coordinate service elements, shared ride taxi, fixed route and special market services.	Promote carpools, vanpools, and subscription bus.	Broad range of functions. Initial emphasis on vanpools and carpools.
Primary Marketing Strategy	Direct mailing (Marketing material prepared under third party private contract)	Direct to employers and employees through group presentations (marketing material prepared under third party private contract)	Marketing to employers and to general population using mass media.
Contractual arrangements for ridesharing services	Shared ride taxi provided by private company under contract to Transit District. Maintenance on all vehicles provided by local school bus operator under contract to Transit District.	Vanpool service provided as a "turnkey" operation by private company under contract to Transit Commission.	"Seed Vans" leased by city to private individuals

Commuter Vanpooling in Knoxville, Tennessee; City-Owned Vans are made available through the Transportation Broker.

including buses, autos, vans and taxis, regardless of ownership, and to increase both supplier productivity and individual mobility. In pursuing these objectives the Knoxville brokerage service has promoted and achieved institutional/regulatory changes which facilitate the operation of the brokerage system and broker-related services, primarily with regard to publicly and privately owned vanpools. As part of this demonstration the City of Knoxville has purchased 51 vans and leased them (as "seed vehicles") to private individuals as a promotion of the vanpooling concept (the Knoxville vanpooling program is discussed in more detail in the section on vanpooling in this chapter.)

Westport

The Westport, Connecticut, demonstration project, which began in April 1977, provides integrated transit services by expanding the role of the transit district currently operating a fixed-route minibus service. The Westport Transit District (WTD) acts as a transportation broker and in addition to operating its own fixed-route transit service, coordinates the following:

- Shared ride taxi service
- Supplementary fixed-route service by use of taxis
- "Special market" services for the elderly and handicapped
- Package-delivery service

The integration and operations of these services have been described in a previous section. This section will describe the institutional framework within which the services function.

Figure 4-4 is a diagram showing the overall operational structure of the Westport demonstration project in terms of the WTD brokerage, its contractual relationships with the private sector and the services provided to the public. All vehicles used in this demonstration (minibuses for the regular fixed-route service and vans for the paratransit services) are owned by the Transit District. The operation of the paratransit services, including the maintenance of all vehicles and the marketing, is performed under private contracts to the WTD. WTD manages and operates the regular fixed-route minibus service and all drivers and support

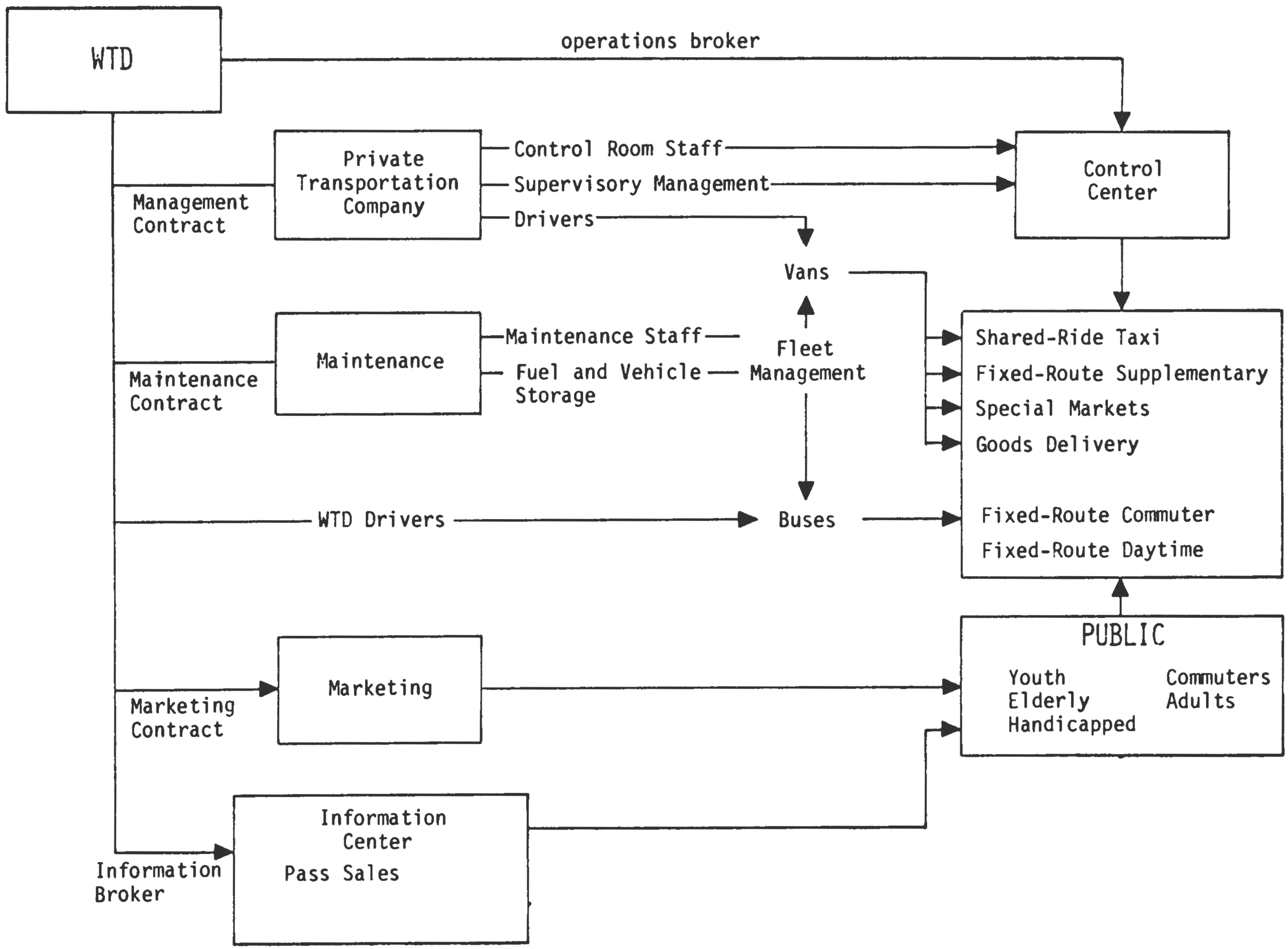


FIGURE 4-4. STRUCTURE OF WESTPORT DEMONSTRATION

personnel are employees of the Transit District. Paratransit services are managed and operated by a newly formed prviate transportation company, Westport Transport Corporation, which is jointly owned by a local taxi company and the local school bus operator. All drivers for the paratransit services are employees of the new corporation (including those who drive the fixed-route supplementary service). The Westport Transport Corporation also provides the supervisory management and staffing for the Control Center. This center provides for communications with all vehicles (including the minibuses used in the fixed-route service) and performs the dispatching for the other paratransit services. Equipment for the Control Center is provided by the Transit District. The private company has the responsibility for hiring its own personnel, as well as having the responsibility for its own payroll and other personnel activities. The contract is on a cost-plus-fixed-fee (CPFF) basis. Under this agreement, the Transit District collects all revenues derived from the paratransit service; the company submits bills for salaries, supplies, and other expenses. A fixed annual management fee is paid on a monthly basis to the private company.

The WTD also has a fixed price contract with a professional firm to provide marketing for the integrated services. The marketing program emphasizes the comprehensiveness and the complementary nature of the services provided. Promotional media used include local newspaper advertising, local radio stations, direct mail, in-vehicle advertising, and information display at the central transfer point and the local railroad station.

Brokerage functions include the operation of a Transportation Information Center. This Center provides comprehensive information on all transit and paratransit services in Westport and also handles the annual pass sales. Future plans call for this Center to provide comprehensive information on other transit services such as premium-ride taxi, regional bus service, commuter rail service, and rent-a-car service. In addition, the WTD brokerage functions will be expanded to include coordinating carpool and vanpool matching.

Minneapolis

This demonstration which began in the spring of 1977, establishes a transportation broker to coordinate a variety of ridesharing services at each of three separate multi-employer work centers (ranging in size from 3,600 to 7,700 employees) in the South Hennepin County area of Minneapolis.

Share-A-Ride Van to be Used in the
Minneapolis, Minn. Brokerage Demonstration

Matching Potential Carpoolers at the Brokerage
Office, Minneapolis, Minn.

The Brokerage Office will structure, coordinate and promote carpooling, vanpooling and subscription bus, as well as promote existing public transit at these sites. The overall objective is to develop and implement a coordinated and comprehensive ridesharing program to reduce the number of single occupancy automobile work trips. The Metropolitan Transit Commission (MTC), is acting as the ridesharing broker.

Initial program management activities are provided by an "implementation team" consisting of members of a consulting organization, a third vanpool provider (both of which are under contract to the Transit Commission) and MTC employees. Together this team has the responsibility for marketing and initiating the various services at the employment centers as well as structuring and establishing an on-site Brokerage Office. This strategy allows the maximum application of resources in implementing the project, leaving behind the Brokerage Office which will require a lower resource commitment for the continuing operations. In addition, a built-in replication ability is provided by allowing the implementation team to move on to other locations once a project gets started.

This project will offer a variety of service options to persons working at the employment centers. Listed below is a brief description of the services to be offered:

Carpooling - Carpooling will likely be the largest form of ridesharing. This program will attempt to register all persons who are currently carpooling at a particular employment site as well as those persons who desire to form a carpool. This information will be processed manually, with potential matches being determined on the basis of residence, zip code and workers' normal work shift. The Office will work with the employees in forming carpools and will actively monitor the pooling activity, adding to existing pools and reforming pools that break up.

Vanpooling - The vanpooling portion of this demonstration, described in more detail in the next section of this chapter, represents a significant departure from other projects involving vanpooling in that the service will be operated by a single vanpool provider under contract to MTC. This provider will supply the vehicles and will operate all elements of the vanpool service including insurance, maintenace and driver training. Under terms of the contract, the vanpool provider would be offered public financial support to mitigate the risks of the program and to cover start-up costs. The vanpool provider will work with the Brokerage Office is marketing the service and will coordinate the matching of poolable employees similar to the carpool matching.

Subscription Bus - This service will be offered to groups of employees if this mode of ridesharing appears to be viable at a site. The service will be provided by the bus operator who holds the operating rights in the residential pick-up areas. The users will pay the fares directly to the operator on a monthly subscription basis. The Brokerage Office will structure and monitor the service and will verify that the proposed routes are consistent with the policies and ordinances of the community. It will also contract with the service provider to guarantee the operation a subsidy (for up to 90 days) if revenues fall below costs. If after 90 days, the service still operates at a loss, the users have the option of either terminating the service or increasing fares.

Promote Existing Transit - All of the sites selected for the demonstration has regularly scheduled bus service. The Brokerage Office will promote these service and encourage the development of new services if the demand situation warrants.

The marketing for this project is performed by the Brokerage Office and will be directed first to employers (to gain their support for the program) and then to employees (for participation in the ridesharing services). The marketing effort for employers includes discussions with managerial staff, the distribution of promotional material and the establishment of a cooperative arrangement with a designated liason office. Marketing for employees includes a one-hour group presentation at the employer's facility, as well as direct mailings, poster and bumper sticker campaigns, and the distribution of a ridesharing newsletter at the employment sites. The overall marketing plan as well as the promotional material has been developed by the Brokerage Office in conjunction with a marketing firm under contract to MTC.

Transportation Brokerage in a Metropolitan Area

During the next fiscal year, a broker concept for paratransit operations will be implemented in Chicago. The northeastern Illinois Regional Transportation Authority (RTA) plans to fund six of the paratransit service proposals submitted to it by local governmens in its service area.

Rather than contract directly with operators for the provision of service as it currently does for conventional bus and rail transit, the RTA plans to contract with the local governments. The local government will in turn arrange for the provision of service. The advantage of this insitutitional structure is that local communities are able to design their own systems, consequently the services funded will at least theoretically reflect local transit priorities. In addition, the division of responsibilities between the local governments and operators can take advantage of differences in resources and capabilities.

A mixture of services will be funded under the broker during the demonstration; these include: elderly/handicapped dial-a-ride, general public dial-a-bus, and peak period feeder service to commuter rail stations. There will also be a variety of contractual arrangements between the local governments and public and private service providers, including transit companies and taxi operators.

Impacts of Brokerage Projects

While each of the current projects has the ultimate goal of increasing ridesharing through the promotion and coordination of a variety of ridesharing strategies (such as carpooling, vanpooling, shared-ride taxis), the most significant near-term impacts have been in the legal, institutional and regulatory areas.

The Knoxville brokerage project has been in existence for approximately two years and has provided ridesharing information to over 18,000 people in its 16 county service area. As of the end of FY77, the service has 46 of its 51 "seed vans" in vapooling operation, carrying approximately 460 individuals to and from work daily. Complete data on the extent of private carpooling and vanpooling made possible by the commuter matching service are not yet available. Initial indications are that about 20% of those driving alone who received match-list information indicated that they would try to arrange ridesharing. However, the percentage of those who actually began ridesharing is estimated to be considerably lower.)

While the modal shift impacts of this operation may not as yet be large, other accomplishments of the demonstration are very significant, both for the future of the project itself and for vanpooling on a national basis. For the first year and half of the demonstration, the elimination of existing institutional barriers to private vanpooling was a major objective. As a direct result of the efforts of project leaders, the Tennessee legislature eventually exempted vehicles hauling 15 or fewer passengers to and from work from Public Service Commission regulation. A second major problem facing the project was the prohibitively high cost (and the unavailability) of insurance for vanpooling. The brokerage project leaders succeeded in convincing the Insurance Services Office (an industry classification and rating service bureau) to publish a specific rate structure for vanpools (rather than rely on individual underwriters to determine rate classifications). This resulted in significantly lower rates in many cases and presumably increased the nation-wide availability of vanpool insurance.

In Minneapolis, the issues of insurance and regulation of vanpools by the Public Service Commission had been resolved before the start of the demonstration, primarily because of the area's past history in ridesharing programs. Several major employers in the Twin Cities area have long supported efforts to promote ridehsharing. In fact, the area is a national leader in employer based vanpooling programs. Since vanpools were pioneered by the 3M company (currently operating 86 vans), it is estimated that there are now over 130 vans carrying approximately 1400 commuters in the metropolitan area.

Local policy support for the brokering of ridesharing programs has been provided by the Minnesota Legislature, the Governor's Office, the Minnesota Energy Agency, and other state and regional agencies.

The Westport brokerage project does not (as yet) offer vanpooling as one of its ridesharing services; consequently the legal/regulatory issues central to the Knoxville and Minneapolis projects have yet to be addressed. The WTD has contracted with the private sector to provide paratransit services, including management, marketing and some maintenance.

In summary, the models established in Knoxville, Minneapolis and Westport exemplify different institutional approaches to transportation brokerage. They are demonstrating that an institution (whether it be the city or transit agency) acting as a broker can fulfill an important function in developing and effectively coordinating a variety of transportation services within an urban area.

VANPOOLING

Overview

Vanpooling is a type of commuter ridesharing designed for users who cannot be economically served by regular fixed-route transit. Normally vans carry from 8 to 15 passengers, and all costs of operating the van including the capital cost of the van are divided among the passengers. In many cases the driver receives a free ride and other incentives in return for his duties as driver. Because of the economics of vanpooling, which are dominated by the cost of the van and the collection and distribution time involved in picking up the passengers, the service will have the greatest appeal for commuters who live further than 10 miles from work. Thus, vans might best serve areas that are outside or at the fringe of the range of most transit systems. Vanpools will also be used for travel to suburban employment centers with inadequate transit service. In addition to areas where transit coverage is inadequate, vanpooling also has the potential for serving some of the peak period demand on routes where transit vehicles are operating at or above capacity.

Initial experience with vanpooling has produced positive impacts including the following:

- Significant cost savings to commuters
- Savings to employers in garage and parking lot construction and parking subsidies
- Deferral or elimination of highway construction in one situation
- CBD parking spaces freed to short-term parkers
- Reduced local congestion (e.g., at the entrance to plants)
- Reduced need to expand an existing transit system
- Reduced fuel consumption and pollution

Most of the current vanpool operations have been sponsored and organized by an employer for its employees. However, a considerably larger potential market for vanpooling exists. The SMD supported vanpool demonstration projects are aimed at a much larger market with a public agency taking an active role in promoting vanpooling. Several approaches to the provision of vans are being implemented: vans owned by the public agency and leased to drivers; vans provided by a private firm under contract to the public agency administering the program; and privately leased or owned vans.

The SMD vanpool projects will involve varying target populations, organizational structures, and institutional arrangements. Through the evaluation of these demonstrations, knowledge will be gained on the effectiveness of a public agency organizing and operating a vanpool program. Some of the issues and questions which will be examined include the following:

- Impacts of vanpooling on conventional transit usage and other ridesharing modes.
- Effectiveness of a vanpool program organized by a public agency in attracting and maintaining riders who work for local employers.
- Legal, institutional and operational aspects of vanpool programs, particularly for public agency programs, including marketing, matching, staffing, maintenance.
- The level of service provided by vanpools, such as trip times, cost, reliability, and coverage.
- The market for vanpooling in different types of urban areas and employment centers.

Several significant obstacles to vanpooling have been encountered, and some of these have been resolved. For example, regulatory barriers still exist in many states which restrict vanpooling programs other than those run by employers. The Insurance Services Office, an insurance industry classification and rating service bureau, has recommended lower rates for vanpooling to the insurance industry. Efforts are being made to overcome other insurance problems, such as the high concentration of risk in a vanpool. The SMD program has worked closely with the Department of Labor to clarify the provisions of the Fair Labor Standards Act. The Department of Labor has determined that in most vanpool arrangements the driver will not be considered an employee and thus will not be subject to the requirements of the Act. Although significant obstacles remain, much progress has been made in encouraging vanpooling, and it appears that the concept can capture a small but important segment of the commuter market.

Current Projects

Four vanpool demonstrations are being sponsored by the Service and Methods Demonstration Program. The grantees for the vanpool demonstrations are the Tidewater Transportation District Commission in Norfolk, Virginia; the Golden Gate Bridge, Highway and Transportation District in San Francisco, Marin and Sonoma Counties of California; the City of Knoxville, Tennessee; and the Metropolitan Transit Commission in Minneapolis/St. Paul, Minnesota. Table 4-6 presents information about the four vanpool projects. It contains a summary of demographics, institutional, and operational characteristics of each project.

The grants for the Norfolk and Golden Gate projects are primarily for vanpool programs. In Knoxville and Minneapolis, the vanpool projects are part of broader brokerage operations involving other forms of ridesharing and transit improvements. The Knoxville project has been underway for approximately 2 years, the programs in Norfolk and Golden Gate began operation of a few vanpools in the fall of 1977, and the Minneapolis vanpool operation in early 1978.

In Norfolk, all drivers and riders must be civilian or military employees of the Navy. There are five major naval bases in the Norfolk region which may participate in the program. The large base, Sewells Point, employs almost 63,000 persons. The bases are divided into commands, which vary in size from 2,000 to 10,000 people. The Navy assistance for forming pool groups will be organized by commands. Thus, while there is one overall employer, the Navy, multiple work sites are involved. The residential area for drawing participants is from throughout the Tidewater region.

In Knoxville, the drawing area for work sites and residential areas is the Knoxville region. In the Golden Gate project, the residential areas served are in Marin and Sonoma Counties north of San Francisco and primarily along U.S. Highway 101. Work sites will be in San Francisco, just south of San Francisco and in two northern counties (Marin and Sonoma). In Minneapolis, three employment sites, each with multiple employers, have been selected to be served by the vanpool program. Approximately 17,300 persons work at these sites.

The programs differ in the administration of the vanpool operations. In Norfolk and Golden Gate, the grantee, who is a transit operator in both cases, is buying the vans, leasing them to drivers, and administering and

TABLE 4-6. DESCRIPTION OF VANPOOL DEMONSTRATION PROJECTS

	Norfolk	Golden Gate	Knoxville	Minneapolis
Grantee:	Tidewater Transportation District Commission (transit operator)	Golden Gate Bridge, Highway and Transportation District (Bridge operator, highway lane control, transit operator of buses and ferries)	City of Knoxville (city government)	Metropolitan Transit Commission (transit operator)
Date for Start of Grant:	September 1976	October 1976	October 1975	April 1977
Scope of Grant:	Vanpools (private hauler association)	Vanpools	Vanpools, carpools, express bus, social service agencies (brokerage)	Vanpools, carpools, subscription bus, improve fixed route bus schedules and ridership
Amount of Grant:	$490,000	$684,096	$997,959	$335,000
Site Description				
Population:	Tidewater Region 729,000	Marin & Sonoma Counties 411,000	Demonstration Service Area 16 County Region 723,000	Minneapolis, St. Paul SMSA 1,814,000 Employees at 3 target work sites 17,300
Median Household Income:	$7,560	$11,800	$8,217	Minneapolis, St. Paul SMSA $11,700
Aver. Autos per Household:	1.2	1.5	1.3	1.3

TABLE 4-6. DESCRIPTION OF VANPOOL DEMONSTRATION PROJECTS (CONTINUED)

	Norfolk	Golden Gate	Knoxville	Minneapolis
Starting Date of Vanpool Operation:	September 1977	October 1977	January 1976	January 1978
Description of Vanpool Operation:	Grantee purchases vans and leases to drivers. Participants must be Navy employees	Grantee purchases vans and forms operating vanpool groups to be seeded to non-project vans at later date.	Grantee purchases vans and leases to drivers.	Grantee contracted with 3rd party to furnish vans to drivers. Project targeted at 3 work sites with multiple employers.
Management of Vanpool Operation	By grantee	By grantee	By Knoxville Commuter Pool at Univ. of Tennessee. Knoxville Commuter Pool transferred to grantee after July 1977	Jointly by grantee, consultant and third party provider.
Number of Vans:	50	35	51	Contract with provider allows for 50
Model of Van:	Dodge B300 Royal Sportsman	Plymouth Voyager	Plymouth Voyager	Dodge B300 Royal Sportsman
Van Seating:	12 passenger bench seats	18 twelve-passenger vans with bench seats. 17 ten-passenger vans with reclining seats.	46 vans for 12 passengers 5 vans for 15 passengers All vans bench seats	12 passenger bench seats
Cost of Vans:	$6300	12 seat - $7,800 10 seat - $9,300	12 seat - $6035 15 seat - $6654	Not available. Third party provider leases vans from Chrysler dealer.

TABLE 4-6. DESCRIPTION OF VANPOOL DEMONSTRATION PROJECTS (CONTINUED)

	Norfolk	Golden Gate	Knoxville	Minneapolis
Insurance	Carried by Grantee.	Carried by grantee on project vans. Deluxe / Lux Marin $1200 / $1350 Somona $1620 / $1400	Carried by grantee	Provided by 3rd party provider.
Marketing	Marketing centered around Navy bases.	Marketing aimed at employers and riders. Mass media used.	Marketing aimed at employers and riders. Mass media used.	Marketing aimed at employers and riders. Limited mass media. (only at program inception)
Driver Selection Process	Drivers apply to grantee who selects drivers.	Drivers apply to grantee who selects drivers.	Drivers apply to Knoxville Commuter Pool who selects drivers.	Grantee and third party provider collect names of interested drivers and third party van provider selects drivers.
Rider Selection Process:	Drivers will obtain riders with assistance of Navy.	Pool group will be organized by drivers, other riders, or by grantee who will receive names of interested riders.	Applicants apply to Knoxville Commuter Pool who contacts persons about joining a vanpool.	Grantee and third party provider collect names and third party provider organizes riders into pool groups.
Fare:	Drivers set fares, but grantee publishes suggested fares based on 8 passengers covering expenses. Sample monthly fares: 50 miles (round trip) $38 100 miles $63	Fares set by grantee. Rate varies with number of pssengers. Sample monthly fares: 50 miles (round trip) $34-49 100 miles (round trip) $49-58	Fares suggested by grantee and are based on eight passengers. Driver may change fares. Sample Monthly fares: 50 miles (round trip) $32.88 100 miles $48.88	Fares suggested by third party provider. Driver may change fares. Sample monthly fares based on nine riders: 50 miles (round trip) $40 100 miles $51

TABLE 4-6. DESCRIPTION OF VANPOOL DEMONSTRATION PROJECTS (CONTINUED)

	Norfolk	Golden Gate	Knoxville	Minneapolis
Incentives to Drivers:	Free commute, personal use of van at 7¢/mile plus gas, and can keep fares collected in excess of lease fee which is based on 8 paying passengers	Free commute and personal use of van at 11¢/mile including gas up to 500 miles per month	Free commute, personal use of van at 9¢/mile plus gas, and can keep fares collected in excess of lease fee which is based on 8 paying passengers	Free commute and personal use of van for first 200 miles in a month at cost of gas and 8¢/mile plus gas after 200 miles. Can keep ½ of fares of 10th and 11th passengers.

Vehicles Used in the Golden Gate Vanpool Demonstration organizing the vanpool program. The grantee is directly involved in conducting marketing, although a marketing firm is used to assist in developing the marketing program. The grantee also collects and processes applications for drivers and riders.

In Knoxville, a brokerage organization called the Knoxville Commuter Pool located at the University of Tennessee planned, developed and operated the vanpool program under contract to the City of Knoxville. After 18 months of operation, the management of the program was transferred to the City. The city is currently in the process of selling the vans to current vanpool drivers. In Minneapolis, the Metropolitan Transportation Commission is contracting with a third party to furnish vans. The third party will provide the vans to drivers and administer the maintenance and servicing of the vans. A consultant has also been hired to assist in organizing and managing the marketing, selection, and matching of riders and drivers.

All four vanpool programs encourage the formation of vanpools which do not use project vans. The Golden Gate program, for instance, leases a van to a pool group for a period of about six months after which the group or an employer will be expected to purchase or lease its own van. In this situation, the Golden Gate Transit District will provide assistance in obtaining a van and insurance. The demonstration van would then be leased to a new group.

The local objectives of the four grantees are similar; increase ridesharing, decrease traffic congestion and associated problems such as air quality, reduce the need for new highway facilities, and save energy. The grantees are interested in ways of increasing ridesharing without adding new buses. Adding new buses is often unattractive because the service areas are sparsely populated or because adding new buses would increase the deficit of the transit operations.

Site Descriptions

All four vanpool demonstration projects are in urban areas. There is a variation in median household incomes among the areas to be served ranging from $14,000 in Marin County for the Golden Gate project to $7,560 for the Tidewater Region for the Norfolk project. There is a similar variation in household auto ownership among the project areas ranging from 7% with no auto available in Marin County to 20% in the Tidewater Region. The project areas provide a range of economic characteristics, blue collar and white collar occupations, and auto ownership characteristics.

All of the project areas have public bus service, although the service is infrequent or non-existent to many residential areas and work sites. In Norfolk, the largest base, Sewells Point, is served by 3 local bus routes and 2 express routes with 3% of commuters using public bus. The Navy bases are also served by approximately 100 private haulers who are Navy employees driving vans and old buses and carrying fellow employees to work. The Norfolk vanpool program is being designed so as not to draw from those who are served by the private haulers.

In the Golden Gate corridor, the buses serve primarily the downtown area of San Francisco. There are many other work sites in San Francisco not served by Golden Gate buses which would be candidates for vanpooling.

The local bus system in Knoxville serves 76% of the city's population within 1/4 mile; however, most headways are 30 minutes or more during the peak period. Transit serves less than 3% of all intra-city trips. The service area for the vanpool program extends beyond the city's boundaries over a multi-county region. In Minneapolis, all of the 3 employment sites are served by public buses, but only one site has a reasonably high level of service. Thus, in all four demonstration sites, while there is public bus service, there are many work and residential areas which are not adequately served by buses. The projects will demonstrate the potential of vanpooling for these trips.

Implementation

Major regulatory obstacles to vanpooling were resolved during implementation of the Knoxville and Minneapolis programs. In Knoxville, legislation was sought and passed to exempt commuter ridesharing vehicles carrying 15 or fewer passengers from state economic regulation. In Minneapolis, there was a potential problem with a third party leasing the vans. Drivers could be considered employees of the third party under federal labor regulations and be subject to minimum wage and other labor regulations. An opinion was issued by the U.S. Department of Labor that drivers would not be considered employees of the third party leasor if: (a) driver participation is voluntary, (b) drivers make no more than one round trip per day for commuting, (c) there is no cost to the driver other than a portion of costs shared among passengers, and (d) drivers are not responsible for any maintenance or repairs other than occasional voluntary maintenance or cleaning of the vans.

Obtaining insurance has been a problem for the vanpool programs. Before the Knoxville program, insurance for vanpools was very expensive and difficult to obtain. The Knoxville project leaders helped convince the Insurance Services Office to publish a specific rate structure for vanpools rather than relying on individual underwriters to determine classifications. This has resulted in significantly lower rates in many cases. The Norfolk and Golden Gate programs were seeking insurance at about the time the new vanpool insurance rate structure was going into effect. Both of these grantees received one bid for supplying insurance. The fact that the grantees wanted an umbrella policy to cover the respective transit districts while vans were on their property as well as driver coverage appeared to increase the policy cost.

Marketing for the vanpool programs has been aimed at both employers and prospective riders. In the Golden Gate, Knoxville and Minneapolis programs, phone contacts and meetings with interested employers are conducted to elicit their support and meetings are held with employees to distribute information. In the Norfolk program, marketing is centered around the Navy with advertising and displays on the bases and meetings with naval personnel. Golden Gate and Knoxville have mass marketing campaigns using radio spots, newspaper ads, and handouts.

Minneapolis, Norfolk and Golden Gate projects have begun with manual matching; however, all are considering using computerized matching procedures. In Norfolk, the matching procedures will be set up in the Navy commands, and some larger commands will use computerized procedures. Minneapolis is considering a mini-computer matching system similar to that being used in the Knoxville Demonstration. Knoxville has used a computer matching system at the University of Tennessee and is currently installing a new computer system for matching and vanpool accounting purposes.

Project Results

The Knoxville project has had vans operating for approximately two years, the Norfolk and Golden Gate projects for a few months, and the Minneapolis project has not begun van operation. The evaluation of the Knoxville project is incomplete, and a detailed assessment of the project is not available. Norfolk and Golden Gate have not been running vans long enough to warrant any discussion of results. However, a comparison can be made of the start of the programs. Table 4-7 shows the number of vans in operation for each month during the first few months of project operation. In addition to the demonstration projects, the table includes for further comparison, formation rates achieved by a private employer vanpool project, 3M Company in St. Paul, Minnesota, and a private, multi-employer project, Commuter Computer in Los Angeles.

The vanpools in the Commuter Computer program in Los Angeles served multiple employers. Commuter Computer had run a carpool program for two years before starting the vanpool operation. This experience in marketing and matching for pool groups greatly aided the implementation of the vanpool operations. Several pool groups were organized in anticipation of the arrival of vans, and thus, the program began with 10 vanpools in operation the first month. The vans were ordered in several shipments, with 20 vans in the first shipment, and hence, there were not large numbers of unused vans during the initial months of project operation. The 3M program had the advantage of being organized by an employer for only its own employees. Also 3M ran a pilot program of 6 vanpools for 4 months before expanding the program.

The three demonstration projects had similar rates of vanpool formation during the initial months of each program. These rates were below that for the private programs. In both Norfolk and Golden Gate, an important element in the organization of the first pool groups were efforts on the part of the driver or someone else in the pool group. The Knoxville project did fill its vans and had 46 of 51 vans in vanpool operation in November 1977. The initial attraction of riders and the setting up of a viable matching process appears to have resulted in slower start up times for the demonstration projects.

In summary, there are many factors influencing the rates of formation, including differences in:

- Densities of initial target market
- Institutional environment
- Staff and marketing resources
- Vehicle availability
- Pricing structures
- Availability of other transportation
- Startup criteria - some programs start operating a van before a full complement of riders have signed up.

TABLE 4-7

NUMBER OF VANPOOLS IN OPERATION

Month of Operation	Knoxville	Norfolk	Golden Gate	3M	Commuter Computer
First Month	1	3	3	6*	10**
Second Month	4	4	4	9	13
Third Month	5	5	5	18	14
Fourth Month	9	10	10	25	18
Fifth Month	16	12	18	31	19
Sixth Month	16	8	25	40	20
Seventh Month	17		30		20

*3M had a pilot program of 6 vans for 4 months before expansion of the vanpool program.

**Commuter Computer had run a carpool program for two years before starting a vanpool program, and thus, their staff had experience in organizing pool groups. Several vanpool groups had been organized in anticipation of the arrival of the vans.

SUPPORT ACTIVITIES AND FUTURE PROJECTS

Studies undertaken by the program are intended to: (1) improve our understanding of the applicability of paratransit service concepts, (2) assist communities in planning and implementing paratransit, and (3) develop site specific plans for future demonstration projects. These activities are discussed in this section.

Paratransit Service Innovations

The objective of this project is to assess and document promising applications of paratransit services such as dial-a-ride using shared-ride taxis, subscription bus or commuter van services, feeder service to line-haul transit, and jitney service. Since considerable uncertainty exists about the benefits and potential difficulties of implementing these types of service, they are unlikely to be considered by policy-makers, planners, or regulators until their potential is much better understood. Some of these applications are examined through detailed case studies of existing operations, while other applications are being tested in demonstration projects.

For home-to-work travel, two comprehensive reports have been prepared, describing current experience with commuter vanpools. Based on an analysis of more than 30 operations, these documents describe the planning, organization, and operation of this type of service, how to set up and administer employer-based programs.

Reports being developed on innovative services provided by taxi and limosine operators will describe and illustrate new types of services, travel markets, and implementation issues. Particular attention is being paid to existing applications of shared-ride taxicabs for low-density travel in small towns or suburban areas and as feeders to conventional transit.

Employment Center Subscription Bus Service

Past uses of subscription-bus service, in order to economically utilize the driver and vehicle while charging a reasonable fare, have necessitated a relatively long trip distance. A demonstration project is being developed to provide short-haul subscription-bus service to a large non-CBD employment center with little or no existing transit service. In this project, based on the existing staggering of work hours among employees, multiple trips per peak period will be made, greatly improving vehicle productivity and lowering costs to the user.

Prior analysis had indicated that the concept was feasible and particularly applicable to the El Segundo employment area in Los Angeles. Service will be provided along fifteen routes of various lengths with seven standard transit buses. The routes are designed to serve the employees of two firms, employed on various shifts and at several work locations. Each bus in the project will make several pre-aranged pickup stops to serve walking or park/ride customers and then will travel express to the employment center. The bus will then dead-head to a second pickup, repeating the operation. Continued marketing of the operation will be directed at employees in the employment center.

An additional component of the demonstration, if successful, will include planning to expand the service to another employment center in the Los Angeles area.

Analysis of Unregulated Paratransit

There is an explicit need to study paratransit operations which are meeting travel demands of persons in urban neighborhoods. There is a transportation void in many urban neighborhoods where auto ownership is low, regular public transit does not meet the destination demand, and conventional taxi service is not adequate. Unregulated transportation services have developed to meet the unfulfilled transportation needs in some urban areas. However, very little is known about these operations. Knowledge of the underlying factors inherent in these services is necessary to determine their impact on a region's transportation system.

The purpose of this study is to research and analyze an on-going inner city paratransit operation in a specific site. The project has three primary objectives: supply and demand analysis; alternate fare pricing and range of services analysis; and recommendations and preliminary analysis for future research. Four types of unauthorized paratransit service will be analyzed: bus and airport terminal service, station service (call taking and dispatching center), flexible and fixed-route service, and supermarket transportation service.

Shared-Ride Auto Feasibility Study

This study assessed the feasibility of shared-ride auto transit (SRAT), a concept which involves licensing commuters to carry passengers for profit on the trip from home to work and back. It has the potential of increasing auto occupancy in rural and urban areas. Operational, legal, institutional, and behavioral aspects of the concept were investigated and discussed in a report summarizing the study findings.

SRAT has several possible applications in urban and rural areas. It can provide sufficiently high service levels that moderate driver and rider participation is possible. However, concerns over personal security, reliability, and social acceptability will have to be met. Legal and regulatory problems can be overcome or avoided in most areas, including Federal, state, and local regulation, insurance, taxes, traffic regulations, registration of participants, and liability of the SRAT agency. A number of potentially serious institutional barriers to SRAT exist, but by designing the system to reflect a site particular institutional setting, it appears that in many cases these barriers can be overcome.

Demand-Responsive Transit Patronage Model

A critical problem local planners face when they attempt to design DRT systems is the difficulty of forecasting future patronage; many of the major decisions on capital outlays such as the number of vehicles purchased depend on expected ridership levels. In response to this need for planning methods, a computer-based procedure has been developed that is intended for use by local planners for predicting DRT patronage.*

Work has been completed on the design, development, implementation and validation of a detailed patronage forecasting model. The methodology utilizes disaggregate travel demand models for predicting both work and non-work trips in conjunction with a level of service prediction capability. The detailed model and a simplified, manual sketch planning version provide planners of potential DRT

---

*S.R. Lerman, et.al., Method For Estimating Patronage of Demand-Responsive Transportation Systems, TSC Urban and Regional Research Series, DOT-TST-77-77, July 1977.

systems with a method for forecasting demand for alternative systems.

Preliminary specifications of the demand models were based on data from Haddonfield, New Jersey, and a suburb of Rochester, New York. Due to a small data sample and coding problems associated with the Haddonfield survey, only the Rochester data were used to calibrate the final set of models.

The final work-trip model was also constrained to incorporate one variable (the cost coefficient) that was insignificant in virtually all estimations, but which was deemed essential for forecasting purposes. The coefficient selected was derived from prior studies of work trip mode choice.

The non-work trip models (home-based and non-home based) represent a significant methodological advance over prior models. It explicitly allows for varations over the day in the propensity of people to travel and also includes complex tours; existing models used in practice only represent simple tours, i.e., trips which leave home, visit one location and return home. The non-work models not only represent a traveler's choice of mode, but also the choice of destination. Thus, the models are capable of forecasting how DRT service will alter the pattern of non-work travel in an urban area.

The level of service, or supply, model is a set of equations which predict period by period DRT average systemwide wait time and ride time on an origin/destination basis. These equations were estimated using data generated with the MIT simulation model, which in turn was validated using data from the Haddonfield DRT system. While originally intended for use in the overall model system, the service prediction equations can be used as simple, stand alone forecasting models.

Demand and level of service models are solved simultaneously to obtain the equilibrium travel pattern. This solution involves an iterative procedure (see Figure 4-5) that attains an approximate equilibrium very close to the true equilibrium. The model system was used to predict ridership levels for a set of highly simplified prototypical cities representing a wide range of DRT systems. The resulting forecasts serve as a sketch planning tool which can be used by planners who lack the time or resources to use the detailed model system. It requires a simplified description of the area being served, the DRT system design

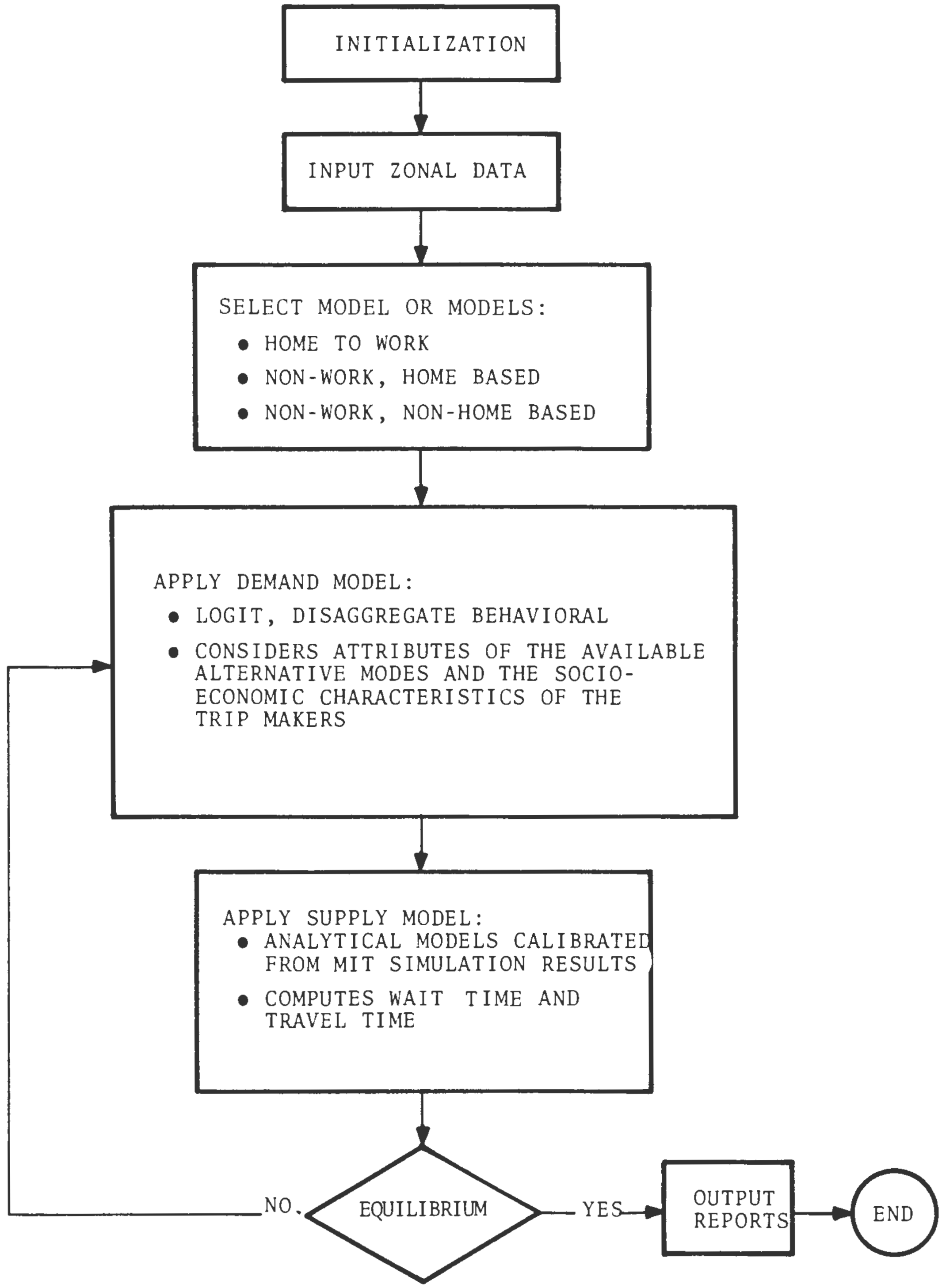


FIGURE 4-5. FLOW DIAGRAM OF DRT PATRONAGE MODEL

including fleet size, fare, service area size, and service area population.

Validation tests on two existing systems (LaHabra, California, and Davenport, Iowa) indicate that the detailed system predicts total daily ridership (passengers per day) reasonably well (within approximately 30% of actual ridership levels). However, the observed errors are greater when patronage forecasts are disaggregated into work and non-work travel.

Foreacasts from the sketch planning model were compared with data from six additional existing DRT systems in the U.S. As in the validation of the detailed, computer-based model system, the total daily patronage forecast was reasonably accurate (again, the error was less than or equal to $\pm 30\%$, with a total average error of -.2%).

While the overall total daily ridership predictions are relatively accurate, a closer look at the work and non-work predictions for the two validation cities and the additional six sketch planning test cities seem to indicate that the work model is consistently overpredicting, sometimes by a factor of two. Because of the equilibrium nature of the system, this causes non-work trips to be underpredicted during periods when both types of trips are competing for use of the system. When the non-work models were used solely by themselves in off-peak periods of the day and compared with data that was available for two of the six cities, the non-work sketch planning model produced errors of less than 30%. These comparisons suggest that (a) the models work well for total daily ridership predictions (b) the non-work models might also be used as a first approximation for off-peak design and evaluation and (c) further adjustments to the work trip model constant will be required if this model is to be used for peak period system design and evaluation.

SUMMARY AND IMPLICATIONS

The demonstration projects reviewed in this chapter have produced important findings and impacts relative to the further application of paratransit services. Innovative techniques and approaches are being investigated within the four major paratransit concept areas; integration of demand-responsive and fixed-route services, subsidized shared-ride taxi service, brokering of transportation resources to meet intra urban travel requirements, and areawide organization of vanpools in coordination with existing public transit operations. The status of most of the paratransit demonstrations is such that conclusive findings are not yet available. Therefore, the implications listed below relate primarily to institutional issues and early findings from the projects described in this chapter.

- Results from Rochester and Westport imply that, under certain conditions, flexible route and subscription services are more economical than fixed-route systems.

- Route rationalization, or the replacement of established bus routes with demand-responsive coverage may reduce the level of service for regular users living near the route. Resultant demand is likely to decrease, especially if the new service will require transfers that were previously unnecessary.

- Demand responsive services such as dial-a-ride are likely to improve transit travel times relative to fixed-route service only when trip patterns are diffused and transfer between fixed-routes would be required. For most other trip patterns fixed-route service offers more direct service and consequently shorter travel times. Furthermore, demand-responsive services are intrinsically more variable than scheduled fixed-route services, due to their greater flexibility.

- Transit operators should select a single proven make of transit vehicle to simplify maintenance and spare parts requirements. Maintenance procedures for demand-responsive vehicles are especially important since vehicle breakdowns have a more pronounced effect on demand-responsive than on fixed-route service levels.

- Results from Rochester indicate that computerized dispatching of demand-responsive vehicles has the potential of providing more effective service more economically than manual systems. The computer aided system used in Ann Arbor improved service levels provided skilled dispatchers were utilized. Manual dispatching systems are appropriate for small cities.

- The incorporation of demand-responsive services in a transit system may be opposed by fixed-route operators, and requires close cooperation between planners, elected officials, and transit operators. A large, unionized, traditional transit operator may not easily adjust to offering personalized demand-responsive service.

- The labor-protection clause - Section 13(c) of the Urban Mass Transportation Act of 1964 - which effectively gives organized labor the prerogative to veto Federal grants, provides substantial leverage to unions and can prolong or hamper efforts to initiate paratransit services. However, the successful introduction of a number of paratransit projects, including those reported in this chapter, has proven that 13(c) is not an insurmountable barrier to the implementation of paratransit service.

- The Knoxville and Westport projects demonstrate that institutional, legal, and regulatory barriers, including insurance rates and policies, can be overcome without destroying the economic and operational viability of innovative services.

- Public and private providers can be successfully integrated into a coordinated community transportation system.

- An institutional concept referred to as a transportation broker can be effectively used to coordinate a variety of public transportation resources in an urban area. Examples of a public agency and transit authority acting as broker are being demonstrated.

- Market segmentation, or the identification of specific markets, such as commuters traveling to the rail station in Westport or commuters traveling from outlying suburbs in Knoxville, is an effective means of determining transportation needs and attracting auto users who will not ride conventional transit. A significant number of commuters can be attracted from autos to buses and pool vehicles.

- A large capital investment is not necessary to establish a vanpool program

- While the rapport of employers is a key ingredient in a publicly sponsored vanpool program, vanpooling can be successfully sponsored by a public agency and need not be focused on the employees of a single company

- A varying supply rather than a fixed number of vehicles is a key feature enabling shared-ride taxi services to economically adapt to changing demand levels

- Providing shared-ride taxi service opens up a previously untapped market and may even stimulate increased transit use, as evidenced by the taxi-feeder service in St. Bernard Parish and the use of SRT service in Westport.

- Shared ride taxi operations can provide a high level of service compared to other demand responsive operations.

- Operating costs per vehicle hour for SRT systems are substantially lower than public bus operations. This is primarily due to more flexibility in fleet deployment, number of dispatching and administrative staff required, and lower labor rates.

- Although the cost per passenger for SRT trips is high, the higher fares commensurate with the higher level of service results in higher operating ratios (revenue to cost). Ratios close to .5 were achieved in Westport and Xenia. These ratios are higher than those obtained for most publicly operated transit.

Contracting with the private sector is a major feature in establishing integrated services. Contractual relationships may be developed for service provisions, project management, fleet maintenance, and professional marketing. Smaller transit entities can benefit from this approach since they usually do not have the capability to undertake such a project with their own direct resources; in addition, the contractual approach clarifies the operational responsibilities and the financial relationships between the parties involved.

A public transit entity contemplating the introduction of integrated services should first investigate the legal and regulatory context in which it operates relative to enabling legislation, regulatory agencies, and local ordinances. This will provide an understanding of the options available for implementing integrated services. A similar investigative effort should be applied to potential taxi operators who may serve as management contractors to establish the options available to the taxi operator in terms of participating in a project of this nature. A review of the public records associated with these taxi operators will reveal the financial condition of their businesses and serve as useful information in early negotiations.

Formal negotiations should be preceded by informal meetings stressing each entity's role in providing transportation services and the potential for increased efficiency, productivity, and profit if the public and private sectors could collaborate in the provision of services. This effort would be conducive to a more congenial negotiating environment.

If the public agency is dealing with several taxi operators at one time, it should explore the most appropriate communication mechanism and implementation method. Methods include joint meetings, individual meetings with the agency serving as a broker, and buy-out or cooperative ventures. The most appropriate means depends on the future goals of each taxi business and their relationship with one another.

If negotiations should fail and result in legal proceedings, the public transit entity should be fully versed in the legal issues and precedents concerning unfair competition, what constitutes a mass transportation company, compensable damages, and the interpretation of UMTA Paratransit Policies.

REFERENCES

1. Abkowitz, Mark, Howard Slavin, Robert Waksman, Larry Englisher, and Nigel Wilson, TRansit Service Reliability, March 1978, Transportation Systems Center, Cambridge, MA, Report, No. SS-24-U.3-146.

2. Aerospace Corp., Feasibility Study of the Employment Center Bus Service Concept, August 1976. PB 259-941.

3. CACI, Inc., Pre-Demonstration Activities of the Westport Integrated Transit System, Interim Evaluation Report, July 1977, Report No. UMTA-MA-06-0049-77-7.

4. Cambridge Systematics, Inc., Feasibility Study of Shared Ride Auto Transit, September 1977, PB 276-539/AS.

5. Kirby, Ronald, "A Grid Fare Structure for Shared Taxi Services", 22 pp., Urban Institute WP 5050-2-7, June 1976.

6. Kirby, Ronald and Gerald Miller, "Some Promising Innovations in Taxicab Operations," 27 pp., Urban Instiute WP 5032-2-3, July 1975.

7. S. Lerman, M. Flusberg, W. Pecknold, R. Nestle, and N. Wilson, Method for Estimating Patronage of Demand-Responsive Systems, December 1977, Report No. DOT-TST-77-77.

8. Miller, Gerald, "Monitoring Plan for the St. Bernard Taxicab Feeder to Bus Project," 52 pp., Urban Institute WP-505-2-6, July 1976.

9. Miller, Gerald, "Taxicab Feeder Service to Bus Transit," 27 pp., Urban Institute WP 5050-2-8, August 1976.

10. Miller, Gerald and Melinda Green, "An Analysis of Commuter Van Experience," 34 pp., Urban Institute WP 505-2-2, February 1976.

11. Miller, Gerald and Melinda Green, "Guidelines for the Organization of Commuter Van Programs," 87 pp., Urban Institute WP 5050-2-5, February 1975.

12. Poage, James, The Norfolk Vanpool and Contract Hauler, Demonstration Project, Evaluation Plan, August 1977, Transportation Systems Center, Cambridge, MA, Report UMTA-MA-06-0049-77-6.

13. SYSTAN, Inc., The Rochester, New York Integrated Transit Demonstration: Suburb of Greece, Draft Final Report, December 1977.

14. SYSTAN, Inc., The Rochester, New York Integrated Transit Demonstration: Suburb of Irondequoit, Draft Final Report, January 1978.

CHAPTER 5

TRANSPORTATION SERVICES FOR SPECIAL USER GROUPS

Introduction

The term, special user groups, generally refers to those persons who, because of age, income, or disabilities, do not have use of an automobile, and are therefore dependent on public transportation or special arrangements to meet their mobility needs. Such arrangements may include taxis, specialized private providers, agency transportation services, or riding as passengers in private automobiles.

Included within the special user group definition are:

- Young -- persons with independent mobility needs but without access to an automobile except as a passenger.

- Old -- persons who have reached advanced years or retirement status, living on reduced incomes and possibly without access to an automobile except as a passenger.

- Poor -- persons whose incomes are under the poverty threshold and who therefore have minimal travel budgets.

- Handicapped -- disabled persons who require special assistance or special vehicles to travel.

In urban areas, these people look to public transit to meet their travel needs. The economic constraints on this population generally mean that they have no automobile because of the high costs of ownership and operation. Taxis, too, are normally too expensive for regular travel. If disabled, these individuals may face the separate problem of having physical difficulty using most forms of auto transportation. Even if the individuals are able to make use of automobile rides furnished by others, the degree to which they can rely upon such services being available when needed is still another factor limiting their independence. Also, agency provided transportation services, while tailored to client needs, are usually available only for particular trip purposes, such as medical visits or agency-sponsored programs.

Public transit's inability to be responsive to all the travel needs of the elderly and handicapped prompted several initiatives to improve transportation opportunities and services for those special users groups. One initiative was an amendment in early 1970 to the Urban Mass Transportation Act now known as Section 16. This amendment declared as national policy that elderly and handicapped are entitled to the same rights as other persons in utilizing mass transportation services and facilities. It stipulated that special efforts are to be made in the planning and design of these services and facilities to assure their availability and effective utilization. Subsequent to that legislation, UMTA issued guidelines and regulations prescribing acceptable planning and programming to meet these requirements. The Secretary of Transportation has also mandated the purchase of wheelchair accessible buses after September 1979. Most recently, HEW's Section 504 regulations require further efforts in this area.

The thrust of the demonstration projects covered in this chapter is to provide models of various approaches to the planning, design, implementation, and operation of special user group transportation. These models cover a range of service designs, institutional frameworks, funding arrangements and providers.

Three specific concepts which have emerged and are being demonstrated under varying site conditions are:

1) Social service agency transportation coordination. At issue is how best to provide transportation services to the medical and social service institutions that administer programs for the elderly and handicapped. Many of these institutions provide their own form of transportation services. Coordination of the many and disparate ongoing transportation services and funding mechanisms of these agencies into a unified and more effective centralized program seems to offer potential for eliminating redundancy and inefficiency without sacrificing the objectives and flexibility.

2) User-side subsidies. In this approach, users can purchase transportation vouchers or tokens at a price below their face value. Transportation providers accept these vouchers as payment for transportation services and then redeem them at face value from the public agency. The subsidy, then, is passed along to the provider only when a traveler is served, thus acting as an incentive

for the provider to offer attractive service rather than to take the subsidy for granted. In this kind of market, operators must present an efficient and competitive service in order to collect subsidy benefits.

3) Accessible fixed-route bus service. Little information is currently known about the impact of introducing wheelchair accessible buses into regular fixed-route transit service. Transit properties considering this action are faced with many unknowns in terms of routing, operational costs, service impacts and the level of handicapped use. Special accessible bus demonstrations and evaluations of larger local efforts to introduce accessible buses into regular route service should provide answers to many questions in this area.

The final major area of uncertainty being addressed by the demonstrations is the political and administrative fabric within which such services will be implemented and maintained. Here there are several major issues to be analyzed and understood. One issue is to determine the advantages and disadvantages of providing special services through the public (existing public transit operators) vs. the private (generally taxi) sector, or to consider combinations of these approaches. Questions of costs, reliability, and competition are all of key interest. Tied closely to these basic organizational uncertainties are questions of the appropriate level and type of funding, and the determination of user charges. It is generally agreed that lower fares are important to a disadvantaged clientele and there are a number of ways of accomplishing this if a subsidy is required.

The following sections describe in detail the concepts being tested. Most of these deal with only one aspect of a total approach to elderly and handicapped transportation, and are thus to some degree component demonstrations. Future directions will be to address more comprehensive approaches.

COORDINATION AND BROKERING

Overview

The provision of transportation to clients by social service agencies, particularly those funded by HEW, is an integral part of most programs. As the lack of transportation has been increasingly identified as a barrier to services, more funds are being devoted to client transportation. This is resulting in a proliferation of special transportation projects where, typically, each agency serves its own clients, with separate vehicles, staffs, facilities and budgets. Historically, there has been little coordination among agencies to avoid duplication, inefficiencies and fragmentation of service potential and resources. In addition, agency accounting procedures often make it impossible to clearly determine the amount of resources being spent on such transportation.

The requirements for UMTA grant recipients to plan for and provide service to the elderly and handicapped have increasingly brought local transportation planners and operators into contact with human service agencies who either fund, or actually provide specialized transportation for a wide range of client needs. Such "paratransit" services are only beginning to be recognized as part of the network of transportation services available in a community.

This category of projects is designed to demonstrate effective ways to improve transportation service for transit dependent target groups by coordinating and/or consolidating existing resources of human service agency programs and local public and private transportation providers.

A variety of approaches to this concept is being tested. These range from public transit operator provided service which pulls together agency funds for client transportation through contracts or purchase of service agreements, to pooling of equipment and drivers under a centralized dispatch system. The role that private non-profit organizations can play as providers of service and attractors of funds is being examined.

Social service agency coordination efforts can present an excellent opportunity for utilizing a broker type arrangement, particularly in larger urban areas where service areas could be too wide to be served effectively by one centralized provider. Institutional arrangements required to set up a broker function are being developed. Ultimately the coordinated/consolidated mechanism for specialized transportation will be those which can provide the most cost effective service to meet a wide variety of needs, while able to attract resources from ongoing UMTA programs as well as HEW funded programs.

Current Projects

The concept of coordinating transportation services for elderly and handicapped clients has been the prime focus of five Service and Methods demonstrations. One of these, in Mercer County, New Jersey, has not yet initiated service and consequently is not included in any significant detail in this discussion. Two others, in Mountain View, California, and Naugatuck Valley, Connecticut, have been completed and final reports are being prepared. The remaining two, in Portland, Oregon, and New York City, are still in progress.

The Mountain View and Naugatuck Valley demonstrations utilized a brokerage scheme to generate and match trip requests with a transportation provider. In Naugatuck Valley the brokering was accomplished by a Community Council while in Mountain View the broker was also the transportation provider.

Table 5-1 gives site and operational characteristics for the five demonstrations.

The following is a brief summary of each demonstration and some of the more significant findings and implications derived from each.

Naugatuck Valley Transit District Project

A multifaceted experimental demonstration with special emphasis on the handicapped and elderly was initiated in the Lower Naugatuck Valley of Connecticut, an area of 56 square miles, in January, 1973. The system has included limited fixed-route service, demand-responsive service, subscription service, and contract bus service (for social service agencies and other groups in the Valley). An automated fare computation system, which used credit cards and monthly billing to eliminate the need for cash payment, was operational until 1975. At present the fare is determined manually. The dispatching system currently in use is also a manual system based on sorting slips containing ride information into slots representing vehicle tours.

Fare subsidization of agency-sponsored handicapped and elderly citizens is facilitated by a computerized system which bills sponsoring agencies according to use of the service by their clients. Other concepts tested by the Valley Transit District (VTD) included new vehicle types and coordination of agencies requiring transport service.

TABLE 5-1. DEMONSTRATION SERVICE AND SITE DATA

Project Status	Valley Transit District Naugatuck, Conn. Demo Service Completed	Handicapped and Elderly Special Needs Transportation Program Portland, Oregon Operational	Community Services Cooperative, Mountain View, California Demo Service Completed	Experimental Transportation Service, New York City, New York Operational
Transit Service Area (sq. mi.)	56	89	NA	2.0
Target Population	12,000	22,138	328	9300
Target Population Density (per sq. mi.)	214	248	NA	4600
Eligibility Requirements				
Elderly	60 years and over	Transportation handicapped	Apartment resident	Over 60
Handicapped	Agency Certified	Transportation handicapped	Apartment resident	All
Alternate Modes				
Existing Transit	Very limited	Extensive	Limited	Extensive
Taxi	Limited	Yes	Yes	Yes
Demonstration Vehicle Fleet Size	17	15	1	10
Total Fleet Operations Hours/Weekday	120	98	8	70-80
Operating Hours				
Weekdays	6:00 AM 6:00 PM	7:00 AM 7:00 PM	7:00 AM 7:00 PM	8:00 AM 6:00 PM
Saturday	None	None	7:00 AM 3:30 PM	None
Sunday	Very limited	None	7:00 AM 3:30 PM	None

TABLE 5-1. DEMONSTRATION SERVICE AND SITE DATA (Cont'd)

	Naugatuck	Portland	Mountain View	New York City
Services				
Demand Responsive Short Notice	No	Yes	Yes	Not Encouraged
Advance Reservation	Yes	Yes	Yes	Yes
Subscription	Yes	Yes	NA	Yes
Group Charter	Yes	Yes	Yes	Yes
Fixed Route with Deviation	Yes	No	No	No
Fare Ranges - Demand Responsive	$.75 to $5.00	Agencies $3. Individuals $.50	$.40 to $3.00	Free $1.00 subs. work Donations Suggested
Subsidy Demand Responsive	Directly to Operator, and User-Side	Directly to Operator	None	Directly to Operator
Operator	Public	Public	Private	Private Non-profit
Service Restrictions and Important Features	Service area zoned. System also available to segments of general public	Service restricted to those unable to use regular fixed route bus.	Service provided by one van and broker/driver to an apartment community	Door through door service for those unable to use public transportation; self screening
Innovations	Automated fare collection with remote third party billing	Automated fare collection with remote third party billing	Testing of community broker concept	Rehabilitated ex-convicts and ex-addicts are drivers

During the entire demonstration, the Lower Naugatuck Valley Community Council (LNVCC) acted as a "broker" of VTD services, assisting agencies in obtaining VTD services for their clients and their activities, resolving service problems, etc. In addition, LNVCC has coordinated and pooled the transportation components of several HEW programs to provide the user-side subsidy for some VTD users.

Individual-user subsidies ended in October, 1977 when the demonstration funding ended. Other social service agency subsidies will terminate in June 1978. VTD is continuing to provide transportation service under state and local funding. However, there is concern on the part of the beneficiaries of the agency subsidies about the possibility of VTD becoming increasingly dependent on general population users to generate revenues and, consequently, reducing the level of service for the elderly and handicapped.

Project Results

Vehicle unreliability has been a major problem from demonstration inception to the present. This is due to the generally poor design of small buses coupled with the difficult terrain of the Valley.

The coordination of social service agency client trips and funding sources for these trips was a successful element of the demonstration. However, the inter-town fixed-route service was not heavily patronized due to the small demand for this type of trip and the competition from the two fixed route transit operators in the region. The demand-responsive and subscription trips proved more popular. A goal of the project was for the higher subscription fares for the general population helped to cross-subsidize the trips of the handicapped and elderly target population; however, subscription ridership and revenues did not reach the level necessary for cross-subsidization to occur.

Total ridership continued to increase throughout the demonstration with the 1977 monthly average (16,350) exceeding the 1974 monthly average (10,850) by approximately 50 percent. Contract service usually accounted for two-thirds or more of the ridership.

The continued existence of VTD, which was created to operate the demonstration, after demonstration funding ceased is considered an indication of the success of the project in effectively meeting local transportation needs. Sufficient support has been generated to subsidize (through state funding) a continuation of the services.

Several site characteristics are relevant to an assessment of the transferability of this demonstration's results to other areas:

- Conventional transit is relatively limited in the Valley.

- Although VTD has recently received PUC approval to provide service outside the Valley for health related trips and for certain subscription runs, for much of the project PUC regulations limited VTD's ability to provide all needed service to its target population, and restricted its revenue potential as well.

- VTD operating costs are lower than those which can be achieved in most locations due to a low driver wage rate ($3.20 per hour).

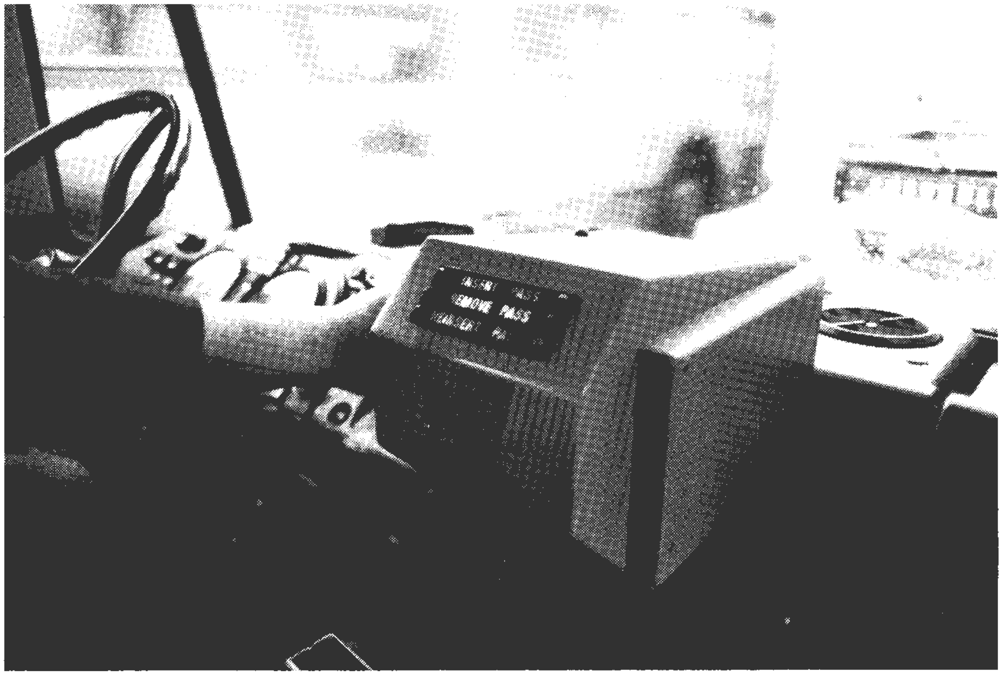
- VTD serves a large, relatively low-density area, thus limiting its vehicle productivity on most trips.

Portland Special Needs Transportation Program

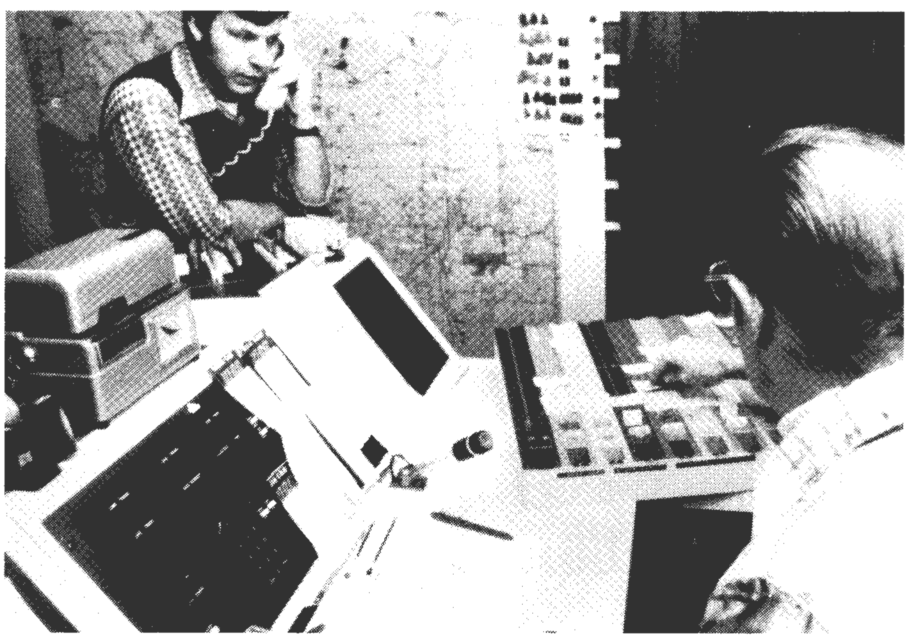
The Portland Special Needs Transportation demonstration project, the LIFT, provides curb-to-curb transportation services for elderly and handicapped persons who cannot use the regular transit systems and who do not have access to or cannot afford alternate means of private transportation. Service is provided by the Tri-Metropolitan Transportation District of Oregon (Tri-Met), the public transit agency. The LIFT provides demand-responsive bus service on a 48 hour advance reservation basis. The LIFT fleet of 15 Mercedes Benz diesel buses is specially equipped with wheelchair lifts, tiedowns, and a retractable lower step.

A central feature of the LIFT project is its emphasis on coordination of special transportation with public agencies and social service organizations which serve the transportation handicapped. This coordination is intended to eliminate duplication and lower the overall costs of special transportation services city-wide. Under the current arrangement, the LIFT serves as a central source of rides, and agencies contract with the LIFT for transportation for their clients. Agencies are billed by Tri-Met at a flat rate of $3.00 per trip for client trips. (Eligible riders not affiliated with a public agency pay Tri-Met 50 cents per trip.) Contract taxi service is provided for trips that create scheduling problems or at

Wheelchair Lift in Operation,
Portland, Oregon.



Automated Fare Identification Recorder to be used in Portland, Oregon project. Passengers will insert pass in slot for automated recording of fare.



Control Center, Portland, Oregon

times when LIFT bus service is at capacity. The 13(c) labor agreement currently limits the amount of taxi trips to $55,000/year, or less than 10% of all trips.

Project Results

Trip demand has grown steadily from 90 rides per service day in December, 1976, to about 325 trips per day in October of 1977. Although demand is still increasing, the rate of growth is tapering off and ridership will probably reach the original system design expectation of 850 trips per day. As of October, 1977, individual passenger (those not affiliated with an agency) trips amounted to about 40 percent of total trips. Sixteen percent of all LIFT trips were made by wheelchair passengers.

The coordination between Tri-Met and social service agencies is intended to provide improved service and reduced costs due to more efficient use of transit vehicles through increased group riding. The improved service is available to a disadvantaged market at a much lower cost to the user than alternative modes, such as taxis. For example, the actual cost to Tri-Met of a taxi trip is $5.70 on the average. This is still less than the LIFT cost of $7.40 per trip. The LIFT cost is high because demand is much less than estimated and vehicle utilization is low (about 3.0 passengers per vehicle hour). Most importantly, the amount of prearranged group trips (periodic or otherwise) that have been provided has been far below expectations. This is receiving more emphasis during the second half of the project.

From the on-board survey and follow-up interviews with riders, the following user impacts were reported:

- A substantial monetary savings -- as much as $5.00 per trip for general passengers who would have had to use taxis.
- Users feel that the LIFT is very convenient in terms of transporting them where they need to go.
- The LIFT has increased access to necessary goods and service for transportation handicapped individuals.

From agencies the following was reported:

- The LIFT has replaced some but not all of the agency transportation that was provided before.

- Reimbursement to Tri-Met for LIFT trips ($3.00 per trip) is less than they were paying for equivalent trips prior to the project.
- The LIFT is somewhat easier to schedule than the services that existed before the LIFT; however, it is not always easier to schedule than taxis.
- LIFT availability has not noticeably increased client usage of primary services.

<u>Experimental Transportation Service for Elderly and Disabled Residents of the Lower East Side of Manhattan</u>

This demonstration project provides a very high quality advance reservation, door-through-door transportation service to elderly and/or disabled residents in a 2 square mile area of the Lower East Side. One of the objectives of the project, operated by the Vera Institute of Justice, is to provide a centralized source of transportation services to meet the needs of agencies for transportation of their clients. Residents over 60 years of age or disabled are eligible to register for the service (EASYRIDE). Registration is accomplished by an individual through an agency or directly with the project. The registration process is self screening (i.e., the individual determines his own eligibility). The project operations, which consist of 10 fifteen-passenger vans (5 lift equipped), began pilot operations late in 1976 and gradually built up to full operations by the summer of 1977. Registrants can be taken anywhere within the entire area of New York City. No fare is charged except for subscription work trips ($1) but donations are suggested. A unique aspect of the operation is the hiring of rehabilitated ex-offenders and ex-addicts to drive the vans.

The project has received major funding from HEW, as well as UMTA, to determine impacts of mobility improvements on the quality of life and health care costs of the target population. In this connection Vera has obtained a very significant waiver from HEW to allow elderly persons on Medicare to receive transportation as a covered service (i.e., paid for by HEW Medicare). This is the only waiver which is solely related to transportation that HEW has granted to date anywhere in the country.

Project Results

The project operations have not achieved high vehicle productivity (2.26 passengers per vehicle hour as of June 1977). This has been attributed to a number of causes including the accommodation of trips to destinations far away from the Lower East Side, the time consumed in waiting or escorting clients into homes or facilities, and a delay in receiving radio communications equipment. The evaluation will provide specific information on the causes for low productivity. Preliminary data indicates that the human service agencies operating in the Lower East Side do not have transportation budgets, but rely on their clients to make their own way to the services. If this is found to be true for all local agencies there will be no existing agency transportation services to coordinate or consolidate and coordination aspects will be limited to serving various agency client trip requests in the most efficient manner.

Mountain View Community Broker Project

The Mountain View Community Broker demonstration project tested an innovative way of providing transportation and transportation-related services (i.e., information, scheduling) to a small target market of elderly and low-income people in Mountain View, California. Under the concept tested, a single individual with an office at a housing project for the low-income elderly worked directly with potential clients to plan and organize group rides to common destinations on a pre-scheduled basis. This process is a form of transportation brokerage. The broker, alternatively called a driver/broker, also drove the twelve-passenger van used in the demonstration.

The operating agency formed to register members who need transportation and arrange group travel was the Community Services Cooperative (CSC). Both standard taxi rides and trips in the CSC van were provided by the local operator, who leased the van to the project. The driver/broker was an employee of the taxi company.

The key issues in the demonstration concerned the brokerage model's workability, economic feasibility and acceptability to the client group. The project was intended to determine whether a driver/broker could aggregate demand and raise vehicle productivity to the point where the service could operate on a self-sustaining basis and still charge low fares.

Project Results

The following findings regarding the Broker concept were reported:

- Aggregating demand required a high level of contact with riders -- an average of seven personal contacts per vehicle trip.

- The most popular trip purposes were shopping (34 percent of all passenger-trips delivered), the nutrition program (23 percent), and commercial meals (11 percent).

- Analysis showed that a single driver/broker can deliver at most 800 hours of revenue time in a year due to his brokerage duties and necessary amount of vehicle deadheading.

- Revenues of $3,512 were about twelve percent of the estimated operating cost of $29,285. A total of 8776 trips were delivered during the year of operations. This brings the cost per passenger-trip to $3.34 and subsidy cost per passenger-trip to $2.95.

- The project provided a significant portion of the transportation used by the user-group. Between one-fourth and one-third of the people making a given type of trip (with the exception of medical trips) relied exclusively on the van service.

- Users were extremely enthusiastic about the service. They particularly liked the personalized nature of the service, the escort features, and the convenience it afforded. The existence of this transportation service provided a sense of security to users, even when they did not choose to use it.

- The CSC service had a positive impact on the social and emotional aspects of people's lives. The group riding made a large degree of social interaction possible and a large portion of the trips the broker organized were of a social and recreational nature.

- Private transit operators will probably not view the trip-planning and scheduling aspects of the Community Brokerage operation as something they would want to take on.

- Modifications to the Mountain View community broker model may have potential for increasing its revenue generating capacity. Specifically, it is possible that more money could be generated by integrating the transportation service with other primary services (such as food-buying services, legal services, etc.) for program clients.

Mercer County Agency Coordination Project

The purpose of the Mercer County demonstration project is to determine the extent to which the mobility of the handicapped and elderly can be improved by coordinating the transportation resources of various human service agencies, the public transit agency and private transportation providers. The operating agency for the project is TRADE (Transportation Resources to Aid the Disadvantaged and the Elderly) which will be a separate organization within the Mercer County Department of Human Services. Area human service agencies including some that are directly County controlled are participating in the project which will offer the following services in the first phase:

1) centralized dispatching
2) centralized purchasing and maintenance
3) centralized accountability and billing

The initial focus will be on the centralized dispatching function, with other services to be incrementally provided as the project matures. The project is in an early stage of development. Seven agencies with 21 vehicles have agreed to participate in the first phase. Initial operations on a centralized dispatching basis are not expected to begin until the Spring of 1978.

The second phase of the TRADE demonstration will be the consolidation phase. Under consolidation TRADE will take title to all participating agency vehicles as well as taking control of agency transportation funds. In this manner TRADE will assume responsibility for transportation operations for these agencies. Other agencies, however, may still participate under coordination arrangements or purchase service from TRADE if sufficient capacity is available.

Comparison of Findings Across Projects

This section compares and contrasts the findings from the coordination and brokering projects. Cooperation of social service agencies, fare collection, user registration, mobility provided, efficiencies in operation and cost of service are among the issues addressed in this section. Table 5-2 summarizes results from the four demonstrations discussed here.

Two projects (Portland and Naugatuck Valley) have achieved coordination of transportation services for social service agencies or their clients. A third demonstration project, in Mercer County, NJ, has not yet begun service but seven agencies with 23 vehicles have agreed to pool their vehicles as part of the first demonstration phase. In the Portland and Naugatuck projects, agency funding of client trips is an important revenue source. For the transit authority, contracts or agreements with social service agencies help defray the cost of providing specialized services. However, as will be discussed later in this section, public transit vehicles are not often the most cost effective means of providing service.

The cooperation and participation of nine of the ten major social service agencies in the Portland area and the extensive participation by agencies in the Naugatuck Valley would seem to indicate that they are benefitting from the coordinated approach. However, in neither case have the precise benefits nor the amount of former transportation resources relinquished been identified. This information will become available during the next year.

Likewise, it is still too early to assess whether there has, in fact, been any major impact on the cost of providing agency client transportation. Even though some agencies might be paying less, the aggregate cost of providing coordinated transportation for the agencies in a region might not be any less than before. More information should become available on this element during the next year.

The agreements established in Portland, Naugatuck Valley, and Mercer County have demonstrated that there are no insurmountable barriers which inhibit coordination of transportation for clients of social service agencies. Impediments have been largely existing practices and institutional arrangements rather than legislative or regulatory obstacles.

In Portland and the Naugatuck Valley, an innovative fare computing and third party billing scheme based on the use of credit cards issued to agency clients was part of the demonstration. This system was used in the Naugatuck area to calculate the agency share of payments for client trips and as the basis for sending monthly bills. Useful

TABLE 5-2. DEMONSTRATION RESULTS

	Naugatuck	Portland	Mountain View	New York City
I. LEVEL OF SERVICE				
Vehicle Coverage:				
Sq. Mi./Vehicle	3.5	5.9	NA	0.2
Eligible Users/Vehicle	412	1475	328	930
Average Ride Time (min.)	12	22	NA	NA
Average Trip Length (mi.)	2.6	3.7	3.6	NA
II. REGISTRATION				
Number of Persons Registered	3296	4462	112	1300
Percent of Registered Who Are Elderly/ Handicapped	59	100	100	100
Percent of Eligible Persons Registered	16.2	NA	34.1	14
Percent of Registered Using System at Least Once	75	NA	36.6	NA
III. PROFILE OF USERS				
Percent Who Own and/or Drive Automobile				
Users	8	0	18	0
Non-Users	62	NA	55	NA
Percent Below $5,000 Annual Income				
Users	76	NA	NA	75
Non-Users	51	NA	NA	NA
IV. RIDERSHIP PATTERNS				
Average Weekly Ridership	2600	1097	217	650
Percent of Users Using System at Least Once a Week	33	NA	56	34
Percent of Trips That Would Not Be Made Without Special Service	42	23	NA	19
V. ECONOMICS				
Average Passenger Demands/Square Mile/ Weekday	89	3.8	NA	65
Passenger Trips/Vehicle Hour	6.8	3.0	12.2	1.7
Operating Cost/Vehicle Hour (less labor)	$7.80	NA	NA	NA
Total Operating Cost/Vehicle Hour	$11.57	$22.48	$43.93	NA
Cost Per Passenger Trip	$1.71	$7.40	$3.34	NA
Operating Ratio (oper. cost/rev.)	2.0	3.3	8.35	NA

operational data that was recorded by the automated fare computation devices would be difficult to collect by other means. These devices are not yet operational in Portland. It seems as though the most appropriate application of this system would be in large projects with many different agencies participating and several different fares and fare splitting arrangements negotiated. Operational record keeping and data collection would also be considerably enhanced by such a system. However, the efficiency of this approach is adversely affected by users' forgetting to carry their credit card and requiring the driver to manually enter the necessary information.

All the demonstration projects required a registration process in order to use the transportation service. The percent of eligible persons registered is an often-used statistic in discussing project operations. However, this is an inappropriate measure if used as one of the criteria to judge the project's success. In the first place, the identification of the eligible population is not always clear cut, especially where the eligibility is dependent on an inability to use certain other modes. Secondly, eligibility does not indicate a need for the service. Presumably, those persons without a reasonable need for the service would not take the trouble to register. These individuals, therefore, should not be considered as part of the "target market" even though they are part of the eligible population. Nevertheless, the percent of eligibles (to the extent they can be determined) registered can be useful in assisting planners in establishing the supply of transportation necessary to provide adequate service capacity.

In the demonstration projects, the number of eligible persons registering for transportation service ranged from about one-seventh to one-third of the total eligible population. The highest participation was achieved in the Mountain View project, where the broker was able to make personal contacts with the residents of the two apartment complexes which comprised the bulk of the target market. It would be expected that the highest registration would result from this type of outreach.

The projects exhibit considerable variation in regards to eligibility requirements and ease of certification. some projects permit telephone registration while others require a letter from a doctor or agency. some accept all elderly and handicapped while others offer service only to those with a mobility problem and no access to an automobile and an inability to use public transportation. These factors, plus differences in the amount of advertising and marketing conducted, have an impact on the number of individuals registering for project sevice. In spite of these varying circumstances, the demonstrations exhibited a reasonably narrow spread (14 to 34 percent) of eligible population registration percentages.

Data on system usage are still limited but evidence from other sources seems to indicate that frequent users comprise a small fraction of the number of persons registered. Analysis of data from current demonstration projects during the next year will shed more light on frequency of use by the target population and the reasons for use or non-use.

The coordination or brokering demonstration projects have had a positive impact on the mobility of the target population. Upwards of 20 percent of the trips taken on any of these projects were reportedly made possible by the service. The very high value of over 40 percent in Naugatuck Valley is probably due to the fact that the contract service, which form the bulk of the system's ridership, have been operated in some form for over ten years and have built up a large clientele which does not perceive other modes as available for these trips. A value of 20 to 30 percent is more typical in the short run. This is an indication that these projects are providing a valuable commodity, transportation, which permits access to needed services and enhances the quality of life of its users.

Advanced reservation and subscription trips are the backbone of special handicapped and elderly coordinated service demonstrations. All projects will, however, accept short notice trip requests if they can be reasonably accommodated. This type of trip is definitely not encouraged, and some operators have established a trip request priority policy which can be enforced whenever the capacity of the system is being strained by the demand. In all four projects there are normally sufficient vehicles available to accommodate the demand quite easily and trips are seldom, if ever, refused. However, some trips may be shifted slightly to a time period wherein they may be better handled.

The operational efficiency of special transportation services are difficult to evaluate because of the many variables that impact a system's performance. It is important to recognize that operators have to make tradeoffs between operational efficiency and service quality. For example, offering door through door service as in the NYC project, or wheelchair lift service results in longer dwell times at each stop, thus reducing the number of passengers that can be served in a given period of time. On the other hand, the requirement of advance reservations permits more efficient scheduling but reduces the flexibility available to the user.

In light of these tradeoffs and the many other factors that constrain a system's performance, the achievable performance of a system cannot be precisely determined. However, factors influencing a system's performance can be identified and it is important to consider them in the evaluation.

Service area size and density of the target market appear to have the greatest influence on the efficiency of vehicle utilization. Other influencing factors include the accuracy of the original estimates of the number of vehicles required to meet the demand, the ability of the control room staff to organize group trips and schedule efficient vehicle tours, the average speed of the vehicles, the geographic and temporal pattern of trip demands, the type of trips most commonly served, weather conditions, geographic barriers (such as rivers), and the trip rates and mobility limitations of the target population.

As would be expected because of the differences in operating constraints, the efficiencies of the four active or completed projects exhibit a very large variation. Vehicle utilization, in terms of passengers per vehicle hour, range from 2.3 to 12.2. The Portland value of about 3 passengers per vehicle hour seems low compared to most demand-responsive systems; however, it must be evaluated considering its low proportion of scheduled group trips, and the low-demand density due to dispersal of the registered users over a large area (89 sq. miles). The Naugatuck figure of 6.8 is quite good considering size of the area covered. This is largely due to more group riding, plus the fact that the service is also used by some of the general public which increases the demand density. The Mountain View productivity is naturally the highest due to the type of trips developed (i.e., group trips are not usually scheduled unless there is a reasonable demand for them) and the concentrated geographic area of the clientele served. The New York City productivity of 2.3 seems surprisingly low; however, though the target market area is only 2 square miles, the service will take registrants anyplace within the boroughs of New York City. The low registration for this project is another contributing factor; in addition, the door-through-door service means vehicles often dwell longer at pick-up and drop-off points than for door-to-door service.

A correlary to efficiency is cost of service. Some of the factors contributing to the cost of service in addition to the efficiency of vehicle scheduling include the wages of the drivers (union drivers are significantly more expensive than non-union drivers) and control room staff and the amount of effort spent on registration, marketing the service, and other administrative matters. The latter functions are typically greater for elderly and handicapped services because of extensive registration procedures and marketing efforts generally pursued through personal contacts with social service agencies, senior citizen clubs and similar organizations.

With a large area, lower than anticipated demand and union wage scales to contend with, the Portland cost per passenger trip by minibus is $7.42. The trips that are diverted to taxis cost an average of $5.69, and the distances are generally longer than the bus trips. As ridership continues to increase the cost per trip should decrease. Nevertheless, the Portland project goal of a $3 per passenger trip cost is not likely to be attained. The low cost per trip in Naugatuck ($1.71) reflects higher vehicle productivity and a much lower wage rate for the transit employees. The transit system was created to operate the demonstration and consequently did not have a history of progressively higher union wage demands as found in other areas. At first glance the Mountain View cost of $3.34 per passenger seems high in terms of the average number of passengers per trip. However, much of the cost of the service is due to the large proportion of time spent in contacting the eligible population and trying to develop group trips. The total system cost per hour the vehicle was in operation was $43.93, which included administrative and project development costs. Preliminary data from the New York City project indicates a cost per trip of about $8, reflecting high administrative costs and the low productivity of 2.3 passengers per vehicle hour.

In general, the social service agencies participating in the demonstrations of coordinated service are paying much less than the actual cost per trip. In Portland, agencies are paying $3 for trips which, on the average, cost Tri-Met over $7, or taxis over $5 to provide. In the Naugatuck Valley, however, agencies are billed at $14 per vehicle hour for service, which is very close to the full operating cost. The full cost per trip in Naugatuck is probably lower than that which could be provided by any other means, a situation which is clearly not the case in Portland. The low cost, together with the specialized services offered, in the Naugatuck area are the major reasons why the service has been continued under state funding after the demonstration funding ended.

The operating costs of the Mountain View Community Broker project were intended to be covered by revenues. This did not happen because, as discussed above, the marketing and scheduling activities required too much of the broker/driver's time. This is a continuing task as new trips must be developed to increase the ridership. In order to keep the operating cost per trip to a minimum, the number of trips should be maximized. Unfortunately, a single broker/driver cannot do both. If a large amount of time is spent in the brokering effort, there is insufficient driving time available to provide trips at a price low enough to attract the needed riders. Hiring more staff only increases the revenues required to break even. For these reasons and from all evidence available from non-work trip oriented brokerage efforts to date, it seems doubtful that a similar service could be self-sustaining from the revenues generated, especially when fares are set at levels that the target market can afford.

Social service agency transportation coordination, on the other hand, does seem to offer potential for reducing the cost of providing needed transportation for the handicapped and elderly. Pooling of vehicles, dispatching, and maintenance should result in a lower cost per trip than that of several agencies operating completely independent services. Grouping of trips, possible because of the centralized dispatching, should also be a means of achieving improved efficiency. However, this potential may be severely reduced or eliminated if high wage rates must be paid to the operating employees or if a substantial operating staff is required. The Mercer County demonstration, to begin operations during FY78, will be a good test of coordinated service which makes use of agency vehicles rather than vehicles provided by a public transit operator.

USER-SIDE SUBSIDIES

Overview

Subsidies for public transportation have traditionally been provider-side subsidies. These subsidies are made available directly to the transportation provider for offering certain specified services at fares which produce insufficient total revenues to cover the provider's costs. The user-side subsidy offers an alternative method of subsidization for transportation services. This subsidy scheme has been focused on specific "target group" users such as the elderly and handicapped who pay a reduced fare for transportation services. The provider accepts tickets or vouchers (or any mechanism that can be used to provide evidence that trips have been made) and redeems them from the subsidizing agency for a value agreed upon in advance. The user-side subsidy has the effect of subsidizing the provider only for rides taken, not just for operating the service. This method provides an incentive to the provider to offer an attractive service in order to increase his ridership. This is especially evident in an area where more than one provider is operating and no exclusive franchises are granted. User-side subsidies have primarily been employed with shared-ride taxi service although use on fixed-route bus systems, both public and private, will be tested in the future.

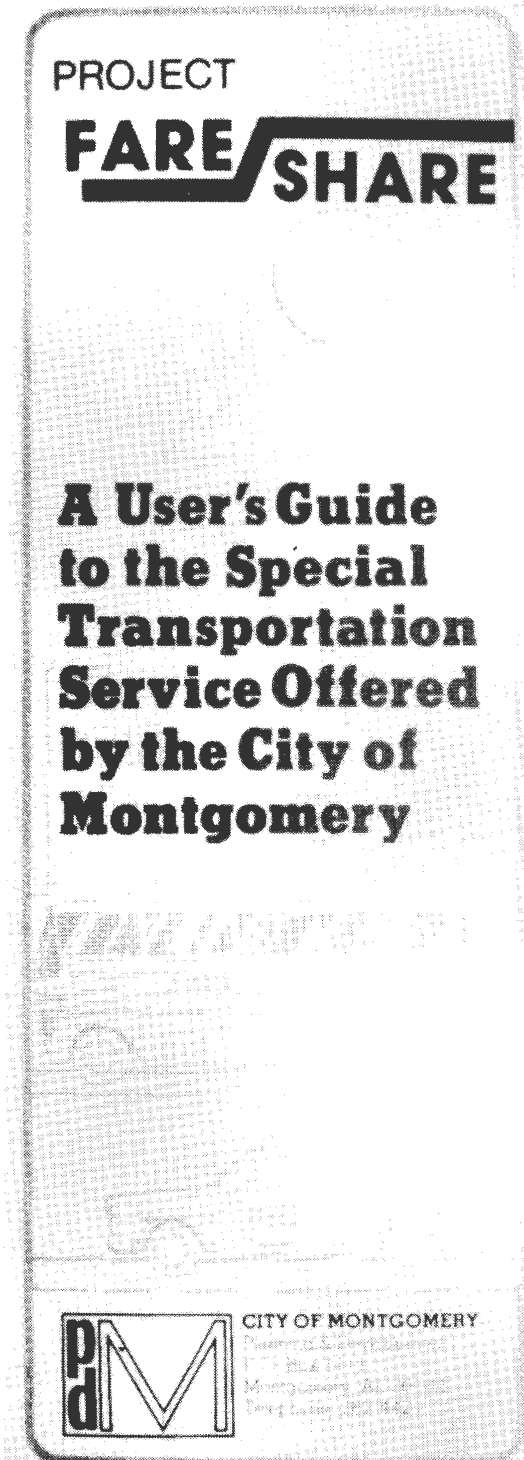
By incorporating a reduced fare component, the user-side subsidy also serves as an incentive to the user. The user can afford to make trips that were not possible due to their costliness.

Presently, there are four user-side subsidy projects in various stages of operation. Thus far this subsidy technique has proven to be effective in providing service to target groups and has been generally well received by providers.

Current Projects

User-side subsidy projects are being tested by the Service and Methods Demonstration Program at four sites: Danville, Illinois; Montgomery, Alabama; Kinston, North Carolina; and Lawrence, Massachusetts. Demonstration services are currently in operation in Montgomery, Kinston and Danville and are in the planning phases in Lawrence. Phase I of the project in Danville involved the application of the user-side subsidy to taxi services; phase II, which extends the use of the subsidy to include fixed-route transit service, began operation in November 1977.

The design of the user-side subsidy demonstration series attempts to test the concept in a variety of conditions, and in slightly different versions in order to bring out important implementation differences that can only be determined under real-life conditions. The discussions to follow will describe how the pre-implementation environment varies across project sites, and how and in which form project innovations, operations and


PROJECT

FARE/SHARE

A User's Guide to the Special Transportation Service Offered by the City of Montgomery

CITY OF MONTGOMERY

Brochure Describing Use of the Special
Transportation Service, Montgomery, Alabama

administrative systems evolved. The presentation concludes with a discussion of results, to the extent they are available from each site, in the following four areas: project impact on travel demand and user mobility; project impact on the level of service and productivity of service supply; administrative feasibility and cost of the concept; and impacts on social service agencies.

Comparing Sociodemographic Profiles

With regard to sociodemographic characteristics, the four sites are a mixture of similarities and contrasts. As shown in Table 5-3, Montgomery has the largest population; Lawrence is about 1/2 the size of Montgomery, Danville about 1/3 as large, and Kinston, the smallest, about 1/5 the size of Montgomery. The population densities of all except Lawrence are virtually equivalent. Lawrence is a very compact city, typical of old cities in the industrial northeast; it has roughly 3 times the population density of the other sites. Also typical of cities in the American Northeast, Lawrence has experienced the greatest decline in population over the past decade. The 10.1% population decline for Kinston between 1960 and 1970 is a deceptive indication of its growth and vitality. Recent data shows a considerable growth since 1970 and in fact total population now exceeds the 1960 figure.

The sites differ sociodemographically in two obvious ways. According to census information, the two southern sites appear to have a much smaller proportion of elderly citizens than the northeastern and midwestern sites. The percentage of elderly in the population is approximately 50% higher in Lawrence and Danville than it is in Kinston and Montgomery. None of the project sites differ substantially with regard to the percentage of eligible handicapped persons; thus Lawrence and Danville have higher percentages of eligibles in the population than the other sites.

The other major factor on which the sites differ is family income. Here again Lawrence and Danville differ from the two southern sites. Median family income is roughly equivalent in Danville and Lawrence, though each is about $1000 below the average for urbanized areas. Income in Montgomery is approximately 11% lower and in Kinston is about 27% less than in Lawrence and Danville. Income differences may be important in viewing variations in project use across sites and in transferring results to other sites, since the amount of an individual's travel has been shown to be strongly correlated with disposable income.

TABLE 5-3

CHARACTERISTICS OF PROJECT SITES

	Danville IL	Montgomery AL	Kinston NC	Lawrence MA
1970 Population, City	42,570	133,386	22,309	66,915
Growth Rate (%change in population, 1960-1970)	1.7%	-.7%	-10.1%	-5.7%
Area (square miles)	12.9	46.4	6.08	6.8
Population Density (persons per square mile)	3,300	2,875	3,785	9,840
Persons 65 Years of Age and Over (percent)	5,530 (13.0%)	12,400 (9.3%)	2,190 (9.8%)	9,970 (14.9%)
Total Eligible Population (percent)	7,430 (17.4%)	20,990 (15.7%)	2,860 (12.8%)	13,320 (19.9%)
Median Family Income (1970)	$9,658	$8,462	$6,913	$9,442
Auto Ownership (% households with one or more autos)	80.4%	78.5%	77.5%	81.1%

Pre-project Transportation

Before implementation of the project, each of the sites possessed a relatively extensive taxi industry. In addition, Montgomery and Lawrence had bus systems available for public transportation. Special transportation services were also offered by social service agencies at each of the four sites. A profile of the various prior transportation services is illustrated in Table 5-4.

The fixed-route transit service in Lawrence is provided by a private operator while in Montgomery the system is publicly owned but operated under contract by a private management company. While elderly and handicapped persons were offered discount fare privileges on transit in both areas before the project, a further discount will be provided through the subsidy program. The elderly and handicapped fare in Montgomery is currently 15¢ off peak; the fare in Lawrence for elderly and handicapped is currently 15¢ at all times of day. Both systems carry large numbers of elderly travelers. Neither system offers evening service, nor do they provide service on Sundays. Headways in Lawrence are 60 minutes or longer, while in Montgomery headways range from 20 minutes to one hour.

A considerable portion of the target population at each site is provided transportation through the resources of social service agencies. In Kinston, transportation services are provided by four agencies, serving about 2400 monthly trips for a variety of purposes. Approximately 20% of the trips are non-agency related. The agencies provide services through a fleet of 12 vehicles augmented by volunteers. In some cases clients are provided reimbursement of taxi fares. In Danville, elleven agencies, operating a combined fleet of 11 vehicles, provide approximately 6000 monthly person trips to elderly and handicapped citizens in that area. In Montgomery an estimated 3000 persons per month receive transportation services from agencies. Eight agencies provide service with a fleet of 29 vehicles. As yet the volume of trips made through specialized services in Lawerence is unknown, although 7 agencies provide these services using a combined fleet of 9 vehicles and volunteer services.

Each of the project cities has a substantial taxi industry which is being used to provide project services. In terms of fleet size and coverage characteristics, the southern cities lead the group; there are almost twice as many vehicles per capita in Kinston as in Lawrence, and almost three times as many in Kinston as in Danville.

TABLE 5-4. PRE-PROJECT TRANSPORTATION SERVICE

	Danville, IL	Montgomery, AL	Kinston, NC	Lawrence, MA
PUBLIC TRANSIT				
# Vehicles	None	31	None	7
# Routes		16		6
Operating Hours		5:15am/7:50pm		5:40am/5:40pm
Operating Week		Mon.-Sat.		Mon.-Sat.
Median Headway		1/2 hour peak 1 hour off-peak		1 hour peak, 2 hour off-peak
Fares		30¢ Regular Pass. 15¢ Elderly and Handicapped in off-peak		30¢ Regular Pass. 15¢ Elderly
TAXI				
# Firms	3/2*	16	8	9
# Vehicles	30	168	54	61
Fare Structure:	4 zones: $.75 1st zone $1.25 2nd zone $1.50 3rd zone $1.75 4th zone	Mileage System $.85 1st 1/2 mi. $.25 each add. 1/2 mi.	4 zones: $1.00 1st zone $.25 each add. zone	2 zones: $1.25 1st zone $1.50 2nd zone

*After April 23, 1976.

TABLE 5-4. PRE-PROJECT TRANSPORTATION SERVICE (CONTINUED)

	Danville, IL	Montgomery, AL	Kinston, NC	Lawrence, MA
TAXI (CONTINUED)				
Group Ride	$.15 extra	$.25 extra	$.10 extra	$.25 extra
Shared Ride	Yes	No	No	No
Average Revenue per Ride	$1.23/$.137*	$1.65	$1.25	$1.50
Coverage				
persons per licensed cab	1550**	790	410	1100
square miles per licensed cab	0.43**	0.27	0.11	0.11
SOCIAL SERVICE AGENCY PROGRAMS				
# Agencies providing Transportation Service	11	8	4	7
# Vehicles	11 total (1 w/ lift)	29 total (6 w/ lift)	12 total (1 w/ lift)	9 vans total (1 w/ lift)
Monthly Ridership	6000	3000	2400	NA

*After fare and subsidy rate change on January 1, 1977.

**The 30 cabs serve the same areas outside Danville for a total service area of 15.9 square miles and 46,500 people.

With regard to taxi fare, computation of fare from a network of zones is the most common method among the project sites. Montgomery is the exception, where the operators derive the fare from a mileage formula. Pre-project fare levels for the four sites, as measured by the "average" fare, varies from a low of $1.23 in Danville to a high $1.65 in Montgomery. Danville was the only site where a ride-sharing ordinance existed in the taxi regulatory code prior to the demonstrations. Shared riding was implemented in Danville during the energy crisis period in 1974, and has been an effective service policy since its initiation -- perhaps owing to the limited number of taxicabs per capita and the zone fare system. The implementation of shared-ride service was a demonstration requirement, but was expected to occur without great difficulty at the sites where zone fare systems were used. In Montgomery, where the fare was based on a mileage formula, implementation was more difficult.

Comparison of Project Designs

The user-side subsidy concept was implemented in broadly similar design at each of the four sites, but with some significant variations. A summary of innovations is presented in Table 5-5. In all four sites (with the exception of Danville Phase II) eligibility is restricted to the handicapped and elderly and registration is required before project use. The Montgomery, Kinston, and Lawrence experiments were designed to produce a subsidy discount of 50% of the regular taxicab fare. A 50% subsidy was also adopted in Danville as of January 1, 1977, but in the prior period the subsidy was approximately 73% of the normal fare. During this period, the average fare per project user in Danville was $1.33 which, combined with the 73% subsidy, produced an average user cost of $.35. This was much lower than the equivalent estimated user cost at the other sites, which ranged from $.63 in Kinston to $.83 in Montgomery. After the rate of subsidy in Danville was decreased, the average user cost per trip increased to $.73.

All sites restrict the dollar amount of discountable taxi fares which may be accumulated by a project user in a single month. This restriction was adopted to control potentially high consumption of project services by particular persons and discouraging use for such purposes as work trip travel, in order to conserve project resources. Usage limitations only apply to taxicab travel. Montgomery, at $30, is the only one of the four sites where this monthly limit is greater than $20. Translating this budget into actual taxicab rides using the average fare at each of the sites, travellers in Danville and Kinston may take as many

TABLE 5-5

SUMMARY OF INNOVATIONS

	Danville IL	Montgomery AL	Kinston NC	Lawrence MA
TAXI				
Fare Discount (subsidy)	73%/50%*	50%	50%	50%
User Cost, Average Trip	$.35/$.73*	$.83	$.63	$.75
Monthly Budget Limit on Users	$20	$30	$20	$20
(ride equivalent)	16	18	16	12
Subsidy Mechanism	Vouchers	Vouchers	Tickets	Tickets
Other Innovations	Shared Ride	Shared Ride & Fare System	Shared Ride	Shared Ride
FIXED-ROUTE TRANSIT				
Fare	$1.20	$.15	N/A	$.25
Amount of Subsidy	.80	.15		.24
User Share	.40	0		None
Budget Limit	None	None		None
Subsidy Mechanism	Tickets	Tickets		Tickets

*After fare and subsidy rate change on January 1, 1977.

as 16 discounted rides per month, while travelers in Lawrence will be limited to 12, and those in Montgomery may take 18.

Another important variation in project design is the method of subsidy transaction. There are two principal methods being tested, tickets and vouchers. Danville and Montgomery are testing the voucher system. With vouchers the project rider presents his ID card at the time of the trip to qualify for the discount. The driver completes a standard form which contains the user's name, information about the trip, and the fare and which the user must sign. The user pays the discounted portion of the fare at the time of the ride, and the voucher is subsequently submitted to the project for reimbursement of the balance.

The essential differences between the ticket and voucher systems are that with tickets there is no money exchange involved at the time of the ride and users of tickets must pre-purchase them prior to using the project service. In Kinston, tickets are sold one day per week at each of five community sites and daily at the City Hall. In Lawrence, only one downtown sales office will be used but tickets may also be purchased by mail order. Tickets are purchased at the discounted fraction of their face value. In order to keep track of the levels of individual use, taxi drivers maintain a record of ticket transactions, vis-a-vis entry of ride information in a special log which must accompany the tickets returned for reimbursement. Each system has advantages and disadvantages. The superiority of either of the two methods, in terms of the relative costs and benefits, is an important question that the experiments will hope to answer.

Shared ride service by taxi is a fundamental element in project design at each site, although as mentioned earlier, Danville had implemented a shared-ride policy prior to the demonstration. In Kinston and Lawrence, an ordinance change was introduced mandating shared riding for all taxicab trips, project or otherwise. In Montgomery only project trips must be organized on a shared-ride basis, all other taxicab trips may be exclusive ride.

In order to implement shared riding in Montgomery, the only site without a zone fare system, a new and highly-articulated zonal fare network was developed for project rides, although the system is optionally available for fare calculation on all city taxi trips. The zonal system was designed to replicate as nearly as possible the existing fare structure based on 1/2 mile increments, and as such consisted of a grid of 400 one-half mile squares covering the entire city. The fare is calculated by summing the number of grid boundaries traversed from origin to destination.

In both Lawrence and Montgomery, the user-side subsidy is to be applied to use of the public transit system as well as taxis. There are some differences in the methods to be used at these two sites. In Montgomery, elderly and handicapped are already eligible for a 50% discount off-peak. Under the project, the user-subsidy will cover the remaining 50% or 15¢, reducing fares to zero in off-peak hours. No discount is offered during peak periods. In Lawrence, the fare for senior citizens is currently 15¢ in all time periods. During the project, Lawrence bus ticket books will cost 25¢ for 25 tickets. This 1¢ charge has been established in an attempt to remove the stigma of a welfare program for users. However, the difference between a zero and one cent fare is not likely to have any effect on the number of bus rides taken.

While it has been previously indicated that Danville was not one of the project sites where fixed-route transit was an option to subsidy users, a second two-year phase of the Danville demonstration extends the application of the user-subsidy concept to transit as a new mode. Fixed-route transit had existed in Danville as recently as 1970. The private operator discontinued service at that time for reasons of unprofitability, although 60,000 passengers rode the system per month and two of the routes still paid for themselves. These facts have led the City of Danville to believe that a signifcant market still existed for fixed-route transit, wherein they applied for State and Federal subsidy assistance to reintroduce a fixed-route system.

Phase II of the project is designed to test whether the user-side subsidy concept, already successful in its application to taxis, might be an effective way to initiate and maintain a fixed-route transit service instead of the provider-side subsidy methods normally employed. Contract providers, selected through a competitive bidding process which will be repeated every four months, will be used to provide the service. Contractors must detail and deliver service according to a schedule of routes, frequencies, and fare levels which they determine from the quoted subsidy-fare ratio and expected ridership levels. The bidders are encouraged to propose service changes at each new bidding period in order to tailor the service to meet changing demand. The City must approve any changes in service and may also negotiate the fare or subsidy ratio if profits are excessive. In order to allow ridership time to grow, the oprators will be guaranteed their costs during the first two four-month periods.

Unlike the earlier RTR project, all transit rides will be subsidized rather than just those of the elderly and handicapped. Riders will prepurchase tickets at the face value of $.40. However, when these tickets are turned in to the city by the provider they will be matched on a 2:1 subsidy ratio so that the provider receives $1.20 for each rider carried. The elderly and handicapped as well as youth under 18, will be permitted to ride the fixed-route system at half-fare. Registered RTR users can continue to obtain a 50% subsidy on taxicab trips. It will be interesting to compare ridership levels on the bus and taxi modes across the three projects where both bus and taxi fare subsidies are provided.

Project Implementation

User-side subsidy demonstration projects have been implemented in Danville and Kinston without difficulty or incident; Montgomery had problems which will be explained later. Program marketing and user registration plans involved similar methods at all three active sites. The sites have promoted the project through advertising on television and radio, and in newspapers in the period immediately preceeding and during the first month of operation. Social service agencies were also used as a resource to promote the project, and in some instances to participate in registration.

Similar methods and guidelines were also employed in the registration of users. Eligibility was granted all persons 65 years of age and over, or under 65 and meeting disability criteria contained in either the San Francisco Bay Area Task Force on Handicapped Definitions, or equivalent HEW standards. In Kinston and Montgomery, participants were required to travel in person to a registration site for certification. In Danville, individuals were also registered over the telephone. Lawrence has no plans for telephone registration. As part of the registration process at all four sites, individuals were interviewed and issued a numbered project identification card. The Montgomery card bears a picture, as will the Lawrence card. For persons whose eligibility under the handicapped criteria was not obvious, a one-page form was submitted to the individual's doctor for verification. During the first month of registration in Montgomery and Kinston, registration sites were set up throughout the community. Thereafter, in Kinston, a rotating schedule or registration sites has continued, but in Montgomery registration was restricted to the project office in the City Hall. In Lawrence, as in Danville, only one registration site will be maintained throughout the project.

The Montgomery project has been beset by difficulties from beginning of the planning activities through the initial phases of implementation. Problems began in February 1977 when the incumbent mayor, who had been a strong proponent of the project, and around whose leadership various project innovations had been planned, resigned from office. His successor was less interested in the project, and, as a result, important lines of coordination with the taxi industry and the public along with planned changes in the taxi ordinance did not materialize. Also, implementation of the zone fare system combined with the various project paperwork activities constituted a significant departure from the status quo for most taxi operators, and seriously diminished their interest in participating. Only 3 of 16 taxi operators in Montgomery are actually carrying project rides (in contrast to 6 of 8 in Kinston, and all 3 in Danville). Even with only three participating companies, the project has not gone smoothly. The taxi operators have complained about the equity of the fare structure; the project staff has been disturbed about the amount of incorrect fare computation, submission of erroneous or incomplete vouchers, and falsification of vouchers; and the eligible customers have complained about being refused service by the taxi companies.

Montgomery is the largest demonstration site and the most complicated in terms of the number of innovations introduced. The problems experienced during implementation and early operation of this taxi subsidy project contrast with the smooth performance of other sites. It is too early to tell whether the difficulties experienced in Montgomery are due to the complexity of the changes required to operate the demonstration or due to peculiar local conditions. Further study and careful examination of the data from all projects is planned during the demonstration period with the aim of resolving this critical issue.

Results

Impacts on Demand and User Mobility

As previously discussed under the coordination/brokering project results, the amount of registration of the eligible population is an interesting and in some ways useful statistic. However, it is not valid to use this value as a measure of the success of the demonstration since eligibility does not necessarily correlate with need. Those with a definite need for the service are the true target population but in most instances this figure will not be known either before or after the demonstration. Nevertheless, as the knowledge of the percent of eligibles registered for these projects may help others in planning similar systems, a discussion of this subject is appropriate.

In Danville, after an initial surge of registrations, a relatively steady rate has been sustained throughout the project, as shown in Figure 5-1. By June 1977, the 19th month of project operation, 3260, or 45% of the estimated eligible population of 7430 had signed up for the project. The level of registrations in Montgomery and Kinston fall short of Danville. If Montgomery and Kinston continue their current rate of registration, by the end of the demonstration period only 20 to 30 percent of the eligible population would have registered. However, there are several factors that must be used to qualify these projections and in making appraisals based on existing trends.

In Kinston, a rotating schedule of registration locations and hours is followed. This procedure may not be well understood or convenient for a large segment of the population. Actual reasons for non-participation will be learned when a survey of non-registrants is conducted.

Montgomery's registration profile must be qualified in two ways. One element is the lack of participation by the black taxi firms. It appears that taxi use follows racially segregated lines in Montgomery, and 33% of the City's population is black. If these potential users cannot expect to acquire service, the appeal of registration may be limited. A second element, which should increase registrations, is the upcoming implementation of the bus discount program. Persons seeking discount privileges on transit will also need to register for the project and show an ID card when riding. There has recently been a detectable upsurge in registrations apparently in anticipation of the bus program still months away. As in Kinston, a factual accounting of the reasons for non-participation will not be possible until a survey of non-registrants is undertaken.

Of the 4200 eligible persons in Danville who did not register for the subsidy program, a survey showed that the

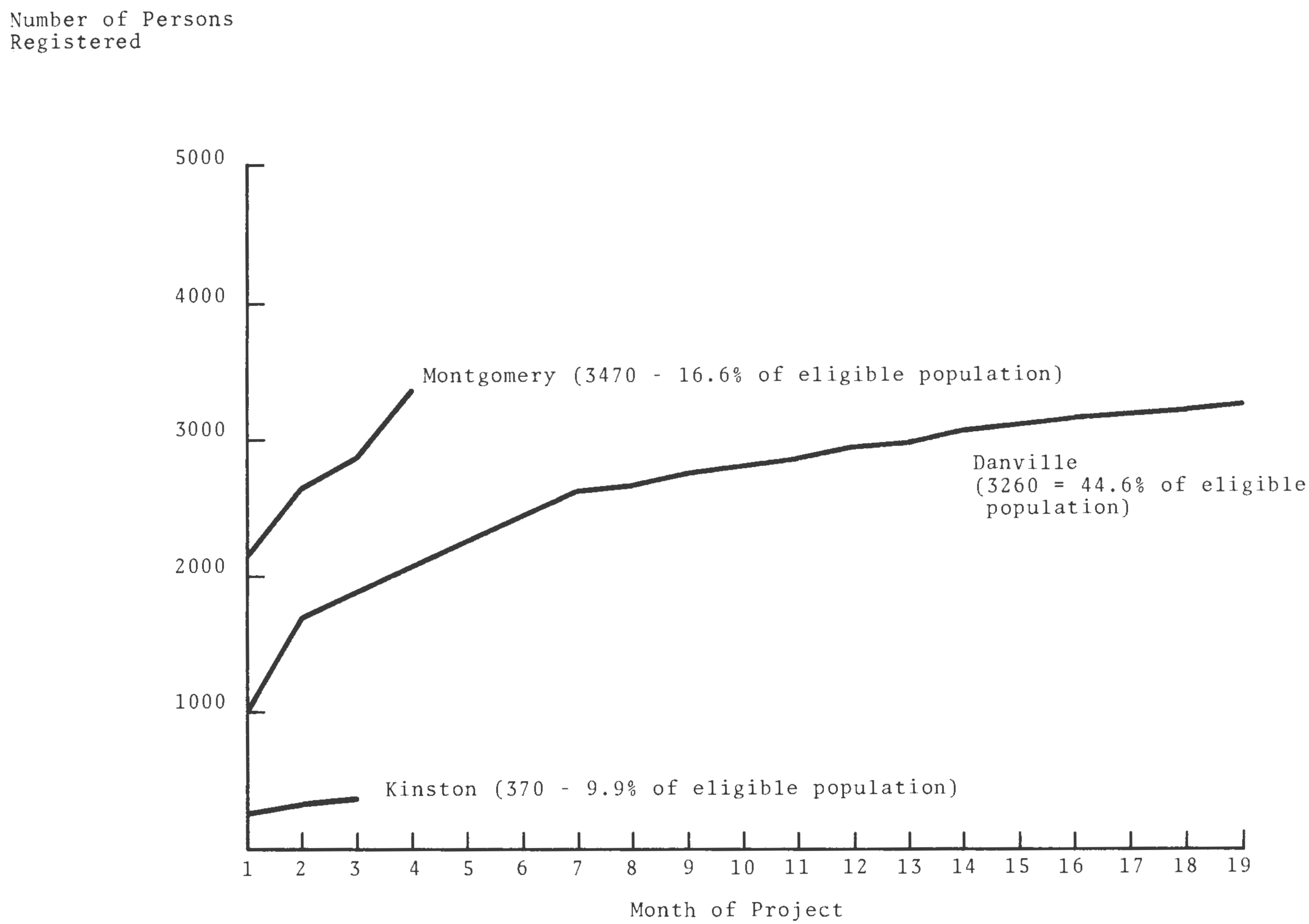


Figure 5-1. Project Registration By Month

principal reason was that the individual had acceptable transportation alternatives available. Of those persons registered for the project, it was found that only 25% had independent mobility as drivers, 59% depended on others for rides, and 73% lived in households with less than $5000 annual income. In contrast, the non-registered eligible indiviudal had a much higher level of self-sufficiency. Sixty-one percent of these people had driver's licenses, only 36% depended on others for transportation, and only 41% resided in households with annual incomes under $5000.

Ridership trends of project users are shown in Figure 5-2. A total of 8,400 rides were taken by project users in the thirteenth month of operation in Danville, the month preceeding the drop in subsidy to 50%. This accounts for an average of 2.8 rides per registered person per month, or an average of 5.6 trips per person for persons actually making trips in that month. About 18% of all registered indiviudals have never used the project. The reduction in the rate of subsidy from 73% to 50% combined with a general 12 percent increase in fare had a significant effect on project demand. The volume of project trips fell 38% in the first month after the change, from 8400 to 5200 trips. The effect of both changes caused the average user payment to increase from $.37 to $.73 for these users, or 100%. This suggests a short term fare elasticity of about -.4 for project taxi trips. Subsequently, project ridership has risen to about 80% of the level attained before the fare increase. This implies that the long term elasticity is about -0.2.

Kinston and Montgomery are at approximately the same stage of operation, and in spite of a much smaller population of registered users, Kinston has begun to pull even with Montgomery in total ridership. Kinston project users account for an average of 5.3 monthly project trips per registered individual while Montgomery users average only 0.5 rides per month. The Kinston user rate per registrant is almost double the highest experience in Danville and is more than triple the use rate in Danville after the fare increase and change in subsidy level. There is insufficient data presently available to determine the reasons for the high Kinston usage rate. This will be addressed in the project evaluation. The relatively low rate in Montgomery can probably be attributed to the problems with taxi service providers as many persons may not be using their project privileges at all.

Although some sense of the general impact of the user-subsidy mechanism can be gained through registration and project use rates, of greater importance is the insight

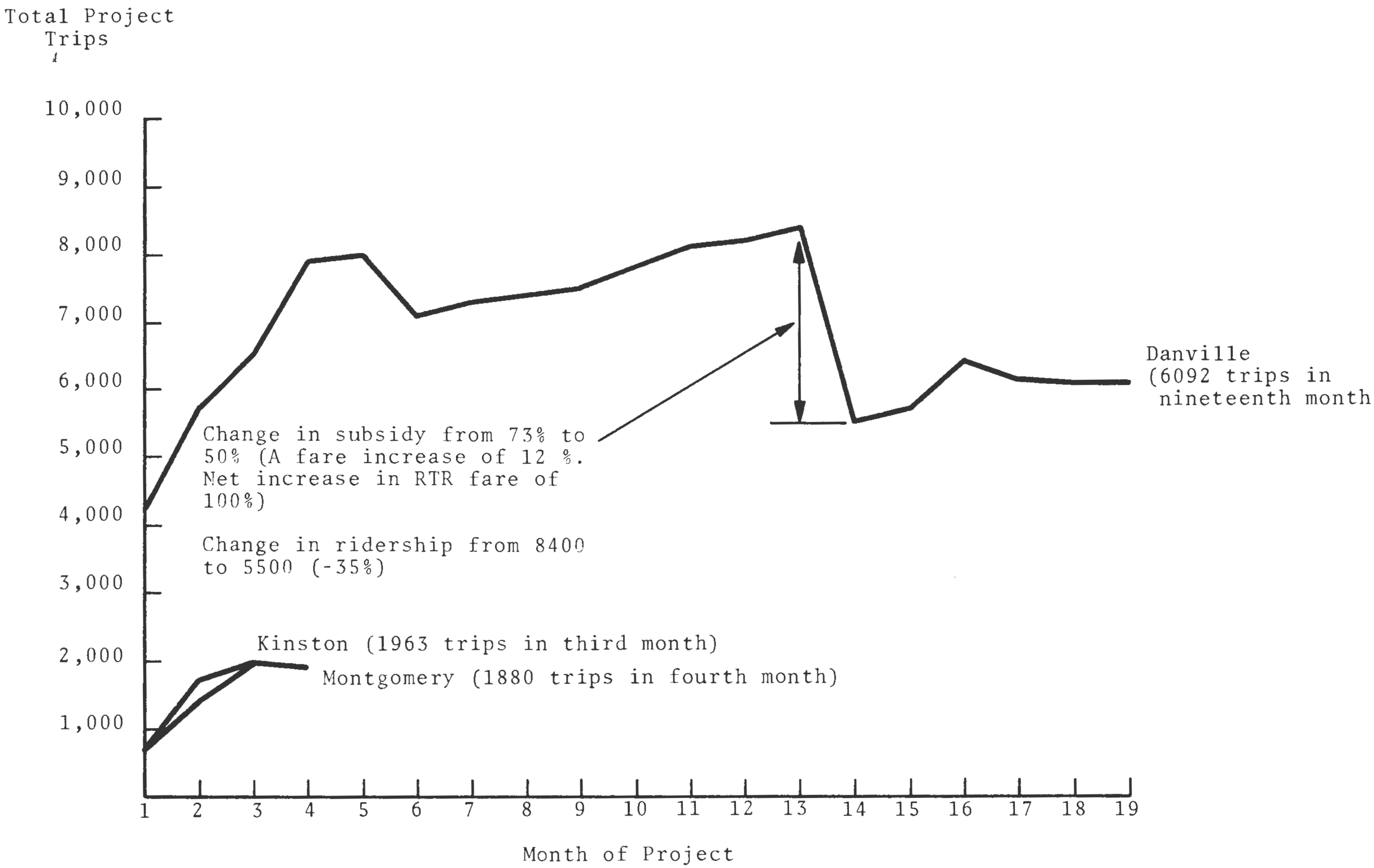


Figure 5-2. Project Use By Month

offered by the evaluations on the impact on the lives of the users in terms of improved "mobility." The concept of mobility includes whether or not to travel, and how often; freedom to use travel modes with lower disutilities; freedom to choose a preferred destination; freedom to make trips for any particular purpose; and freedom in the time of day, week, or month that the trip is made. In Danville, follow-up surveys of registrants were conducted to investigate project impacts on travel behavior. Forty-one percent claimed that they travelled more often under the project, 43% said that they were able to take trips they couldn't take before; 58% alleged to be less dependent on others for transportation; and 30% said that they were able to take more trips during a particular part of the day.

These responses, while providing qualitative support that the subsidy project does have impact on the lives of its users, must, nevertheless, be viewed as limited in two ways. First, they deal only with perceptions and lack the statistical validity of objective measurements. Second, they tell nothing about the aggregate, that is, how travel behavior is being affected overall. Data compiled on the Danville project show, in fact, that the project impact on the travel behavior of users was actually quite small. Project trips amounted to less than 10% of total daily trip-making for project users. Total trips were increased by less than 1.5% by the project, and less than 3.5% of total trips were project trips shifted from other modes. The Lawrence demonstration will attempt a more rigorous evaluation of the effect of the project on the "mobility" of its users through application of appropriate research techniques.

Impacts on Service Supply

The theory behind the user-side subsidy concept is that the reduced user travel cost should increase demand which in turn should impact service supply. One type of impact involves potential changes in level of service. Two possible levels of service changes are foreseeable: (1) in the absence of increases in fleet or driver capacity (a likely condition for the short run), an increase in demand might produce a net decrease in level of service; or (2) competitive pressures could motivate some operators to provide improved service overall or at least to some market segments. A second impact of the subsidy-induced demand increase may be improved productivity, and hence profitability, for providers. All subsidy projects will attempt to monitor these two categories of impacts through on-board surveys and collection of various operating and financial data from operators.

In regard to level of service, results are available for Danville only (on-board surveys for Montgomery and Kinston have not yet been analyzed). Unfortunately, the interpretation of the Danville results are complicated by the fact that, six months into the project, the second largest cab company ceased operations. This ultimately precipitated a net loss of 6 out of 30 vehicles from the industry, and placed a burden on the remaining two firms. Aggregate level of service, however, measured four months later showed only a slight degradation over pre-demonstration levels. Average wait time increased only by .4 minutes (attributed to additional dispatching time) and ride time by only one minute.

In regard to project impacts on service productivity and profitability, again the only results available are for Danville. By the sixth month of project operation the increase in total ridership due solely to the project approached 4000 trips per month, or a 15% increase in total demand. Taxicab owners also acknowledged a corresponding 15% improvement in operating income. Analysis also shows that the revenue yield for project trips was comparable to that of non-project trips on a per-mile basis, though somewhat less on the basis of driver minutes. Because of the sudden and drastic change in taxicab supply precipitated by the withdrawal of the second largest firm, it is not possible to determine the effects of the RTR project on overall vehicle productivity or efficiency of taxicab operations.

Administrative Cost and Feasibility

A third vital area being evaluated in the user-subsidy experiments is the determination of the feasibility of the concept in terms of the various administrative procedures and difficulties involved in management of the subsidy. A particularly important element is the "administrative cost" necessary to implement and manage the subsidy, which must be included in the profile of total service cost for comparison with other subsidy methods.

There are three basic responsibilities in subsidy management: subsidy transaction, project accounting, and public information/promotion. Subsidy transaction consists principally of verifying that the various forms filled out by service providers are in order and that users are charged the correct fare. In Danville, where vouchers are the exchange mechanism, little difficulty was encountered in reviewing voucher returns and accomplishing reimbursement. Because of the large volume of project rides, a special computer program was developed that checked forms and performed the various accounting tasks necesssary to furnish reimbursement. The program made weekly billings and payments possible, solving potential cash flow problems of the operators. In Kinston, where tickets are used in combination with backup logs, project accounting and reimbursement are accomplished manually by a single clerk. This procedure is rather effective given the present registration and use rates. In Montgomery, however, where vouchers are also used, the administrative process is lagging behind. While the volume of project forms is about equal to that of Kinston, two factors complicate the administrative burden. First, some taxi drivers in Montgomery have had difficulty adjusting to the new administrative procedures and often file incomplete or incorrect forms. Second, the implementation of the zone fare system made fare calculation more difficult. Most drivers do not compute fares correctly from the zones and project staff ends up making computational checks of many trips. A result of this additional workload on the project staff was a straining of relationships between the city and the operators. Arguments about fare and timeliness of reimbursement were common and one operator was accused of falsifying information on vouchers.

A second important administrative task is monitoring project use and being watchful for misuse, overuse, and fraud. There were no cases of fraud reported in Danville, and to date there have been no instances of user fraud in Kinston or Montgomery. On the provider side, a non-franchised operator attempted to cash-in project tickets in Kinston. In Montgomery, alterations to fares on completed vouchers were uncovered; after ample warning that this practice was unacceptable, subsequent vouchers showing tampering have not been paid. With regard to project overuse (in excess of budget limit), only 3% of users in Danville exceeded the specified monthly limits. Some overuse in Kinston has been reported. The data for Montgomery has not yet been analyzed.

The third element of project administration is communication and coordination. This role involves responding to public information needs and answering complaints. The only site where service complaints have materialized has been Montgomery. These complaints are due largely to two factors: first, not all taxi firms, or even all drivers of participating firms, have consented to carry project rides. This limited supply of operators is not always available or accessible to project requests. Second, users are required to phone in requests with 1 hour's advance notice, and identify themselves as project riders. Users do not always identify themselves because of the anticipated impact on service availability. As a result, a driver may be dispatched who is not equipped to carry a project rider, and conflict can develop.

Administrative cost data are collected at all sites, but as yet the only official estimates of the cost of the administrative element have been made in Danville, where the administrative cost per project ride was calculated as $.18. Combining the average subsidy and user cost per trip, the total cost per subsidized ride in Danville prior to the fare change was calculated to be $1.51.

Impact on Social Service Agencies

The fourth major type of impact being evaluated in the demonstrations is whether subsidy-based service can supplement or replace the individual and often costly transportation programs of the agencies. Evidence of this would be the agencies' willingness to support the program.

To date, agency responses to project support have been similar: enthusiastic about the availability of a supplemental service, but highly reserved about contributing financial support or using the project to replace their existing service. The most complete record of social service agency attitudes towards participation in a user-side subsidy project was developed from the Danville agency survey.

The first objection offered by agencies in Danville was that the project imposed a budget limit on users. This clearly constrained the number of visits to the agency that could be made by the user in a given month.

Another drawback was the logistics and complications of third-party payments. The administrative staff for the City felt that it was an unmanageable extension of their responsibility to become involved in third party accounting using vouchers. Use of pre-purchased tickets or tokens was suggested as a possible remedy to this accounting dilemma, and this will be studied in the contexts of Lawrence and Kinston.

A third reason for low-agency interest is based on the nature of their transportation funding. Agencies have interpreted their funding arrangements as allowing them only to pay directly for transportation services and not to reimburse clients for their travel. Whether or not viable funding alternatives could have been fashioned, the experience in Danville clearly illustrates that work must be done to covercome the real or perceived transportation coordination barrier among social service agencies.

Fortunately, the successful demonstration of the user-side subsidy concept, while enhanced by social service agency participation, is not dependent on that participation. Other aspects of the project can be tested irrespective of the level of cooperation attained between the user-side project and social service agencies. Nevertheless, the prospects for project continuation at demonstration sites or implementation of user-side programs at other sites will be improved if large scale social service agency involvement is obtained. The finding of appropriate avenues of cooperation is more in the realm of social service agency coordination than in the study of the user-side subsidy concept. The degree to which significant social service agency support in Danville and other demonstration sites was obtained is an important evaluation issue, but substantial attempts to overcome institutional and bureaucratic barriers to coordination were not planned as part of the demonstration activities.

ACCESSIBLE FULL-SIZE BUS SERVICES

Overview

In meeting a full range of transportation needs of handicapped persons, both the issues of mobility and accessibility must be addressed. While a considerable number of "alternative" specialized demand-responsive services for the handicapped and elderly have been operating for several years, there is practically no operating experience using full-sized accessible transit buses in regular fixed-route service. The Secretary of Transportation's decision requiring that all buses purchased after September 30, 1979 be accessible to the handicapped has made even more immediate the need for collecting data and disseminating information about the actual implementation process, experiences, and usage by the handicapped of such services.

The SMD program is taking two approaches in evaluating such accessible services. First, the program is conducting demonstrations in two small urban areas, Champaign-Urbana, Illinois, and Palm Beach County, Florida, of fixed-route buses equipped with lifts to accommodate wheelchair users.

These sites have small, 40-50 bus transit systems where, as part of the demonstration, the entire fleet will be made accessible. In addition to these projects, SMD is conducting evaluations of projects which are being undertaken locally in major urban areas to introduce accessible buses into regular service. Such transit systems are initiating conversion of segments of their bus fleets through the Capital Grant program. The number of accessible buses being put into operation ranges from five to 200. The cities being evaluated are St. Louis, San Diego, Atlanta, Los Angeles, and Santa Clara County.

Both of these approaches entail the first large scale use of wheelchair accessible full-sized transit buses, and as such, the experience gained will be of great interest to many other transit systems planning similar programs. Specific aspects to be addressed include: handicapped market penetration; trip and rider characteristics; operational and maintenance cost increments; equipment suitability and reliability; impact on general service; interface with complimentary specialized services for the elderly and handicapped such as user-side subsidies and demand-responsive services; and the planning process for route selection, headways, etc.

The use of fully accessible buses will, to some extent, improve the mobility of handicapped persons. However, because of the limitations of transit area coverage, it is obvious that a fully accessible fixed-route system will not meet all of the travel needs of the handicapped. Through the following demonstrations and evaluations, we hope to identify which travel needs are not being met and determine appropriate services to supplement fixed-route service in order to meet these needs.

Project Descriptions

Experience to date with fixed-route accessible buses has been extremely limited. Only two cities, San Diego and St. Louis, had such service by November 1977, and only one of those, St. Louis, offered any substantial amount of service. San Diego Transit Corporation (SDTC), in February, 1977, became the first transit agency in the country to equip any part of their regular transit fleet with level change mechanisms to accommodate wheelchair confined passengers. It was considered to be a test project by SDTC and, consequently, only 5 buses outfitted with wheelchair lifts began regular fixed-route service. The Bi-State Development Agency, the transit operator in St. Louis, initiated a much more significant test of accessible service with 60 accessible buses beginning in August 1977. Ninety-seven more were added at the end of November 1977. Other transit authorities, both large and small, will soon be following with partially or fully accessible fixed-route fleets. Los Angeles is awaiting delivery of 200 accessible buses. Santa Clara county has submitted grant applications to UMTA for 100 new and 80 retrofitted accessible buses. Washington, DC is planning to put 150 accessible buses into fixed-route service. Palm Beach County and Champaign-Urbana will receive UMTA capital and demonstration funds for accessible small urban area systems. Although it is not part of the regular fixed-route system, the City of Atlanta offers accessible bus subscription service. The amount of accessible service already offered or to be offered at sites with firm implementation plans are shown in Table 5-6 together with other major special services for the handicapped and elderly in each area.

The following is a description of the services which are existing or firmly committed. Preliminary results are included where available.

San Diego

On February 7, 1977, the San Diego Transit Corporation implemented a pilot program to demonstrate the need for wheelchair accessible transit buses in fixed-route service. Five transit coaches were retrofitted with wheelchair lifts. Four buses are used in the service with the fifth bus kept as a spare. The four buses provide approximately hourly service on two of the most heavily patronized routes of the SDTC system. The routes cross in the Central Business District although no special transfer arrangements are provided.

SDTC instituted this pilot program to demonstrate the need for accessible bus services and to test the feasibility of retrofitting buses with wheelchair lifts. The SMD Program was interested in the project since it was the first implementation of lift equipped buses in fixed-route service.

Over the first few months of operation, wheelchair passenger trips were averaging about one per week. The limited origins and destinations served and the difficulty of getting to and from the accessible buses were undoubtedly the major reasons for such low utilization. However, this has not been confirmed and there is not likely to be a study to measure the reasons for non-use.

TABLE 5-6. TRANSPORTATION SERVICES FOR WHEELCHAIR CONFINED INDIVIDUALS

	San Diego	St. Louis	Los Angeles	Palm Beach	Champaign-Urbana	Atlanta
Accessible Buses	5	157	200	51	40	8
Total Fleet	351	925	2394	51	40	744
Accessible Routes	2	17	23	20	10	27 Tours
Total Routes	40	142	222	20	10	NA
H & E DRT	Yes	Limited Area	Cities & Agencies	Limited Area	Half Fare Taxis	None
Area (sq.mi.)	93	10.8	1600	Boca Raton	34	
Vehicles	21	5	1500	6*	NA	
Lift Vehicles	10	5	NA	6	NA	

*Off-peak (9AM-3PM) only.

Retrofitting vehicle
for lift

Transit Vehicle

Stairs in stored
position

Stairs in lowered
position

Wheelchair Accessible Bus
San Diego, California

SDTC stated an intention to keep detailed maintenance records of equipment malfunctions and the labor and material cost of repairs. This information is not yet available. All evidence indicates that the lift devices have been operating reasonably well and feasibility of retrofitting buses has been proven. Nevertheless, equipment malfunctions of the lift or the buses have kept accessible buses out of service when they were scheduled to be out on the route. It appears as though more than one spare bus would be required to operate the service reliably.

St. Louis

The Bi-State Development Agency has implemented accessible fixed-route bus service using kneeling buses equipped with wheelchair lifts on 17 transit routes in the St. Louis metropolitan area. Initial operation of 60 accessible lift equipped buses serving 10 routes began on August 15, 1977. Operation of an additional 97 accessible buses serving seven more routes and increasing coverage on the 10 original routes began on November 28, 1977. Accessible bus coverage on these routes ranges from 53 to 89 percent. In addition to the fixed-route accessible buses, Bi-State will initiate a pilot project demand-responsive service for the handicapped and elderly. A fleet of six small buses will cover a 10 square mile, three town suburban area of St. Louis. Initiation of the demand-responsive service has been delayed due to the lack of a contract with the union representing the transit employees.

The 10 square mile demand-responsive service area encompasses the Town of Clayton, which is the County Seat of St. Louis County. Significant segments of only three Bi-State accessible bus routes (two radial and one crosstown) and very small segments of two other accessible routes (one radial and one crosstown) are operated within the demand-responsive service area. Consequently, the combination of limited fixed-route accessible bus coverage in the demand-responsive service area and the size limitation of the demand responsive area will not allow wheelchair confined persons a choice between fixed-route or demand-responsive service for the great majority of their trips.

The accessible-fixed-route and demand-responsive services were developed as part of the total Bi-State program for handicapped and elderly transportation. Both services will be assessed to determine their effectiveness in providing mobility to the handicapped and elderly, the cost of providing this mobility, and the desirability of expansion of these services to cover more of the region.

The SMD program is developing an evaluation plan which focuses primarily on the accessible fixed-route buses. The Bi-State program is of interest to SMD since it is the first large scale implementation of fixed-route accessible buses and will also be a test of such operations in harsh winter weather conditions. Much less attention will be paid to the demand-responsive element, but the evaluation will determine reasons for use of the service and the potential for use of the fixed-route accessible buses as well as the amount of transferring between the two services and the amount of coordination required.

Los Angeles

The Southern California Rapid Transit District (SCRTD) will soon place 200 accessible buses in fixed-route service. Twenty-three routes will operate with accessible buses. Accessible bus peak and base period headways will be 30 minutes on approximately half of the routes; the remaining will have headways between 20 and 60 minutes. The accessible routes cover a very large area and will stretch out to virtually the furthest reaches of the SCRTD service area, although coverage in these distant locations will not be extensive. It is expected that accessible service will begin during the spring or summer of 1978.

The SMD program will monitor closely the operations and internal evaluation of the SCRTD accessible bus project. The SCRTD operation will be the second major implementation of a partially accessible bus fleet. The SCRTD experience will be valuable in testing accessible bus service in a mild climate and in assessing whether the general level of ridership and extra costs incurred in St. Louis appear to be representative of the results to be expected from partial fleet accessibility in large cities.

Palm Beach County

The Palm Beach County Transportation Authority has received SMD demonstration funding for the testing of a fully accessible bus system in a warm climate, small urban area. The Authority operates 20 regular routes plus an off-peak demand-responsive service in a small segment of the County. Through a combination of new bus purchases and a retrofit program, the Transportation Authority will be operating a totally accessible, 51 bus fleet by Spring 1979. The twenty retrofitted and six existing lift vehicles should be operating in fixed-route service by September 1978.

Champaign-Urbana

The Champaign-Urbana Mass Transit District has also received SMD demonstration funding for the operation of a totally accessible bus service. The 10 route, 40 bus system will likely commence accessible bus operations by Spring 1979. This project will test the acceptance and performance of a small urban area, fully accessible bus fleet in a relatively severe climatic situation.

Atlanta

The Metropolitan Atlanta Rapid Transit Authority (MARTA) special handicapped and elderly service is being investigated by the SMD program even though it is neither an SMD project nor a conventional fixed-route service. The MARTA concept is a regularly scheduled subscription service. Trip requests of potential patrons are analyzed to develop vehicle tours which have at least a certain minimum level of riders and which occur at least once a week. By November 1977, 5 vehicles were used in the service and 75 vehicle tours per week were being operated. Many more trip requests have been filed with MARTA than have been possible to incorporate in tours. More tours are continuously being added; nevertheless, trip requests accommodated will always remain a small percentage of trip requests received.

Of special interest to the SMD Program and other transit agencies will be the comparison of the ridership and cost statistics of this type of service to those of the fixed-route service being investigated or evaluated in other locales. Results from the first seven weeks of service showed an average of 86 passenger trips per week (3 buses, 27 tours) at a direct operating cost of $15.95 per trip. Ridership during the month of November increased to 180 passenger trips per week (5 buses, 75 tours). The effect of the increased ridership on the trip cost has not yet been calculated by MARTA.

Comparison of Findings Across Projects

The most eagerly awaited statistics on accessible bus operations are the number of wheelchair passengers carried and the cost of providing the service. So far the number of riders has been low. Although no pre-service estimates of wheelchair users were quoted, it does appear that ridership figures in San Diego and St. Louis have been disappointing to the sponsoring agencies. However, low ridership should not have been unexpected considering the circumstances of

Transit Vehicle

Vehicle Interior

Driver securing
wheelchair patron

Driver assisting
patron onto lift

Wheelchair Accessible Bus
Atlanta, Georgia

the service quality offered, external mobility barriers and existing travel means of the handicapped.[5] It will be disappointing, however, if handicapped ridership does not increase as service quality increases and external mobility barriers are removed. During the next year, clearer indications of the market for fixed-route accessible buses will be forthcoming from those localities already or soon to be operating these buses. However, wheelchair handicapped ridership on fixed-route buses is very unlikely to reach the level experienced on demand-responsive lift bus services, or even subscription services, due to the inferior level of service it provides to this group.

The second important issue in the investigation of accessible buses is the cost, both capital and operating. Capital costs are easier to ascertain. The extra cost of a lift in the purchase of a new transit bus has been $7,000 to $8,000 on recent orders. Retrofitting an existing bus with a lift has cost up to $10,000. However, if done in quantity the retrofit cost should be closer to the factory installation price. It should be noted that there is only one commercially available lift device suitable for front-door installation which has been generally used by transit agencies and bus manufacturers. In some instances, modifications have been made to the basic lift by the purchasing agency or bus manufacturer in an attempt to improve some aspect of its performance. It is generally agreed that a satisfactory design has not yet been achieved and this fact has caused some operators to develop their own lift device. The state-of-the-art in lift design is continuously being advanced, however, and several companies are currently working on development of wheelchair lift mechanisms. The UMTA Office of Technology Development and Deployment is participating in this effort with the sponsorship of a California Department of Transportation demonstration of four different models of wheelchair lift devices.

The lift device and its installation are not the only equipment or modification expense involved in outfitting a bus for use by wheelchair confined and other mobility impaired individuals. Wheelchair securement devices, removal of existing seats, installation of fold down seats, added grab rails or stanchions, the bus "kneeling" feature and added stairwell and external lighting are items that might be incorporated in accessible bus specifications or

----

[5]R. Casey, San Diego Wheelchair Accessible Bus Study, Report No. UMTA-MA-06-0049-77-8, September 1977.

modifications. The incorporation of all of these items could raise the "accessibility" price to the vicinity of $15,000 per bus.

An item much in doubt is the extra operating costs for wheelchair accessible bus services. It is too early to tell how much standby equipment and operators will be necessary to substitute for buses out of service due to on-the-road lift related breakdowns or for buses seriously behind schedule due to wheelchair passenger usage. Indications to date are that breakdowns will be the more frequent of the two occurrences. Schedule changes necessitated by accessible bus operations may be another factor which will increase operational costs.

Prior to implementation, Bi-State estimated that operation of their first 60 accessible buses would incur an added annual expense of $203,000. This estimated cost was made up of $43,000 for lift related maintenance and $149,000 for 10,000 extra bus hours. The extra bus hours consist of two types: the added layover time built into some of the routes where normal layover time would not be adequate to allow for the extended dwell times for wheelchair passenger boarding and deboarding, and from a reduction in interlining. In Atlanta, the weekly operating cost for the first 39 weeks of the MARTA "L" bus service was $1,463 or $19 per bus hour. These early estimates or actual costs are not indicative of costs over the long term since both situations are for considerably less than full implementation. The coming year will provide much better information on operating and maintenance costs for accessible bus services.

There are no precise data yet available on the reliability of the accessible bus services or the effect of wheelchair lift usage on bus travel times. There is no evidence that lift usage has caused any significant delays to buses. However, dwell times for wheelchair boardings and deboardings have not been measured in actual service. Tests under non-operating conditions indicate a 1 1/2 to 2 1/2 minute boarding time. It would seem that, given the present infrequent usage of the lifts, there should be little effect on overall system operation. A more serious matter is the potential for lift malfunction on the route which would cause the bus to become inoperable. This has happened but the frequency of occurance or the resulting passenger delay is unknown. There have also been many instances where a non-accessible bus was used in place of an accessible bus. This has resulted in wheelchair passenger boardings being denied. Accessible bus availability has been a problem to date in both St. Louis and San Diego due to malfunctions of the buses themselves or the lift devices. A spare ratio in excess of that normally used for regular buses will unquestionably be required. SMD evaluations will address the entire issue of accessible bus equipment and service reliability and the consequent impacts on transit authority operations.

The case study of the MARTA concept will allow comparison of a fixed-route subscription service with a regular fixed-route service. The three MARTA "L" buses carried 133 passengers during the seventh week in comparison with 26 passengers carried during the eleventh week on the 51 in-service Bi-State accessible buses. Bi-State now has 157 accessible buses but ridership has not increased to any extent. This may be due to the advent of winter weather. MARTA now has 5 buses in service and weekly ridership has increased to approximately 180. Winter weather is not quite as severe in Atlanta as it is in St. Louis although it does get cold. Differences in the weather and the fact that the Atlanta service accommodates regular recurring trips may have mitigated the normal winter handicapped and elderly transit ridership decrease that occurs in the majority of cold weather cities and that appears to have occurred in St. Louis.

Reasons for non-use of accessible fixed-route buses by the non-ambulatory handicapped are considerable. Many of these reasons are suggested in the San Diego report previously cited. One would expect that the major obstacle would be the difficulty in getting to and from the bus due to excessive distance, difficult terrain, weather conditions or the lack of ramps at curbs or buildings. During the next year data will become available to prove or disprove this hypothesis and to rank the reasons for non-use according to their stated importance by the wheelchair population questioned.

SUPPORT ACTIVITIES AND FUTURE PROJECTS

In order to develop effective transit dependent service models, the SMD program sponsors planning studies of new concepts or new methods of implementing previously tried ideas. The current studies described in this section are of three basic types: (1) feasiblity studies of new concepts; (2) development of improved implementation strategies, or; (3) identification of transit dependent travel needs and the development of techniques to accommodate these needs. Many of these studies are expected to lead to demonstration projects.

Ride Sharing Paratransit Agency Study

Outside the more central areas of the many major cities the density of travel demand is not sufficient to operate conventional mass transit systems economically. Consequently, nearly all trips in these areas are made by private auto. For many trips, however, it appears that demand densities are high enough to support paratransit or ridesharing arrangements.

This project, conducted in Pittsburgh, Pennsylvania, is designed to determine the feasiblity of introducing a ride-sharing broker into the local instituional structure whose purpose will be to stimulate the demand and supply of paratransit services by consolidating trips currently made via private auto. The study will examine the institutional and regulatory framework into which a ride-sharing agency is to be introduced, design the specific function, services and management structure for the agency, identify potential providers of services and outline a marketing approach.

This study will result in a social service agency transportation brokerage demonstration in FY 1978.

Planning and Analysis for Special Service Transportation Coordination

This project will develop an implementation strategy to increase the efficiency and effectiveness of special transportation services for disadvantaged persons served by social service agencies in Dallas County, Texas. The program hopes to achieve the elimination of redundant service, improve vehicle productivity by reducing non-productive time, and reduce costs through centralized dispatching. Similar HEW projects are being conducted in non-urban areas and small cities. The study will complement their efforts by providing a service coordination model in a major metropolitan area.

The major elements to be developed include definition of the role of transit and paratransit operators, development of an accounting service, the role of private non-profit providers, and operational and management structures for the implementation of this model.

The final phase of the project is to design a detailed plan for the implementation of a project to demonstrate innovative solutions to transportation problems of the elderly, handicapped, and transportation-disadvantaged persons served by social service agencies. Specific steps in this process include: analyses of the current system of providers, development of options for consolidation, delegation of administrative responsibilities, and the development of an implementation plan for the coordination of the transportation system.

Coordination of Human Service Transportation

Little effort has been made in the past to coordinate the provision of transportation among the thirty agencies in the Brockton, Massachusetts, region which provide specialized transportation services to their clients. Agency-transportation expenditures are often uncontrolled because funding is derived from a wide variety of Federal, state, and local sources. This project will develop a demonstration plan, including a strategy to coordinate human service agency transportation services and resources to provide improved service and cost efficiencies.

The planning study will include the following tasks:

- Centralization of Administration - A method of coordinating human service agencies in the Brockton area via a centralized authority for administration and operation of these programs will be developed.

- Analysis of Additional Demand - The means for satisfying any additional demand for specialized transit services in the region will be determined through analysis of the needs of the transit dependent population.

- Design of a Paratransit System - A paratransit system that will meet the needs of agencies and transit dependent persons will be designed.

- Coordination of Operations - Methods will be developed to coordinate Brockton Area Transit (BAT) operations with those of intercity transportation providers.

Study of Inner City Transportation

The objective of this study is to determine the travel desires and mobility needs of inner city residents, and to develop appropriate transit operating services, techniques, institutional frameworks, and financial arrangements to satisfy those transportation needs and desires.

The major features of this project include a literature search of inner city transportation experiences, data collection on the transportation characteristics of inner city residents, and an analysis of inner city transportation deficiencies by trip purpose. Alternative inner city transportation solutions will be developed, including types of services, financial plans, and institutional arrangements. Three demonstration concepts, representing the most promising alternatives, will be selected and developed into site specific project designs.

Research on the Transportation Problems of the Transportation Handicapped

The overall objective of this research is to determine the travel requirements of various classifications of handicapped people and to recommend viable transportation service alternatives using all modes that can satisfy such requirements cost effectively. The central issue to be addressed is the cost/benefit trade-off between developing the needed transportation service by modifying existing and new transportation systems to make them accessible to handicapped persons (including the mentally retarded) and instituting specialized transportation services for the handicapped (including the mentally retarded) market.

This project will characterize the transportation handicapped and their travel patterns and requirements. Alternative approaches for meeting those transportation needs will be evaluated. Demonstrations will be designed to implement or test proposed solutions. Minimum standards and guidelines will be presented in a manual for urban transportation planning for the transportation handicapped. A report presenting a national perspective on what is happening regarding the transportation handicapped will be produced. Several transit systems using Section 5 UMTA grants will be investigated.

Preliminary findings of a national survey conducted as part of this study reveal:

- Almost 7.5 million or five percent of the urban population five years of age and older are transportation handicapped
- Nearly half of the transportation handicapped have a lot of difficulty with or cannot use public transportation

- Those who are transportation handicapped have multiple problems, mostly related to functional mobility

- Transportation handicapped persons tend to be older, less educated, and female.

As an amendment to this project, attitudinal surveys will be conducted in several cities which have transportation programs for handicapped persons. Both handicapped and non-handicapped persons are to be surveyed. This information is necessary for the development of the planned demonstration projects.

Large City Demonstration Planning for the Mobility Limited

The purpose of this project is to determine an effective means of transporting mobility-limited persons in a large urban area. A detailed implementation plan has been developed with project costs, for a pilot demonstration of convenient barrier-free transportation for the elderly and handicapped. The planning includes an inventory analysis of data required to determine the travel needs of the mobility-limited and the most effective approach for meeting those needs in one geographic sector of Chicago.

This planning phase of the project defines the specific boundaries of the sector to be served in a demonstration phase and includes the plans, specifications, procedures and criteria for operating the special transportaiton services. The next phase involves a demonstration of the proposed service plan.

Coordinated Services for the Handicapped, New York City

This project is intended to develop a working model for meeting the transportation needs of the handicapped in a major metropolitan area, New York City, with a complex array of existing transit providers, funding mechanisms, and institutional considerations. The planning study will include the following tasks:

- Seclection of the target service area - There will be an identification and analysis of agencies serving the handicapped, an inventory of the handicapped population and an assessment of their transportation needs.

- Development of a taxi and livery cooperative - In response to an evaluation of the taxi and livery services in the target area, a cooperative or consortium arrangement will be formed if it is found institutionally possible.

- Analysis of dispatch systems - Requirements of the dispatch system will be determined and related to the kinds of dispatching technology available within a reasonable cost framework.

- Evaluation of taxis and vans for the handicapped - Existing equipment alternatives will be assessed and a specification for taxi and van procurement will be developed.

- Assessment of agency commitment - Legislation, policies, and operational precedents that serve as obstacles to pooling of funds and sharing of vehicles or staff will be examined.

SUMMARY AND IMPLICATIONS

Coordination and Brokering

Results to date reflect a number of impacts on agencies, users, and providers. The major findings from the operational projects are as follows:

- Agencies have shown a willingness to participate in coordinated transportation services, proving that barriers to coordination are not insurmountable. Barriers tend to be existing institutional arrangements or traditions rather than specific legislative or regulatory impediments.

- Contracts or purchase of service agreements with social service agencies help public transit operators defray the cost of providing specialized elderly and handicapped service. This arrangement also benefits the agencies, as they normally pay less than they would under most other arrangements.

- Between 15 and 30 percent of individuals eligible for special transportation service actually register for its use.

- Only a fraction of persons registered use the service regularly. Many eligible persons drive their own cars or can easily make arrangements with others who drive and consequently have no great need of the service.

- A substantial percentage, reportedly about 20 to 30 percent, of the trips made on project services were made possible by the service and would not otherwise have been made.

- Cost of providing service has been generally between $4 and $8 per passenger trip. Factors increasing the cost per trip include large service areas, low target population density, and limited grouping of trips (many-to-one). Substantially lower costs are achieved by using taxis instead of publicly operated minibuses where rides cannot be grouped.

- Brokering programs for non-work trips are very labor intensive and appear unlikely to be self-supporting except in situations of very high demand.

<u>User Side Subsidy</u>

Major findings to date from the user-side subsidy projects are as follows:

- On the average, about 30 percent of the eligible population register for user-side subsidy service. The actual or anticipated (based on present registration trends) registration is 20 to 45 percent. This variation may be due to a number of site specific factors such as the attractiveness of the service to the user, the fare charge, the ease of registration, the amount of marketing, etc.

- Even though 41 percent of Danville registrants reported that they travelled more often because of the subsidy, and 43 percent stated that they were able to take trips not previously possible, total tripmaking was increased less than 1.5 percent by the project. This small change in overall tripmaking is principally due to the fact that project trips amount to less than 10 percent of total trips for project users.

- Tickets are administratively simpler to handle than vouchers for provider reimbursement. However, complex fare structures undoutedly will require the use of vouchers. The concern over potential large scale misuse of the tickets or vouchers has proven groundless to date.

- The cost of administering the user-side subsidy in Danville was approximately 20 percent of the average subsidy per trip.

Wheelchair Accessible Buses

The SMD Program demonstrations of fixed-route wheelchair accessible bus service are still in the pre-implementation stage. Some early findings from SMD investigations of locally sponsored projects are as follows:

- Fixed route accessible bus ridership by wheelchair confined individuals has been very low. This is partly a reflection of limitations in the level of service and coverage being provided during the phase-in of accessible buses. It may also reflect the impact of barriers encountered in getting to and from the bus stop.

- Added operating costs due to accessible bus service are not yet known but are expected to be substantial. Capital costs for accessible equipment purchase and installation are likely to average $10,000 or more for each bus.

- Service delays due to malfunctioning wheelchair lift equipment appear to be more serious than the delays caused by boarding and deboarding wheelchair patrons.

REFERENCES

1. CACI, Inc. Special Transportation Services for the Elderly and Handicapped Demonstration Project in Baton Rouge, Final Evaluation Report, November 1976, UMTA-LA-06-0001-76-1.

2. Cambridge Systematics, Inc., The Valley Transit District: Specialized Transportation for the Elderly, Handicapped and Low-Income in the Lower Naugatuck Valley, Connecticut, Final Evaluation Report (draft), February 1978.

3. Robert F. Casey, San Diego Wheelchair Accessible Bus Study, Case Study Report, September 1977, UMTA-MA-06-0049-77-8.

4. Crain and Associates, Cleveland Neighborhood Elderly Transportation Demonstration Project, Final Evaluation Report, April 1977, UMTA-OH-06-0018-77-1.

5. Crain and Associates, Incidence Rates and Travel Characteristics of the Transportation Handicapped in Portland, Oregon, Special Report, April 1977, UMTA-OR-06-0004-77-1.

6. Crain and Associates, User-Side Subsidies for Shared Ride Taxi Service in Danville, Illinois: Phase I, Final Evaluation Report, June 1977, UMTA-IL-06-0034-77-1.

7. Crain and Associates, Community Brokerage of Transportation Services for the Elderly in Mountain View, California, Final Evaluation Report, January 1978, UMTA-CA-06-0002-78-1.

8. Crain and Associates, The LIFT: Portland's Special Needs Transportation Demonstration Project, Interim Report (draft), January 1978.

9. Crain and Associates, Subsidized Taxi Programs for Elderly and Handicapped Persons in the San Francisco Bay Area, Case Study Report, September 1977, UMTA-MA-06-0049-77-9.

10. Kirby, Ronald and Robert McGillivray, "Alternative Subsidy Techniques for Urban Public Transportation," 16 pp., Urban Institute, WP 5050-4-1, October 1975.

11. Kirby, Ronald and Francine Tolson, "Improving the Mobility of the Elderly and Handicapped through User-Side Subsidies," 29 pp., Urban Institute WP 5050-4-4, August 1976.

12. Kirby, Ronald F., and McGillivray, Robert G., "Mobility, Accessibility, and Travel Impacts of Transportation Programs for the Elderly and Handicapped," Urban Institute Working Paper 5050-4-6, Washington, D.C., The Urban Institute, 1977.

13. SYSTAN, Inc. and Central New York Regional Transportation Authority, The Call-A-Bus Demonstration Project-Specialized Transportation for the Elderly and Handicapped in Syracuse, New York, Final Evaluation Report, June 1977, UMTA-NY-06-0041-77-1.

CHAPTER 6

PROJECT EVALUATION

INTRODUCTION

The SMD Program is nationwide in scope and of extremely high visibility as the proving ground for new and improved urban transportation concepts and operations. Both the technical findings and public perception of demonstration activities can have large impacts upon transportation investment and operations decisions and policies pursued at all levels of government. Since the principal output of the Federal investment in demonstrations is the knowledge gained from the evaluations, it is of critical importance that technically sound, objective, and comprehensive evaluations of the individual demonstration projects be performed.

The various demonstrations are intended to serve as either real-world experiments involving innovative service concepts or techniques implemented, or as exemplary models to be applied or adapted by other locales across the country. Accordingly, the focus of the evaluations is threefold: (1) to assess the institutional and operational feasibility of the demonstration concepts and techniques; (2) to assess the transportation and socioeconomic impacts of the demonstration project; and (3) to provide guidance, based on operational experience during the demonstration, for future applications of the concepts and techniques. These evaluations deal with actual events and impacts and should be differentiated from before-the-fact evaluation of potential impacts more commonly encountered in the comparison of service alternatives performed in transportation planning studies.

Under UMTA sponsorship, the Transportation Systems Center (TSC) of the U.S. Department of Transportation conducts a broad program of demonstration evaluation, evaluation methodology development, and research in support of these activities. In order to obtain technically sound, objective, and consistent evaluations of demonstration projects which will increase the understanding and transferability of their operations and impacts, TSC has established a single, coordinated demonstration evaluation program. This chapter describes the major elements of the SMD evaluation program:

- The structured process for conducting SMD evaluations, which entails a high degree of coordination and cooperation among numerous participating organizations

- The conceptual framework or approach for analyzing the general impacts of transportation systems changes, which is based on principles of transportation systems analysis

- Supporting efforts in evaluation methodology development.

SMD EVALUATION PROCESS

The SMD Program represents a cooperative and coordinated effort in applied policy research involving organizations at the Federal, state, and local level. The performance of individual demonstration evaluations does not take place in an isolated laboratory setting, but rather is intimately related to the conduct of the demonstrations themselves.

The various participating organizations and their respective responsibilities are as follows:

- UMTA's Office of Service and Methods Demonstrations, which has responsibility for overseeing and coordinating all aspects of the SMD Program, with special emphasis on demonstration development, administration, and management.

- TSC's Urban and Regional Research Division, with responsibility for the SMD evaluation program including its evaluation planning and management, technical direction for individual demonstration evaluations, evaluation methodology development, cross-cutting and applicability studies of transit innovations, and related technical studies.

- Private organizations under contract to TSC as evaluation contractors with responsibility for planning, implementing, and reporting the findings of individual evaluations.

- Private organizations or universities under contract or grant to UMTA with responsibility for concept definition, feasibility studies, and implementation planning.

- Public agencies at the State and local level which are responsibile for implementing and operating the demonstrations and performing most of the data collection.

- Private organizations or universities under contract to grantees for support in such tasks as project planning, service operations, marketing, and data collection.

The process which is employed for planning and implementing the evaluation allows for close and frequent interaction among the various participating organizations to ensure that evaluation activities are dovetailed with demonstration implementation activities and to secure agreement as to respective data collection responsibilities. Although the SMD evaluation process involves a well-defined sequence of activities and organizational interfaces, the unique operating environment surrounding each demonstration calls for considerable managerial and technical flexibility. The performance of demonstration evaluations occurs in a dynamic, not fully controllable setting. Thus the nature, scope, and schedule of the demonstration may undergo considerable modification over the course of the implementation period, thereby necessitating changes in the evaluation effort.

The specific sequence of events and organizational responsibilities for the planning and implementation phases of the SMD evaluation process are described below.

During the evaluation planning phase, key decisions are made regarding the scope, focus, methodology, budget, schedule, and organizational responsibilities for the evaluation. This phase must be completed in sufficient time so that all necessary "before" data can be collected prior to demonstration implementation. Shortly after an SMD grant is awarded by UMTA, TSC prepares an Evaluation Framework which describes pertinent information on the project and its setting, key issues to be examined, and recommended scope, focus, and approach for the evaluation.

The Evaluation Framework becomes the basis for an Evaluation Plan prepared by one of the evaluation contractors or in some cases by TSC itself. This document specifies in detail the evaluation design and analysis framework, data requirements, data collection methodology, analytical techniques, and the evaluation management plan. The draft Evaluation Plan undergoes a coordinated review by TSC, UMTA, and the grantee and is modified as necessary to insure that: (1) the proposed data collection and analysis approach validly addresses the evaluation issues of interest, and (2) the proposed data collection methodology are feasible with respect to demonstration phasing and local data-collection capabilities. In order to minimize data collection requirements, the evaluations rely to the extent possible on data that the grantee would collect in any case for operational and management purposes.

The implementation phase of the evaluation begins with data collection for the pre-demonstration period. Data collection is a shared effort on the part of the evaluation contractor, the grantee, and, frequently, a local planning agency. Analysis and interpretation of the data gathered are the sole responsibility of the evaluation contractor and TSC.

For each demonstration, TSC and/or the evaluation contractor prepares a comprehensive Final Evaluation Report, the contents of which are described later, and maybe one or more Interim Evaluation Reports covering specific phases of the project or particuar topics of immediate interest to the transportation planning community. All reports are reviewed by TSC and UMTA, circulated to the grantee for comment, and revised in light of these comments prior to publication as part of the UMTA/TSC Evaluation Report Series.

The findings and the data obtained from the individual evaluations, aside from appearing in the above reports, also serve as the basis for the Service and Methods Demonstration Annual Report and are used by TSC in a variety of cross-cutting analyses. State-of-the-art transportation analysis techniques are currently being applied to analyze, compare, and contrast results of groups of demonstrations and other similar transit innovations. The findings are intended to enhance the transferability of the demonstration concepts by leading to an understanding of what factors have been most influential on project outcome and indicating how the results would differ under other circumstances. Particular emphasis in these activities is placed upon: (1) the potential range of demonstration impacts and characteristics; (2) appropriate applications of demonstration services and techniques; (3) potential markets for SMD innovations; and (4) potential improvements to increase the effectiveness of techniques in future experiments and applications.

EVALUATION PHILOSOPHY AND ANALYTICAL FRAMEWORK

The SMD Program attempts to maximize the quality and utility of information gained from the demonstrations by developing and employing a consistent, carefully structured approach to demonstration evaluation and state-of-the-art data collection and analysis techniques. Each evaluation addresses three basic questions -- What changes were made to the transportation systems? What are the impacts of these changes? Why did these impacts occur? -- through careful documentation of the events and circumstances surrounding the implementation and operation of the project, as well as a detailed analysis of impacts and cause and effect relationships. Demonstration evaluations are not designed to judge the capability or performance of the grantee, nor do they emphasize classifying demonstrations as successes or failures. Rather, an important premise of the SMD Program is that every demonstration is of value if it increases knowledge about innovative transit service concepts and techniques and fosters innovation in other locales.

The program's emphasis on a consistent analytical approach does not preclude recognition of the unique learning potential or special circumstances surrounding each demonstration. Since demonstrations vary in terms of objectives, relevant issues, complexity, content, and context, the scope and emphasis of each evaluation are tailored to the specific characteristics of the demonstration. In view of the nature and relatively short (two to three year) time frame of SMD projects, the evaluations typically emphasize examination of short-run impacts. These primarily include impacts on users, transportation operators, and other groups which occur during the demonstration period. However, in the case of demonstrations involving major transportation changes in a large area or corridor (e.g., an auto-restricted zone), the evaluation may be expanded in scope and time frame to include an analysis of longer-run changes such as employment and residential location shifts.

The basic analytical framework underlying SMD evaluations can be understood by examining Figure 6-1, which depicts the sequence of transportation supply and demand changes triggered by a demonstration. The demonstration elements, no matter how many or how complex, serve to alter the characteristics of transportation supply, i.e., the number of travel options available and/or the level of service attributes of those options (e.g., travel time, reliability, convenience) as viewed by potential users. In response to these supply changes, individuals make short-run decisions regarding travel frequency (and whether to travel at all), spatial patterns of travel, mode, and time-of-day on the basis of personal preferences for these attributes. The aggregate effect of individual behavioral responses to supply changes is manifested in the level of demand for each service mode affected by the demonstration. The interaction of supply changes and demand responses produces a level of

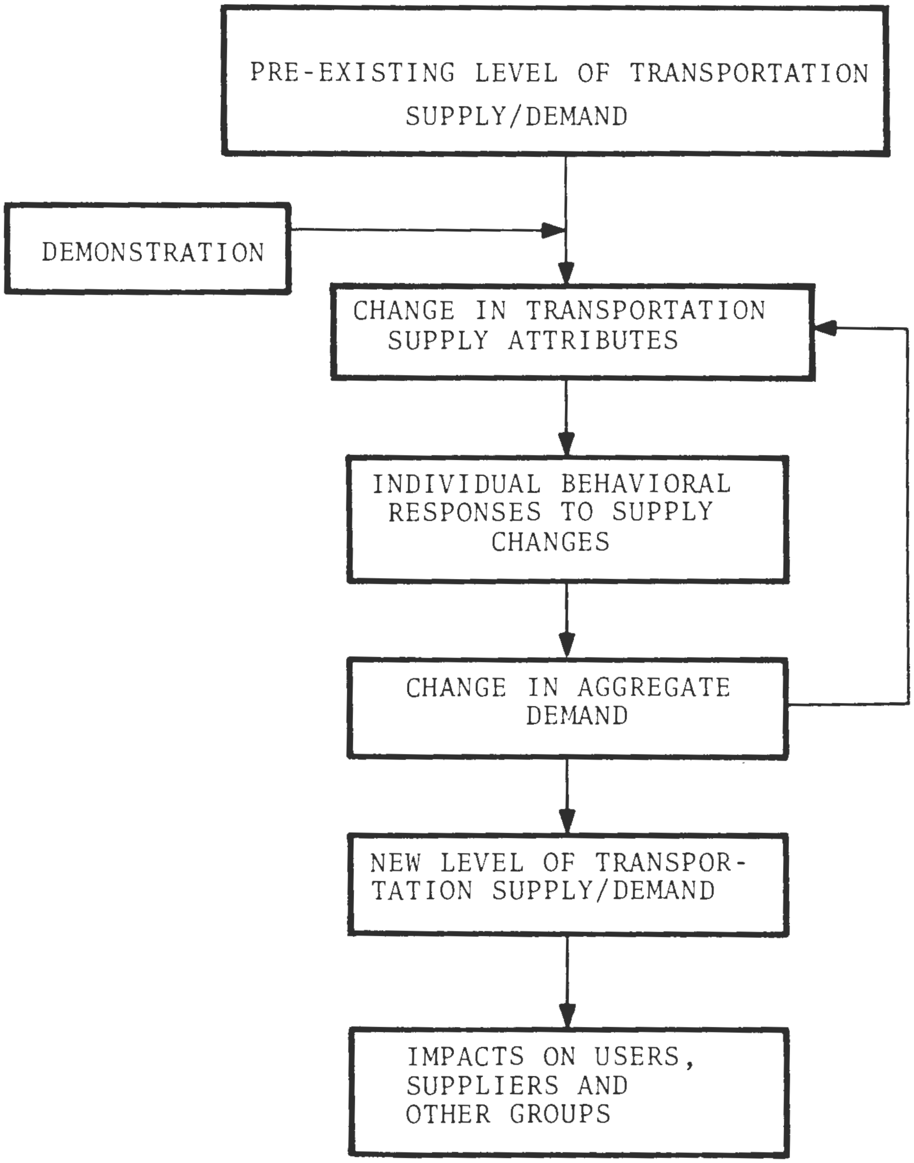


FIGURE 6-1. SUPPLY/DEMAND FRAME WORK FOR DEMONSTRATION EVALUATION

supply and demand which differs from the pre-demonstration level. The ultimate effect of the demonstration is measured in terms of impacts on users, suppliers, and other groups as appropriate. In addition to tracing the effects of a supply-side change on demand, the conceptual framework for SMD evaluations also recognizes that because of the interdependence of supply and demand, changes in demand may affect level of service. For instance, in demand-responsive systems travel time and reliability are a function of levels of demand.

SMD evaluations essentially track this sequence of events by monitoring, describing, and explaining the nature and extent of changes induced by the demonstration and the impacts of these changes on various groups. Application of this basic supply-demand framework to the evaluation of demonstrations involving a wide variety of innovations not only enhances the consistency and comparability of evaluations but also enhances the transferability of project findings by revealing cause-and-effect relationships. The standard components of these evaluations are discussed below, in the order in which they would appear in a final evaluation report.

An evaluation report typically begins with several introductory chapters describing the demonstration concept, background and objectives, and setting. These sections serve to explain the rationale and focus of the evaluation by indicating how and to what extent the demonstration is innovative, major transportation policy and planning issues and SMD objectives addressed by the demonstration, objectives and motivations of various local organizations sponsoring the demonstration, and geographic, socioeconomic, and institutional characteristics of the site which are germane to understanding the outcome and transferability of the demonstration.

The report then presents a lucid documentation of the implementation process and operations, which is needed to understand the viability, impacts, and transferability of the demonstration concept. Although reflecting site-specific conditions, the experience of the demonstration site in implementing the service can provide generally applicable guidance to other locales on possible roadblocks to implementation (viz., institutional barriers), steps required to overcome these obstacles, and a representative time period and resource level to allow for accomplishing these steps. The description of demonstration operations covers the services, equipment, management techniques, fares, marketing, and other innovative aspects of the demonstration. Where relevant, there is a discussion of problems encountered and solutions adopted, which again can be useful to other sites.

Next, the specific transportation changes introduced as part of the demonstration are analyzed in terms of their effect on user-perceived level-of-service attributes. Depending on the nature of the demonstration, one or more of the following transportation supply attributes can be affected: the choice of available modes or submodes and the level-of-service attributes of these choices such as coverage, travel time, reliability, fare, comfort, and other amenities. Current SMD projects tend to emphasize service innovations or techniques which are expected to improve travel time, coverage, and reliability--three of the five Program objectives. The analysis of travel time changes always entails segmentation of time savings into components such as access time, wait time, ride time, and transfer time, to reflect the fact that users perceive different elements of a door-to-door trip differently. Because of the somewhat innovative and complex methods of increasing spatial and temporal transit coverage applied in the SMD Program (i.e., emphasis on submodes such as paratransit services rather than conventional fixed-route bus service), the analysis of coverage changes has required the identification of new types of quantitiative measures to express coverage changes. Similarly, the analysis of reliability changes has proved to be highly complex; research is currently underway to identify an appropriate conceptual and analytical framework for dealing with reliability changes (see Chapter 2). Since a demonstration may improve some service attributes at the expense of others, the analysis of level-of-service changes attempts to understand the various trade-offs involved. Moreover, segmentation of measures by socioeconomic characteristics, time-of-day, trip purpose, or other means is generally performed in order to understand the differential benefits of level-of-service changes to different population groups.

The evaluation report then describes how and to what extent individuals within the service area alter their travel behavior in response to changes in the level-of-service provided by the transportation system and presents the aggregate (system level) demand changes. System level effects are represented by trend data on ridership (disaggregated by time-of-day, day-of-week, trip purpose, service type, and market group, as available), as well as aggregate statistics on market penetration (percent of eligible persons using service, with eligibility defined in terms of certain criteria), mode split (percent of trips by each mode or submode), and spatial patterns of travel (origin-destination volumes) collected at several points before and during the project.

At the individual level, the analysis of travel behavior entails examination of changes in trip length, destination choice, and trip frequency, all stratified by trip purpose. Analysis of demand elasticities are sometimes performed to understand the user's sensitivity to individual level-of-service attributes within or across modes. In order to understand the degree of traveler response to the service innovations and obtain as much feedback as possible on the nature and magnitude of barriers to use of the service, SMD evaluations generally examine non-users as well as users. The definition of the term non-user varies with the nature of the project, and there may be several classes of non-users appropriate for particular demonstrations. Through a variety of data collection techniques, specific reasons for non-use or non-response such as non-awareness of the service innovation, poor perception of the service, availability of alternate transportation modes, and unfavorable experience with the service are solicited from non-users. In addition, the travel and socioeconomic characteristics of users and non-users and the level of service afforded users and non-users are analyzed by a variety of statistcal techniques to determine which attributes are most correlated with usage. The findings obtained regarding barriers to and factors associated with usage can serve as indicators of needed project improvements (e.g., better outreach techniques) and the transferability potential of the demonstration.

Following the chapters on supply and demand changes, the evaluation report describes the combined effect of these changes on operator economics and efficiency. This analysis focuses on (1) the net costs of operations, (2) the utilization of vehicle capacity (one of the five SMD objectives), and (3) the cost-effectiveness of transit services. Trend data on capital and operating costs, revenues, and vehicle utilization and unit costs are broken down into detailed components and stratified by service type, route, and time of day as appropriate. Analysis of operator impacts includes consideration of factors which can explain resulting levels of effectiveness and efficiency. Issues which are typically considered include management policies, driver work rules, vehicle failures, and the size of the service area.

One or more sections of the evaluation report deal with non-travel impacts, which tend to be broader and may be more qualitative in nature than the other categories of impacts considered. These could include user impacts other than travel behavior changes (e.g., increased access to and participation in employment and recreational activities -- especially for special user groups like the handicapped and elderly), ridership and revenue losses experienced by transportation providers other than the one(s) directly involved in the demonstration, reduced transportation costs for social service agencies formerly supplying transportation for their clients, and economic or environmental changes affecting the community.

In keeping with the Program's objective of ascertaining how transferable techniques and results might be to areas other than the demonstration site, the evaluation report typically contains an analysis of the transferability of project findings. The breadth and depth of treatment of the demonstration transferability issue varies from project to project but might include the following: (1) a comparison of the demonstration project with other similar transit innovations in terms of implementation experience, operations, and the nature and magnitude of measured impacts; (2) an assessment of the extent to which demonstration findings are related to unique aspects of the implementation process, operational strategy, or demonstration site; and (3) an analysis of possible results in other settings and of the number and type of places where the demonstration concept might be appropriate.

The summary section of the SMD evaluation report deals with the overall feasibility and impacts of the demonstration service concept or technique. This generally includes an assessment of the degree to which demonstration objectives have been achieved (in particular, the applicable SMD objectives), findings with respect to the major evaluation issues, and implications regarding the potential applicability of the service concept and the transferability of findings.

EVALUATION METHODOLOGY DEVELOPMENT

Because of formidable conceptual problems and the technical difficulty of measuring and identifying the impacts of demonstration projects which take place in complex, dynamic settings, the SMD Program requires the development and application of improved and cost-effective evaluation methodology. Considerable emphasis is placed on employing the most up-to-date evaluation methodology so as to enhance the efficiency and accuracy of the evaluation process. Moreover, there is emphasis on developing and testing improved data collection and analysis techniques which have potentially broad application within the program.

This methodology development occurs through formal analytical studies, which may have a broader focus than demonstration evaluation, and through smaller, more-focused efforts initiated in response to specific measurement or analysis problems encountered in individual demonstration evaluations.

The following methodology development efforts are currently in progress: (1) an analytical study of transit service reliability; (2) a study to assess the utility of attitudinal measurement techniques for predicting and evaluating responses to transportation improvements and demonstrations; (3) an analysis of consumer trade-offs between service level and cost; (4) multi-project evaluation planning efforts for the vanpooling and auto restricted zone demonstrations; (5) research related to new sample design methods for travel demand analysis; and (6) review of and experimentation with alternative field data collection techniques for measuring transit ridership. The transit service reliability study is described elsewhere in this report (Chapter 2). The other methodology development efforts are described below.

The attitudinal measurement techniques study will have two outputs: (1) a manual describing attitude measurement techniques for transportation planning and evaluation, and (2) a final report containing a technical discussion of the validity and utility of attitude measurement techniques based on integration of information from a literature search, field experience, and analyses. In order to develop these two final products, an interim literature search report has been prepared which documents the range of current applications of attitude measurement techniques to transportation analysis and suggests attitude research areas with potential transportation applicability. Additionally, a second interim report has been prepared which is a plan for a multi-stage non-site specific field data collection and analysis of attitudes and travel behavior. Guided by these two reports, this study has begun acquiring attitudinal data from ongoing SMD site evaluations, including the user-side subsidy demonstration in Danville, OH. In the coming year additional data will be acquired and the various data sets will undergo extensive analysis.

It is expected that this study will have a twofold impact. It will make available to transportation planners and system operators specific attitudinal measurement techniques which can be used to evaluate responses to planned or implemented transportation innovations. The study will also validate the methodological bases of attitude measurement techniques, thereby designating the range of applications in which these procedures are useful.

The consumer trade-off analysis will use direct utility assessment data collected as part of the Xenia, Ohio, demonstration evaluation. The analysis involves the following steps:

1) Development of individual utility functions based on each respondent's likelihood of using each of 18 hypothetical service options (which differ in terms of values of one or more service attributes).

2) Estimation of the relationship between people's perceptions of (i.e., self-reported) service attritutes and actual values of the attributes.

3) Calibration and validation of individual choice models using the directly assessed utility functions and observed choice proportions.

4) Examination of the relation between individual differences in utility parameters and forecastable socio-demographic and environmental factors, which would permit identification of market segments with varying sensitivity to different types of transit service improvements.

This study effort will not only enhance the validity and transferability of the Xenia evaluation but also test an innovative methodological approach having widespread applicability for demonstration evaluation and service planning. In particular, this approach appears to have potential as a means of understanding traveler response to situations (as in Xenia) of rapidly or simultaneously changing levels of service and/or fare, when it becomes prohibitively expensive and in some cases infeasible to collect individual behavioral and preference data corresponding to each system change. Moreover, this technique offers significant potential to advance the state-of-the-art in market research and ridership prediction, and can thereby further the understanding of the applicability of demonstration concepts in other locales. Xenia is an opportune site in which to test the approach because: (1) its residents have actually been exposed to a wide range of service types and fares over the past few years, and (2) aggregate ridership statistics are available for each system configuration which can be compared with predicted ridership based on the direct utility measurements.

In order to provide direction for the evaluation of the four SMD demonstrations involving vanpooling, a state-of-the-art review is being conducted to synthesize what is known and needs to be learned through the demonstrations about vanpool operating characteristics, attitudes, institutional issues, and vanpooler characteristics, attitudes, and behavior. This review will entail: (a) a literature search to identify completed and ongoing research efforts related to vanpooling; (b) a review of recent legislative and institutional developments affecting vanpooling; and (c) discussions with cognizant officials in various government agencies, Congressional committees, and national ridesharing organizations to learn about their efforts or interests in the area of vanpooling.

General evaluation planning is also in progress for the five auto restricted zone projects. The intent of developing an overall strategy in advance of site-specific Evaluation Plans is twofold: first, to deal with the complex technical issues associated with ARZ evaluations in a cost-effective and timely manner; and second, to explore how the differing characteristics of each demonstration should be analyzed and the results combined so as to make an overall assessment regarding the feasibility and applicability of the ARZ concept. Among the difficult technical issues being confronted is the measurement of economic impacts, which involves conceptualization of individual and business establishment behavior, identification of appropriate data and data sources, and development or adaptation of appropriate statistical analysis techniques to isolate ARZ-induced changes from other, exogenously-induced changes.

As stated earlier, a major element of every SMD evaluation is the measurement and analysis of traveler response to the transportation changes introduced as part of the demonstration. This process most typically requires disaggregate (individual level) data describing the socio-economic and behavioral characteristic of the population in the affected area, both before and after the demonstration is implemented. Moreover, since in many situations the impact of the transportation changes is confounded with the effect of exogenous changes which occur over the demonstration period, the data collection strategy must often provide an adequate basis to support a multivariate analysis of traveler response.

Given the significant role of disaggregate data in SMD evaluations, the problem of how to collect useful, accurate data in a cost-effective manner is critical. An SMD-sponsored research study is nearing completion on sample design methods for discrete choice analysis of travel behavior. The study examines the theoretical and practical implications of using various stratified sampling strategies (viz., random, exogenous, and choice-based) to infer the distribution of attributes in the population and to estimate choice probabilities (i.e., the probability that a given class of individuals will choose a particular mode). While the study does not offer hard and fast rules for selecting the best sample design for travel behavior analysis, it does propose some general guidelines and findings which will aid the planning and design of data collection efforts for SMD and other evaluations.

Several evaluations of recently funded demonstration projects involving fixed-route transit operations (e.g., off-peak fare free transit and transit fare prepayment) have encountered some difficulties in quantifying changes in the level of transit patronage resulting from the demonstration improvements. Since the project evaluations must provide findings on the statistical significance and extent of changes in ridership, often disaggregated by route, time of day, and payment method, it has generally been necessary to augment the procedures typically used by transit properties A study which is currently underway is reexamining current patronage measurement/estimation procedures in use and will suggest an improved methodology for measuring changes in transit patronage.

CHAPTER 7

INFORMATION DISSEMINATION

INTRODUCTION

The SMD projects and other activities can only have the intended nationwide impact on public transportation improvements if the technical findings are made available in the appropriate form to the appropriate audience. Therefore, effective information dissemination is essential to achieving the ultimate goal of technology transfer.

There are a number of ways in which project findings have an influence on transit improvements in other localities. An innovation that is demonstrated may be replicated elsewhere according to recommendations included in the evaluation report. Findings regarding complex issues that can adversely impact successful implementation are useful in planning a similar project. Planners can use project cost and service results when conducting alternative analyses leading to investment decisions. Certain components of a demonstration project may be transferable in cases where the overall project concept was found to be generally unworkable or costly. Finally, data from SMD evaluations can be useful to researchers involved in long range analytical and model building efforts leading to improvements in the state-of-the-art of transportation planning methodologies.

Different audiences require different information and dissemination channels. Project findings are used by a variety of target groups, including transportation planners, transit operators, and local and state governments. Therefore, much effort has been devoted to identifying these target audiences, and developing the appropriate channels of communication. Since the SMD program attempts to facilitate change and improvement, it must necessarily adopt an active program of bringing the information to those who might benefit, and making an effort to increase the transit industry's awareness of the projects underway and the products that are being made available.

Program activities that fall into the category of information dissemination include: (1) identification of various target audiences and the type of information each will make use of; (2) Determination of the level of technical detail appropriate to these markets and their functions; (3) Recognition of particular areas of need, such as planning efforts underway in response to newly promulgated federal regulations, and development of information products aimed at serving this need; (4) Development of alternative channels and media for disseminating program findings; (5) Develop distribution mechanisms and procedures; and (6) Conduct distribution and dissemination, using the appropriate channels of communication.

Information dissemination activities and program accomplishments in the above areas are described in this chapter. They are organized into sections corresponding to the following major communication channels and media:

- SMD Program Publications
- The Urban Consortium
- Seminars and Workshops
- Conference Presentations
- Site Visits
- Audio/Visual Products

PUBLICATIONS

Because of the many projects and studies that are underway, a significant effort is devoted to writing, publishing, and distributing technical reports. These publications constitute the main channel for communicating interim and final results of projects underway, as well as descriptive information on the status and direction of the SMD program. The variety and range of documents being made available is evident from the types of SMD reports described briefly in the following paragraphs.

1. Project Evaluation reports contain a detailed technical analysis of project impacts and summarize the results of the evaluation effort. Emphasis is given to singling out the most important lessons learned regarding concept viability, cost-effectiveness, and community impacts. Implications regarding concept transferability to other sites are highlighted. Significant institutional, regulatory and labor issues that are likely to exist in other applications are discussed, together with suggested modificiations to the concept that might improve its potential effectiveness. Thus, these documents contain both the detailed technical data and results useful to planners and the summary perspective needed by local decision makers.

When findings from a phase of a project are of a special timely nature, they may warrant publication as an interim report, prepared and distributed before the project is completed. For example, results and methodologies from a pre-project survey of the incidence and trip making habits of transportation handicapped persons in Portland, Oregon, were published separately to provide guidance (see REFERENCES, Chapter 5) to cities attempting to estimate special transportation needs in order to comply with recent Federal funding requirements. Sometimes the evolution and implementation of a service concept is documented to describe the various issues that are likely to be encountered in other cities already preparing to apply the same concept.

2. Case Studies of innovative practices initiated outside the SMD Program are conducted where it appears that the service concept has sufficient applicability to warrant a wide dissemination of findings that would not otherwise occur. The scope of the case study effort will vary depending upon the project uniqueness, complexity, and other factors. Thus, case studies could be a short description of the basic features and major impacts based upon available data, or a more detailed data collection and evaluation might be warranted. During FY 1977, case studies of transit malls were conducted to document a variety of approaches that have been taken in a number of urban areas. This information is a useful adjunct to the SMD effort to demonstrate and evaluate auto restricted zones and related strategies for redirecting and improving circulation in downtown areas.

3. Results of Research and Analytical Studies such as the findings from a study of transit service reliability, or the development of quantitative methods for estimating patronage of demand-responsive transportation systems are published as part of a series of research reports.

4. The SMD Program Annual Report is a comprehensive summary of the SMD Program structure, activities, and accomplishments. It is published annually. An Executive Summary is also prepared and published separately as a digest of the Annual Report.

5. *Manuals* prepared by the Public Technology Institute for the Urban Consortium (described below) cover planning and implementation issues and processes. They contain separate volumes; the *Chief Executive Report*, an executive summary for policy level officials; the *Program Manager Report*, for the project leader; and the *Technical Guide*, with detailed implementation instructions for the project team.

In addition to published technical reports, SMD Program findings are also reviewed in transit industry publications, and the *Newsline* and *Paratransit* newsletters published by the Transportation Research Board.

Technical reports are distributed widely to state and local planning agencies, transit operations, regional planning councils, university transportation libraries, and transportation professionals in public and private organizations. In addition to the standard distribution list, copies are sent in response to individual requests. Also, SMD reports may be obtained from the National Technical Information Service.

THE URBAN CONSORTIUM

The Urban Consortium for Technology Initiatives contains appointed representatives from 34 jurisdictions; the 28 largest cities and 6 selected urban counties with populations of more than 500,000. Its major purpose is to identify, to give priority to, and to encourage technological research for the most pressing urban problems. Where the SMD Program or other offices within the US DOT have developed solutions to these problems, the Consortium undertakes a program for information exchange and dissemination regarding promising new approaches. In other words, the Urban Consortium serves as a two way channel of communication between the SMD program and key representatives of our major urban areas.

Public Technology, Inc. now serves as Secretariat to the Urban Consortium, providing day-to-day administration and technical staff. Public Technology, Inc., was formed in 1971 by six large national public interest groups for local governments and officials, including the Council of State Governments, the National Association of Counties and the National League of cities.

The Consortium developed a list of urban needs which were subsequently broken down into ten areas, such as transportation, energy, and public health. A task force was formed for each subject and is proceeding to study, find funds, and develop solutions for the needs as identified by the Consortium. The Consortium's Transportation Task Force has considered some 94 needs and reduced the number to 10 of the highest priority, e.g., transportation for the elderly and handicapped and transit system productivity.

Of these top priority problems, some will be addressed by major projects aimed at furthering the state-of-the-practice in local government. The form of the project depends upon the nature of the problem -- in some cases the solution might be a conference, a computer program, or a set of manuals.

Manuals developed by the Task Force and staff will be demonstrated in jurisdictions across the US and revised if necessary based on the experienced gained. For example, in the first year, one of the priority problems identified by the Transportation Task Force was "Preferential and Exclusive Lanes." A draft set of manuals on Planning and Implementing Priority Techniques for High Occupancy Vehicles is now available and is being disseminated widely. This manual is being tested in several cities and the manual will be revised in 1978 based upon those experiences.

The manual documentation which has evolved during the first year of the transportation project activities is substantially different than conventional user manuals. Typically, system "manuals" have focused on the technical and operational issues actually involved with putting a new technology in place. While this type of information is critical to localities trying to decide how to address transportation imrpovements, work by the Urban Consortium indicated that simply summarizing such data was not enough.

As a result, the set of Priority Treatment Manuals which has been developed describes a broad decision and implementation process a city must go through to put an improved system into service, and the specific roles of participants in the process. Thus, the comprehensive scope of these manuals, covering issues from early policy development through system planning and implementation, makes them userful not only to localities considering deployment of particular options, but also to federal-level users involved in design and development of urban programs.

Similar sets of manuals will be developed on the topics of Transportation for the Elderly and Handicapped and Trasnportation Planning and Impact Forecasting Techniques.

The Service and Methods Demonstration Program and the Urban Consortium Transportation Task Force recognize the need to get current information about ongoing demonstration projects out to local government officials if those officials are to make intelligent decisions regarding the use of these techniques. One page information bulletins, called SMD Briefs, are being developed to fill this need.

SEMINARS AND WORKSHOPS

Seminars and workshops sponsored by the SMD Program provide for a face-to-face presentation, discussion, and question-and-answer process among SMD technical staff and others in the transportation community. They provide a setting for presentation and discussion of SMD research findings which are related to a class of transportation service concepts or a specific set of issues which are of a timely nature. In this context, needs and priorities for further development can be assessed in conjunction with a discussion of results of recent research efforts.

The six regional seminars on small community transit that were held in 1976 provided a forum for the presentation of case study findings and for the sharing of experiences in all aspects of public transportation for small cities. A similar series of seminars is planned to disseminate information on transportation services for elderly and handicapped persons. A shortage of SMD staff positions prevented conducting these in 1977, and it is hoped that preparation will begin in 1978. Other previous workshops have dealt with applications of bus-priority techniques and the utility of attitudinal survey techniques in transportation planning and evaluation.

CONFERENCE PRESENTATIONS

Various aspects of the SMD program have been presented at technical conferences over the year. SMD Program staff made presentations at seven national conferences, including the Transportation Research Board, Transportation Research Forum and American Public Transit Association (APTA). At these conferences, SMD staff have participated in panel discussions, presented papers on the status and findings of demonstration projects, discussed important issues impacting the implementation of innovative services, and participated in conference workshops.

Presentations interpreting SMD findings were also made at state, local and national conferences designed to address a particular set of issues or class of services. For example, SMD staff contributed to six local and national conferences on transportation needs of the elderly and handicapped, and four state and regional conferences on rural transportation, paratransit, and central city development.

The National Conference on Transit Performance held during FY1977 was a series of workshops sponsored by UMTA and conducted by the Urban Consortium. SMD staff, transit operators, planners, government officials (state, regional and federal), and other transportation professionals were brought together to discuss trends in transit performance, labor, and institutional impacts on transit system productivity. Recommendations regarding standards for measuring and reporting transit performance were presented and published.

The SMD Program Office is represented at meetings of the Organization for Economic Cooperation and Development (OECD), an international technological committee for information sharing. Special meetings held during FY 1977 were concerned with traffic policies for improving the urban environment and low-density area transportation concepts.

These conferences provide an important forum for the direct communication of the experience and perspective of indiviudals who have been involved with implementation and evaluation of SMD projects.

SITE VISITS

Site visits to transit demonstration projects have always played an important role in the technology transfer process. They offer unique opportunities to observe the project and meet with those who have been extensively involved with the implementation and operation. Visits and tours of demonstration sites are actively encouraged by the SMD Program. As one example of the interest local areas have in making such visits, officials from 70 different cities have visited one of the demonstration sites since the project started two years ago.

In addition to visits by interested representatives of other urban areas, visits by grantees to other similar demonstrations is being fostered. For example, grantee representatives of the SMD vanpooling projects in Norfolk, Knoxville, Minneapolis, and Marin County (S.F. Bay Area) have toured the sites to compare implementation approaches and discuss common issues. This exposure is conducive to establishing regular communication between persons at these sites and is likely to foster a cross fertilization leading to more successful demonstrations.

AUDIO-VISUAL MEDIA

Audio-visual media are an effective means of presenting introductory and conceptual information about transportation alternatives to a wide audience. Audio-visual (A/V) products can better illustrate the operation and use of public transportation systems than written material by itself, because of the dynamic nature of the functions and interactions between drivers, dispatchers, equipment, and passengers. A/V media can, in some cases, serve as a substitute for a site visit to an innovative operation or a group of similar transportation systems. In addition to viewing the system in operation, an audience can see and hear riders comment on how they use the service and observe transit operators relating the "whys" and "hows" of their system.

A film showing a variety of cost effective approaches to providing a particular form of service is useful to convey a basic understanding to local decision-makers or citizen's groups who may not be exposed to or inclined to review related technical documentation. Therefore, A/V media are a powerful tool for acquainting the general public with transportation service concepts and stimulating interest in transportation improvements, as well as imparting an awareness of the various considerations involved in the trade-offs between service alternatives.

Audio visual material is developed in conjunction with detailed technical reports which can be referred to by members of a viewing audience who desire to seek out more quantitative information about cost and service characteristics. Thus, while the film or slide presentation is aimed at a target audience with a wide range of familiarity and expertise related to transportation concepts, for some it is sufficient to serve their information needs and for others it is only an introduction to the more detailed documentation.

A film illustrating examples of four transit service alternatives appropriate to small cities, Transit Options for Small Communities, was produced in 1976 as part of the Small Community Transit Program. This film, together with a set of related technical reports, constituted the resource materials for the regional Public Transit Seminars for Small Cities. It is currently being distributed through the UMTA regional offices and the Audio-Visual Division of the U.S. DOT Public Affairs Office. Over 1000 requests for the film were received during the first year of distribution, and it has already been viewed by over 30,000 persons in 47 states, including legislators, local decision-makers, planners, public groups, and conference attendees.

Another film, illustrating recently developed techniques for providing public transportation for the elderly and handicapped, is being produced. It is intended to serve as introductory information on special transportation services, including public and private DRT operations, accessible full sized buses in fixed-route service, methods for coordinating social service agency transportation needs, and the application of user-side subsidies.

Because of the current UMTA regulations requiring provision of transportation services for the elderly and handicapped in federally funded transportation projects, there is a great deal of interest in the subject matter being dealt with in this film. Communities currently engaged in planning services that will accomodate transportation handicapped persons are seeking information on service options and approaches to coordination. This recent surge of activity has created demand for introductory information that can be useful in selecting alternatives for further consideration.

☆U.S. GOVERNMENT PRINTING OFFICE: 1978—700-375/168