Service and Methods Innovations in Urban Transportation in the United States

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I. Introduction

This article describes current U.S. developments and Federal initiatives related to service and methods innovations in urban transportation. The term "service and methods" refers to a broad spectrum of innovative concepts which are directed toward more efficient utilization of existing transportation resources. These strategies are often distinguished from technological innovations on the basis of cost and the time needed for implementation. That is, while technological innovation is generally associated with new transportation systems requiring large capital expenditures on vehicles and guideway facilities and long planning and construction horizons, service and methods innovations typically focus on low-cost modifications to existing equipment, improvements in management and operational procedures, and implementation of novel service concepts.

This article is divided into five sections. Following this introduction, Section II presents a brief overview of urban transportation in the United States. Its purpose is to identify the issues which U.S. urban transit operators must currently address and the constraints under which they function. Section III describes the Federal role in transportation research and development, and identifies several specific Federal programs designed to encourage improvements in urban transportation services and methods. Section IV summarizes the major research, development, and demonstration activities underway in the United States in the area of service and methods improvements. The emphasis in this section is not so much on presenting specific findings related to individual strategies, but rather on illustrating the diversity of service and methods innovations being examined and applied in the United States. Finally, Section V presents a concluding assessment of the current status and future directions of service and methods innovations.

II. A Historical Perspective of Urban Transportation in the United States

Urban transportation in the United States has evolved in response to a variety of long-term trends and changes in urban structure, lifestyle, and economic conditions. To better understand the problems which innovative transit services must presently address, it is useful to review briefly some of these factors.

Perhaps the most influential force on urban structure in general, and on urban transportation in particular, was the trend toward suburbanization ex-

perienced in nearly every U.S. city during the 1950's and 1960's. Initial migrations of middle income households to the fringes of urbanized areas were soon followed by the development of suburban shopping centers and the relocation of employment sites.[1] As the inner suburbs became more densely populated, new growth moved further and further out.[2] This movement was aided substantially by Federally subsidized construction of radial urban freeways, which connected outlying suburbs with their central cities.

As the suburbs grew, the central city tax base was eroded. This resulted in higher taxes and reduced services for remaining urban residents and further hastened the suburbanization process. By the late 1960's, most U.S. cities had experienced some degree of deterioration in their central cities, characterized by increasing proportions of low income households, high rates of unemployment, decreasing retail sales, and high vacancy rates for residential and business property.[3]

The impact of suburbanization and the resultant decline of central cities on urban transportation has been significant. As residential development became more decentralized, it became apparent that conventional fixed-route transit service could not economically provide acceptable levels of service to low-density areas. Substantially better transportation service could be achieved with the private automobile, particularly on relatively congestion-free suburban streets during off peak-hours. As patronage declined in the suburbs, transit service was curtailed to reduce operating costs. This initiated a spiral of further declines in patronage, followed by more service cutbacks until suburban off-peak transit service was all but eliminated.[4]

Transit service in the central city was also adversely affected by suburbanization, but for different reasons. As the residential and business tax base migrated to the suburbs, central city governments were forced to reduce local services or significantly increase local property taxes. Public transportation was among the first services to be cut back because cost savings could be achieved without conspicuous changes in service.[5]

Peak-hour commuter service fared somewhat better in response to suburbanization. Despite the growth of suburban employment sites, a large proportion of the metropolitan work force still traveled to jobs in the central city.[6] The resultant high volumes of radially oriented trips made conven-

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1. A. HAWLEY, URBAN SOCIETY: AN ECOLOGICAL APPROACH, 171-172, 177-185 (1971).
2. *Id.* at 185-187.
3. *Id.* at 248-252.
4. U.S. DEP'T OF TRANSPORTATION, 1972 NATIONAL TRANSPORTATION REPORT 42-59 (1972).
5. For example, by eliminating expenditures on preventive maintenance, operating budgets could be reduced in the short run. The long term consequences of these actions seemed relatively unimportant at the time because the automobile appeared destined to be the dominant mode of urban transportation in the foreseeable future.
6. According to the 1970 Census of Population, BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, CHARACTERISTICS OF THE POPULATION, Table 242 (1970), over 50% of the workers residing in

tional fixed-route transit not only economically feasible from the operator's viewpoint, but competitive with the automobile in terms of level-of-service. However, in order to provide adequate capacity for the peak periods, a transit operator must be prepared to accept excess capacity during the off-peak. Transit drivers are typically unwilling to work split shifts and many labor agreements include provisions that preclude extensive use of part-time drivers. Thus, while commuter operations represent the most productive aspect of urban transit service in the United States today, the inefficiencies arising as a result of idle equipment and operating personnel during the off-peak hours undermine the overall financial viability of transit.

Although suburbanization, with its resultant adverse influence on urban public transportation, is still a powerful force in most U.S. cities, there is evidence that some recently emerging factors are beginning to offset this trend. One such factor is the high rate of inflation presently being experienced throughout the United States.[7] Housing costs have increased at even higher rates. In major U.S. metropolitan areas, the median price of a new home is now over $70,000.[8] These escalating costs are making it more and more difficult for young families to purchase homes in the suburbs.

Inflation is also having a reinforcing influence on certain family lifestyle trends which became prominent in the late 1960's. These trends include a significant increase in the proportion of women in the work force, a general decrease in family size, and a significant increase in the number of childless families.[9] Inflation has increased the need in a number of moderate income households for both husband and wife to work, and has created strong economic disincentives to having a large number of children.

The combined effects of inflation and changing lifestyles have begun to influence many of the values which prompted the trend to suburbanization. While the ideal of a single family home may still be a goal of the average American family, it is becoming unattainable for many because of housing costs. The best housing buys today in many U.S. metropolitan areas are in the central cities, in the form of old rowhouses which can be renovated or new high rise urban condominiums. Moreover, many of the motives for suburban living which centered around children (*e.g.*, high quality public schools or open space for play) are less relevant for young child-

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U.S. metropolitan areas commuted to jobs located in the central city. Over 7% of all workers commuted to the central business district (CBD) of the city.

7. According to the BUREAU OF LABOR STATISTICS, U.S. DEP'T OF LABOR, HANDBOOK OF LABOR STATISTICS 239 (1977), the consumer price index or CPI has risen at a rate of over 6% per year since 1967.

8. For example, in August 1978 the median price of a single family home in California was $71,452. *Famous Last Word*? FORBES, (Oct. 30, 1978) at 50.

9. BUREAU OF THE CENSUS, U.S. DEP'T OF COMMERCE, SOCIAL INDICATORS 1976 62, 365 (1977).

less couples. These motives are often replaced by a desire for such urban amenities as proximity to cultural and entertainment centers, closeness to the workplace, and diversity of shopping opportunities.

The cumulative effect of these factors has been to create a social and political climate in the United States which is supportive of central city revitalization. Since public transportation is seen as a critical element in structured urban development, most plans for revitalization of U.S. cities call for major improvements in the quality of service of their urban transit systems.

Moreover, as a consequence of the widespread movement for social reform which began during the 1960's in the United States, there has been a conscious effort in national domestic policy to focus on the needs of disadvantaged segments of the population. Since public transportation is the primary means of mobility and access to employment for autoless people in urban areas, recent urban transportation policies have focused on the need to provide public transportation which is accessible to all urban residents.[10]

This combination of generations of neglect, followed by a reviving interest in urban public transportation, has placed a tremendous burden on local transit operations. Transit operators are suddenly being besieged with demands for improved service from all segments of the population. New, middle-class urban dwellers want improved levels of service to make public transportation an attractive alternative to the automobile. Local and national transportation policymakers want expanded transit coverage to attract suburban commuters out of their automobiles for the work trip. Special user groups, such as the transportation handicapped, want public transit to be accessible to them.[11] Additionally, everyone wants transit operations, as well as other public services, to hold down costs and local property taxes.

Because of these demands, local transit managers are currently faced with two overriding problems in their operations. The first problem is how to utilize existing resources more efficiently to provide better service at a lower cost. The second problem is how to make transit service attractive to new user groups within the constraints imposed by local financial resources. The solution to these problems lies in more effective management strategies and in technological and service innovations.

The scope of service and methods innovation goes beyond improving the quality and efficiency of transit operations. Planners and policymakers acknowledge that the automobile will continue to be the dominant mode of transportation in the United States for the foreseeable future (as evidenced,

10. *See, e.g.*, B. ADAMS, TRANSPORTATION POLICY FOR A CHANGING AMERICA (1978).

11. *See, e.g.*, GREY ADVERTISING, INC., SUMMARY REPORT OF DATA FROM NATIONAL SURVEY OF TRANSPORTATION HANDICAPPED PEOPLE (1978); Reed, *Equal Access to Mass Transportation for the Handicapped*, TRANSP. L.J. 167 (1977).

for example, by recent statements of the Secretary of Transportation).[12] Consequently, the achievement of broader national goals, such as energy conservation and improved air quality, requires innovative strategies whose objective is the more efficient utilization of the private automobile.

Local transit agencies, planners, and elected officials are reluctant, however, to develop and implement new, unproven techniques. One reason for this is concern over cost. Since most urban public transportation systems in the United States are currently operating at a deficit, there is a justifiable resistance to any additional expenditure of public funds unless an obvious return on the investment can be expected. Fiscal constraints have a strong dampening effect on local and private sector interest in underwriting research and development activities. Another barrier to innovation is a basic aversion to risk, characteristic of local elected officials who want to be reasonably sure that anything they sponsor will produce more positive than negative public reaction. A final reason for reluctance to innovate is inadequate knowledge and experience regarding the operational feasibility and impacts of novel service concepts and techniques. Bridging this barrier requires a combination of demonstrated success in relevant settings and adequate information transfer.

III. The Role of the Federal Government in Fostering Urban Transportation Innovations

Because of the above-mentioned barriers to innovation in urban transportation; the Federal Government has assumed a lead role in the research and development [R&D] of new transit technologies, innovative management, and operational strategies. This Federal R&D effort is conducted within the U.S. Department of Transportation largely through programs administered by the Urban Mass Transportation Administration [UMTA].[13]

The UMTA R&D effort for urban transportation innovation spans the entire spectrum of research activities with:

- basic research on innovative concepts, travel behavior, vehicle and guideway technology, and urban structure;

12. *See, e.g.*, B. Adams, Keynote Speech [delivered at the Conference on Basic Research Directions for Advanced Automotive Technology, Boston, MA, February 13, 1979].

13. The legislative mandate to carry out urban transportation research and development was provided in Section 6(a) of the Urban Mass Transportation Act of 1964, 49 U.S.C. § 1605 (1978). This statute authorizes the Secretary of Transportation to "undertake research, development and demonstration projects in all phases of urban mass transportation . . . which he determines will assist in the reduction of urban transportation needs, the improvement of mass transportation service, or the contribution of such service toward meeting total urban transportation needs at minimum cost." The Act also authorizes "the development, testing and demonstration of new facilities, equipment, techniques and methods." The basic commitment of UMTA to fostering and conducting urban transportation research and development has been reinforced through numerous policy statements issued since passage of this Act.

- development of prototypes for new technologies, services, and methods;
- demonstration and deployment of innovative technologies and strategies in operational environments;
- evaluation of demonstrations to determine institutional and operational feasibility, assess transportation and socioeconomic impacts, and gain new insights for further application and innovation;
- transfer of new technology information to transit operators, planners, and decision-makers.

UMTA currently spends about $70 million annually in support of its R&D activities.[14] Relatively little of the actual research is conducted by UMTA staff, however. Instead, research contracts and demonstration grants are awarded in order to make the most effective use of the wealth of transportation expertise available both in the United States and elsewhere in the world. Recipients of UMTA research funds include state and local transportation agencies, universities, private consultants, equipment manufacturers (both domestic and foreign), and other Federal agencies.

A unique organizational component contributing to the Department of Transportation's research program is the Transportation Systems Center [TSC]. TSC is a multimodal systems research, analysis, and development organization within DOT's Research and Special Programs Administration. The technical staff at the Center is comprised of over 600 personnel reflecting a broad range of engineering, scientific, socioeconomic and other analytical skills. It therefore provides the Department of Transportation with a strong in-house technical capability to look at intra- and intermodal transportation problems from a multidisciplinary perspective.

The Center conducts high priority technological and socioeconomic research for the Secretary of Transportation and all of the modal administrations within DOT. TSC currently performs over $60 million worth of transportation research annually.[15] In terms of urban transportation research, TSC received over $21 million, or 30 percent of UMTA's research budget in fiscal year 1978.[16] Research related to service and methods innovations is conducted principally within three UMTA program areas which are briefly described below.

A. *Technology Development and Deployment*

The objective of the Technology Development and Deployment Program is to direct current and future transportation technology to be responsive to critical issues in urban transportation. Research activities sponsored

14. URBAN MASS TRANSPORTATION ADMINISTRATION, U.S. DEP'T OF TRANSPORTATION, INNOVATION IN PUBLIC TRANSPORTATION: A DIRECTORY OF RESEARCH, DEVELOPMENT AND DEMONSTRATION PROJECTS—FISCAL YEAR 1977; (1977) [hereinafter cited as TRANSPORT INNOVATIONS].

15. RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION, U.S. DEP'T OF TRANSPORTATION, TSC ANNUAL REPORT 18 (1978).

16. *Id.*

under this program include the development, testing, demonstration, and evaluation of selected new vehicle technologies, development and review of equipment specifications, promotion of standardization of transit vehicles and equipment, and qualification of new and improved transit products.[17] The program also sponsors evaluations and assessments of existing technology in the United States and abroad,[18] and transmits relevant information to its client groups through conferences, seminars, workshops, technical papers, and project and special reports.

B. Service and Methods Demonstrations

The Service and Methods Demonstration [SMD] Program is intended to develop new techniques for using the current generation of transit equipment to provide improved quality, quantity, and efficiency in public transportation. A large number of innovative methods for increasing the level of service and productivity of transit have been developed both by UMTA and by various transit properties throughout the world over the past few years. The SMD Program focuses on evaluating the effectiveness of these techniques in real-world operational environments, and in promoting the most promising of them to local transit operators. Current SMD projects and evaluations are being conducted in the areas of conventional transit service innovations, paratransit, pricing policies, and services to special user groups.[19] This program also includes an information dissemination element to insure that local transit operators are kept up to date on promising innovations.

C. Transit Management Techniques and Methods

The Transit Management Program is designed to assist local transit operators in making the most effective use of their limited funds. Assistance takes the form of research and demonstration projects to develop new and improved management techniques for the transit industry, as well as

17. Specific projects sponsored under this program include TRANSBUS—the standardized transit bus design, Automated Guideway Transit Technology, and the Morgantown People Mover Demonstration Project. For a more complete listing of projects funded in FY1978, *see* Transport Innovations, *supra* note 14, at 1-67.

18. For example, the U.S. Department of Transportation has consummated Memoranda of Understanding with both the Ministry of Transportation and the Ministry of Research and Technology of the Federal Republic of Germany, which include exchange of information and cooperation in the field of urban transportation, among other subjects. Specific joint, cooperative projects have been negotiated under the umbrella of these agreements, including assessments of automated guideway systems and paratransit services.

19. Many of the projects sponsored under this program are identified in Section IV of this article. For a summary and discussion of all current SMD demonstrations and activities *see* Urban Mass Transportation Administration, U.S. Dep't of Transportation, Service and Methods (B. Spear ed. 1979) [hereinafter cited as Service and Methods Report].

efforts to implement these techniques in the day-to-day operations of transit systems.[20]

IV. Selected Strategies for Improving the Cost-Effectiveness and Quality of Urban Transportation

This section describes specific service and methods innovations which are being developed and implemented in operational environments with the objective of improving the efficiency and/or quality of urban public transportation.[21] These strategies are indicators of current directions of change within the U.S. urban transportation sector; they also serve to illustrate the varied roles of the Federal government in promulgating innovation. The service concepts and methods to be examined fall into five broad areas:

1. Transit operations and management techniques
2. Traffic management techniques
3. Paratransit services
4. Transit pricing and fare payment techniques
5. Special user group services

A. Transit Operations and Management Techniques

The improvement strategies in this category are all aimed at achieving more efficient deployment of resources available to the transit operator for the production of transit services. Some are designed to improve the process by which services are planned and managed, while others relate directly to improved service configuration and operations. These improvements may provide the transit operator with the choice of increasing the quantity and quality of transit at small additional cost, or maintaining existing levels of service at lower cost.

In recent years, the concept of automated scheduling has been receiving increasing attention within the transit industry as one means of improving the efficiency of operations and reducing operating costs. One such system is the Vehicle Scheduling and Driver Run-Cutting [RUCUS] system, developed by UMTA's Offices of Transit Management and Planning Methods and Support to assist transit operators in the preparation of service, vehicle, and driver schedules.[22] RUCUS produces optimized vehicle schedules by minimizing vehicle layover and deadhead travel time, and has

20. Specific projects sponsored under this program include transit marketing demonstrations in Baltimore, MD, and Nashville, TN, a computerized program to assist transit operators in vehicle scheduling (RUCUS), and the creation of a centralized data bank for mass transit financial and operating information. For a more complete listing of projects funded in FY1978, *see* Transport Innovations, *supra* note 14, at 113-117.

21. As noted earlier, these strategies all have a common orientation toward *near-term* improvements, relying for the most part on existing technology, and relatively *small capital investment*.

22. Transport Innovations, *supra* note 14, at 114.

a driver run-cutting procedure that minimizes the number of driver run assignments, driver pay-hours, overtime, and other resources, subject to the constraints of labor union contract rules.[23]

Since 1974, the Urban Mass Transportation Administration and the Transportation Systems Center have been actively involved in promoting the implementation of RUCUS within the transit industry. Financial support in the form of capital and operating assistance grants has been provided by UMTA to transit authorities for RUCUS implementation projects. TSC has provided on-site technical support to transit operators and state/local transportation agencies in the implementation and application of RUCUS. Additional research and development efforts have included: (1) a review and assessment of current RUCUS implementations; (2) the publication of guidelines for implementing the system; and (3) the development of RUCUS software improvements.[24] At the present time, the RUCUS system is operational or in the process of being implemented in over 30 transit authorities in the U.S. and Canada.[25]

The procedures used by transit operators to plan and evaluate route modifications are unstructured and informal.[26] Two Service and Methods Demonstration projects to be implemented in Omaha, Nebraska and Columbus, Ohio are designed to provide transit operators with improved, more cost-effective data collection and analysis tools to assess the operational characteristics, costs, and patronage of individual routes and to identify new markets or transit service.[27] These demonstrations will emphasize the development of: (1) quantitative service evaluation criteria which explicitly specify the service goals and policies that transit management seeks to attain; (2) efficient surveying and sampling techniques to collect appropriate data; and (3) an easy-to-use software package which can apply the service criteria to evaluate existing routes, and utilize statistical techniques to identify new transit markets.

The Service and Methods Demonstration Program is currently sponsor-

23. URBAN MASS TRANSPORTATION ADMINISTRATION, U.S. DEP'T OF TRANSPORTATION, VEHICLE SCHEDULING AND DRIVER RUN CUTTING—RUCUS PACKAGE OVERVIEW (The MITRE Corporation ed. 1973).

24. Recent publications resulting from this research include: URBAN MASS TRANSPORTATION ADMINISTRATION, U.S. DEP'T OF TRANSPORTATION, RUCUS IMPLEMENTATION MANUAL (The MITRE Corporation ed. 1975), and URBAN MASS TRANSPORTATION ADMINISTRATION, U.S. DEP'T OF TRANSPORTATION, SERVICE, INVENTORY AND MAINTENANCE SYSTEM COMPUTER SYSTEM DESCRIPTION (the MITRE Corporation ed. 1975).

25. URBAN MASS TRANSPORTATION ADMINISTRATION AND FEDERAL HIGHWAY ADMINISTRATION, U.S. DEP'T OF TRANSPORTATION, TRANSPORTATION SYSTEM MANAGEMENT: STATE OF THE ART 150-152 (Interplan Corporation ed. 1977).

26. TRANSPORTATION SYSTEMS CENTER, U.S. DEP'T OF TRANSPORTATION, A PRELIMINARY ANALYSIS OF THE REQUIREMENTS FOR A TRANSIT OPERATIONS PLANNING SYSTEM (M. Couture, R. Waksman & R. Albright ed. 1978).

27. SERVICE AND METHODS REPORT, *supra* note 19, at 128-129.

ing the study, development, and evaluation of a number of techniques designed to improve the quality of conventional transit service with little or no increase in resource consumption. Several of the techniques are specifically intended to improve the speed, reliability, and coverage of transit service in the growing suburban travel market, which has been dominated by the private automobile. One concept, variously known as timed transfer, focal-point or pulse-point service, modifies existing transit schedules so that routes are synchronized to intersect at activity centers or other transfer points at the same time, thereby minimizing transfer times. This technique has been utilized in the Canadian cities of Vancouver and Edmonton for several years and is about to be implemented in a few U.S. cities as well.[28] The SMD Program plans to sponsor a special evaluation of the Canadian and U.S. applications of this concept to obtain accurate information on the impacts on transit service, operations, costs, and traveler response.

Another technique designed to enable transit operators to provide improved suburban service without increasing costs is the zoned bus system. This concept, which was implemented successfully in Osaka, Japan, involves the conversion of a radially oriented bus system into a system comprised of trunk lines and feeders.[29] The SMD Program is interested in examining the applicability of this concept for U.S. transit operations via a demonstration project and evaluation.

The SMD Program is also sponsoring a special in-depth evaluation (but not the implementation) of a major restructuring of bus routes in Denver, Colorado.[30] This is the first example of a system-wide revision of service at one point in time in the United States. The transformation of the bus network from a radial to grid-line pattern is intended to provide improved service to Denver area residents (whose travel patterns are currently less focused on the downtown).

Current SMD efforts in the area of transit service reliability improvements provide an example of the full cycle of Federal involvement in the R&D process. As a first step, a comprehensive study was conducted by TSC on the subject of transit reliability.[31] The study examined the impact of service reliability from the perspective of the transit operator as well as the traveler, developed empirical measures of service reliability, determined causes of reliability problems, explored techniques for improving reliability,

28. TRANSPORTATION SYSTEMS CENTER, U.S. DEP'T OF TRANSPORTATION, TIMED TRANSFER FOCAL POINT SERVICE (K. Schaeffer ed. 1976).

29. SERVICE AND METHODS REPORT, *supra* note 19, at 128-129.

30. TRANSPORTATION SYSTEMS CENTER, U.S. DEP'T OF TRANSPORTATION, EVALUATION PLAN FOR THE DENVER FREE-FARE DEMONSTRATION AND ROUTE RESTRUCTURING PROJECT (DeLeuw, Cather & Co. ed. 1978).

31. URBAN MASS TRANSPORTATION ADMINISTRATION, U.S. DEP'T OF TRANSPORTATION, TRANSIT SERVICE RELIABILITY (M. Abkowitz, H. Slavin, R. Waksman, L. Englisher, & N. Wilson ed. 1978).

and made recommendations for future research and demonstrations. A key finding of the study was the significant influence of reliability on (a) mode and departure time choices, and (b) the cost of providing service. This suggests that operators could, by improving reliability, reduce operating costs and possibly induce additional ridership. On the basis of this research study, planning is currently underway for two SMD-sponsored demonstrations aimed at alleviating problems of headway and run time variability without incurring significant additional operating costs.[32] Under consideration are relatively simple strategies such as scheduling changes and route modifications, as well as strategies involving real-time monitoring and control of operations. These demonstrations will be thoroughly evaluated by TSC; and resulting information derived therefrom regarding the feasibility, operational effectiveness, and impacts of the demonstrated strategies will be disseminated to transit operators, planners, and researchers.

Another major technological innovation which has been the focus of a full-cycle, Federally-sponsored R&D effort is the automatic vehicle monitoring [AVM] system, which is aimed at improving transit fleet management and operations. AVM applies modern electronic tracking and communication technologies to provide continuous information on the status and location of each vehicle in a fleet to a central dispatcher. The dispatcher, in turn, can use real-time strategies to control headways, respond to emergency situations, and notify waiting passengers of service and schedule status. In addition, the AVM system provides a full record of all vehicle operating and passenger load data which can be used for planning and modifying routes and schedules. Since 1974, TSC has been serving as UMTA's Systems Manager for this multi-million dollar program, with the responsibility for performing feasibility studies of multi-user AVM system concepts (including several in operation in Europe), developing technical specifications for a U.S. system, field testing alternative tracking subsystems, and conducting and evaluating a trial deployment of a complete system in the Los Angeles area (the latter phase to be initiated later this year).[33]

B. Traffic Management Techniques

The preceding section focused on a variety of strategies which could be implemented by transit operators for the purpose of improving the quality and efficiency of their own service operations and management. This section describes a set of techniques which are considerably broader in scope and intent (and thus outside the direct or sole purview of the transit

32. Service and Methods Report, *supra* note 19, at 67-70.

33. B. Blood, R. DiGregorio, B. Kliem, M. Miner & P. Segota, UMTA Automatic Vehicle Monitoring System [paper presented at the APTA Annual Meeting, New York, September 1979].

operator), affecting not only the quality and efficiency of transit service, but also the operating environment for the private automobile. Traffic management techniques have as their primary objective the more efficient utilization of existing urban roadspace through the encouragement of high-occupancy vehicles [HOV's] and/or the discouragement of solo-occupant vehicles. Aside from the obvious benefit of avoiding costly new construction of highway and parking facilities, these techniques support broader societal objectives such as energy conservation, improved air quality, and downtown revitalization. Current UMTA R&D efforts (undertaken principally through the SMD Program) involve two main types of innovative traffic management techniques: preferential treatments for HOV's and several concepts which have, at their core, the restriction of automobile traffic and enhancement of the pedestrian environment.

Over the past decade, the SMD Program and one of its predecessors, the joint UMTA/FHWA Urban Corridor Demonstration Program, have sponsored a variety of projects involving preferential freeway lanes and access ramps for buses and carpools. Specific techniques which have been demonstrated include separated exclusive lanes (Shirley Highway in Northern Virginia), nonseparated concurrent flow lanes (Santa Monica Freeway in Los Angeles and Interstate I-95 in Miami), contraflow lanes (Houston, Texas and the appr(ach to the Lincoln Tunnel in New Jersey), and ramp metering (Minneapolis).[34] In general these projects have emphasized positive incentives for high-occupant vehicle usage, such as the travel time and reliability improvements afforded by the preferential treatments, and the addition of express bus service and park-and-ride lots to improve the convenience of using buses and carpools. The widespread dissemination of planning and operational guidelines and evaluation findings from these demonstrations has been an important factor in the growing adoption of the techniques in a number of urban areas.

Recent SMD experience with physically nonseparated concurrent flow reserved lanes is illustrative of two noteworthy points regarding the R&D process: first, the desirability of multiple experiments involving a particular concept, and second, the valuable role of project failures, as well as successes in advancing the state of knowledge. Aside from sponsoring demonstrations of this concept in Los Angeles and Miami, the SMD Program performed a special evaluation of a similar locally initiated project on Boston's Southeast Expressway. The three projects offered considerable variation on the basic concept in terms of site characteristics, operational design, and most notably, degree of public acceptance. The Miami project still operates with only minor operational changes, whereas the Santa

34. URBAN MASS TRANSPORTATION ADMINISTRATION, U.S. DEP'T OF TRANSPORTATION, SERVICE AND METHODS DEMONSTRATION ANNUAL REPORT 73-144, 177-180 (D. Kendall ed. 1975).

Monica and Southeast Expressway projects met with severe public opposition and early demise. Careful analysis and comparison of the implementation process, operational characteristics, and impacts of these varied applications have revealed the many generic weaknesses of this concept compared to other HOV preferential treatments. Moreover, valuable lessons regarding safety, enforcement, and public information have been learned for application in future projects.[35]

To complement its efforts aimed at improving the performance of high-occupancy modes on the freeway or line-haul portion of the trip leading to the downtown, the SMD Program has also sponsored demonstrations and research involving preferential treatment techniques for buses on urban arterials. Techniques under examination include concurrent flow, contraflow, reversible, and median bus lanes as well as priority signalization.[36] In this area as in others, the SMD Program attempts to enhance the effectiveness of its own resources by designing R&D activities which supplement and synthesize the progress and experience gained through local initiative.

Turning now to auto restriction/pedestrian enhancement strategies, the two major areas of research and demonstration within the SMD Program have been auto restricted zones [ARZ's] and transit malls. ARZ's are areas in which auto traffic is restricted or prohibited, and represent a promising means of revitalizing the downtown environment by improving transit operating conditions and pedestrian access. The ARZ concept is not new; several successful applications exist in cities throughout Europe and the Far East.[37] However, it was felt that a major Federal R&D effort encompassing detailed studies, multiple demonstrations, evaluations, supporting research and information dissemination was warranted in order to assess and demonstrate the potential applicability, public acceptance, and impacts of the concept in the U.S. urban environment. A comprehensive ARZ feasibility and site selection study completed in 1977 concluded that there were substantial opportunities for ARZ's in American cities with a strong activity base.[38] Based on recommendations from this study, the SMD Program is sponsoring four ARZ demonstrations in Boston, Massachusetts, Memphis,

35. URBAN MASS TRANSPORTATION ADMINISTRATION, U.S. DEP'T OF TRANSPORTATION, A COMPARATIVE ANALYSIS OF RESULTS FROM THREE RECENT NON-SEPARATED CONCURRENT FLOW HIGH OCCUPANCY FREEWAY LANE PROJECTS: BOSTON, SANTA MONICA, AND MIAMI (H. Simkowitz ed. 1978).

36. URBAN MASS TRANSPORTATION ADMINISTRATION, U.S. DEP'T OF TRANSPORTATION, PRIORITY TREATMENT FOR HIGH OCCUPANCY VEHICLES IN THE UNITED STATES: A REVIEW OF RECENT AND FORTHCOMING PROJECTS (R. Fisher & H. Simkowitz ed. 1978).

37. Well over 130 cities in Europe and the Far East have initiated some form of auto restriction including Besancon, France, Munich, West Germany, Leeds, England, Vienna, Austria, and Singapore, Malaysia. For an overview of this concept and a comparative analysis of the European experience, *see* URBAN MASS TRANSPORTATION ADMINISTRATION, U.S. DEP'T OF TRANSPORTATION, AUTO RESTRICTED ZONES: BACKGROUND AND FEASIBILITY (W. Herald ed. 1977).

38. *Id.*

Tennessee, Providence, Rhode Island, and New York City.[39] These projects offer considerable variation in terms of area characteristics, mix and design of project elements, and geographic and financial scope. They are expected to provide valuable information for planners, transit operators, and local decision-makers on a broad range of issues, including impacts on transit and auto level-of-service and costs, travel behavior, and environmental and economic impacts.

Although smaller in scale than ARZ's, transit malls are gaining increasing popularity in the U.S. as a means of improving the operating efficiency and attractiveness of public transit, while concurrently providing an improved environment for pedestrians and shoppers. A transit mall is a street on which transit vehicles are given exclusive or near-exclusive access, sidewalks are widened, and pedestrian amenities are added. Access for automobiles is denied or strictly limited, except for cross-street traffic. Since a number of transit mall projects have been implemented under local auspices, there has not been a need for Federally sponsored demonstrations of the concept. However, the SMD Program has worked to foster the understanding and diffusion of this traffic management strategy by sponsoring a major evaluative study of the malls implemented to date.[40] The study has produced valuable transferable information on the planning and implementation process, operational effectiveness, costs, and impacts of transit malls.

C. *Paratransit Services*

As noted earlier, the process of urban decentralization has created new travel markets which cannot be served in a cost-effective manner by conventional transit. During the past few years, increased attention has been focused on the potential of paratransit services to satisfy these needs as well as provide mobility options in smaller, low-density communities. Paratransit services are defined as "those forms of intra-urban passenger transportation which are available to the public, are distinct from conventional transit (scheduled bus and rail), and can operate over the highway and street system."[41] Included within this definition are pre-arranged ridesharing systems such as carpooling, vanpooling and subscription bus, and street-hail or phone-requested services such as shared-ride taxi, demand-responsive transportation, and jitney. The possibilities for variation within each of these basic service concepts are numerous, since there is a

39. Service and Methods Report, *supra* note 19, at 46-56.

40. Urban Mass Transportation Administration, U.S. Dep't of Transportation, Streets for Pedestrians and Transit: Examples of Transit Malls in the United States, (D. Koffman & R. Edminster ed. 1977).

41. R. Kirby, K. Bhatt, M. Kemp, R. McGillivray & M. Wohl, Paratransit: Neglected Options for Urban Mobility 9 (1974).

wide range of options with respect to specific operating policies, service levels, providers (public and private), and target markets served. Moreover, there are many possibilities for incorporating individual paratransit services within a "family" of integrated urban transportation services, the specific composition of which can be tailored to the particular activity patterns, local objectives, and financial resources of the urban area.

The SMD Program has taken a lead role in studying and experimenting with a variety of paratransit service concepts, beginning with small-scale, single-concept demonstrations, and then progressing to more complex projects involving multiple service concepts in larger operating environments. The Program has sponsored nearly 20 paratransit demonstrations, plus several special evaluations of public and privately funded paratransit systems.[42] A major feature distinguishing the paratransit demonstrations from other SMD-sponsored projects is their emphasis on alleviating the institutional barriers to service provision, as well as examining operational, behavioral, and cost aspects of the individual service concepts.

One area of concentration within the Program has been the development and promulgation of the transportation brokerage concept. In most urban areas, the agencies traditionally responsible for transportation planning and operations tend to have a skeptical view of the potential role of novel paratransit services. This skepticism may stem from lack of information about such services, general resistance to implementing new concepts, fears about the competitive position of conventional transit services, or other factors. There is typically no established mechanism for determining the travel needs of specific market segments and identifying the most appropriate providers for serving those needs. Underutilized transportation resources may be available in the private sector (*e.g.*, the taxi industry), but there is no functioning channel for tapping these resources and integrating them with ongoing services in an efficient, cost-effective manner.

SMD projects in Knoxville, Tennessee, Westport, Connecticut, Chicago, Illinois, and other locales have developed and are refining the brokerage approach, which is intended to fill this institutional void.[43] The transportation broker can perform a variety of functions, including the identification and coordination of demand and supply, as well as lobbying to remove institutional obstacles to the efficient use of existing transportation resources in the public and private sectors. Moreover, the scope of brokerage operations can vary in terms of geographic area and number of target markets served. The Knoxville demonstration, initiated in 1975, constitutes the first implementation of the brokerage concept on a regionwide basis. While the local mode shift impacts of this project have not been substantial,

42. SERVICE AND METHODS REPORT, *supra* note 19, at 139-190.
43. *Id.* at 161-169.

the demonstration has had a significant impact from a national perspective. Its accomplishments on legislative, insurance, and other institutional fronts and its wealth of operating experience have been widely disseminated to provide guidance for emerging brokerage operations in other areas.[44]

UMTA has sponsored research and development related to demand-responsive transit since the mid-1960's, with a full spectrum of activities ranging from concept feasibility studies to demonstrations (the earliest being in Haddonfield, New Jersey[45]). Recent UMTA efforts in the area of demand-responsive transit have focused on the major operational and institutional issues which have not been adequately explored in previous local or Federally sponsored efforts. Primary areas of emphasis have been: (1) experimentation with and analysis of a variety of service options across a wide range of service areas and target groups; (2) development and assessment of different models for combining paratransit services and integrating them with conventional fixed-route services; (3) testing of different mechanisms for encouraging the private sector to provide such services in a cost-effective manner; and (4) development, deployment, and testing of computer dispatching technology.[46]

SMD-sponsored demand-responsive demonstrations in Rochester, New York, Westport, Connecticut, and Xenia, Ohio have collectively explored a variety of areawide and feeder service options.[47] They have provided useful empirical evidence on level-of-service, demand, and cost characteristics as well as transferable experience with respect to planning, implementation, and operational issues. For example, findings from the Rochester and Xenia projects suggest that demand-responsive services are generally not successful replacements for existing fixed-route systems, but are better suited to providing areawide and many-to-one coverage in low-density areas or acting as a feeder service to existing fixed-route systems.[48] Computerized dispatching techniques and hardware are being developed under the auspices of UMTA's Technology Development and Deployment Program. Operational testing and evaluation at two SMD sites (Rochester and a forthcoming demonstration in Orange County, California) will provide

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44. *See, e.g.*, URBAN MASS TRANSPORTATION ADMINISTRATION, U.S. DEP'T OF TRANSPORTATION, THE KNOXVILLE TRANSPORTATION BROKERAGE PROJECT (F. Davis, J. Beeson & F. Wegmann ed. 1978).

45. NEW JERSEY DEP'T OF TRANSPORTATION, HADDONFIELD DIAL-A-RIDE: FINAL REPORT (1974).

46. SERVICE AND METHODS REPORT, *supra* note 19, at 140-161.

47. For final reports on each of these demonstrations, *see* URBAN MASS TRANSPORTATION ADMINISTRATION, U.S. DEP'T OF TRANSPORTATION, 1 THE ROCHESTER NEW YORK INTEGRATED TRANSIT DEMONSTRATION: EXECUTIVE SUMMARY (SYSTAN, Inc. ed. 1979); URBAN MASS TRANSPORTATION ADMINISTRATION, U.S. DEP'T OF TRANSPORTATION, THE XENIA, OHIO, MODEL TRANSIT SERVICE DEMONSTRATION PROJECT: TRANSIT AND PARATRANSIT SERVICES FOR A SMALL URBAN AREA, (Cambridge Systematics, Inc., ed. 1979).; URBAN MASS TRANSPORTATION ADMINISTRATION, U.S. DEP'T OF TRANSPORTATION, THE WESTPORT CONNECTICUT INTEGRATED TRANSIT SYSTEM (CACI, Inc. ed. 1979).

48. SERVICE AND METHODS REPORT, *supra* note 19, at 158-161.

information on the service efficiency and cost impacts of computerized dispatching which can be disseminated to operators of such systems nationwide.

The final area of Federal initiative within the broad category of paratransit services has been ridesharing, here defined to include carpooling and vanpooling. Although carpooling is by no means a novel mode of transportation (accounting for some 27% of work trips in 1970[49]), the five-year period since the energy crisis has witnessed an increasing flurry of activity aimed at the formal encouragement and organization of carpooling and, more recently, vanpooling. Various Federal agencies have had different areas and degrees of responsibility over this period, making it very difficult to provide a cohesive summary here.

However, the efforts of UMTA's SMD program in the area of vanpooling are illustrative of the manner in which the Federal government has attempted to complement ongoing non-Federally initiated efforts so as to advance the state-of-the-art. Despite the proliferation of areawide and employer-sponsored ridesharing programs throughout the country, there have been rather limited efforts and funds devoted to systematic evaluations of the operational effectiveness, costs, and impacts of these programs. The four SMD-sponsored projects in Knoxville, Tennessee, Marin County, California, Norfolk, Virginia, and Minneapolis, Minnesota are intended to overcome this deficiency through carefully designed, comprehensive evaluations being performed by TSC.[50] At a more operational level, these four projects are developing and testing a variety of third-party, multi-employer approaches to vanpooling which would probably not be attempted by an individual employer or local area due to market and institutional barriers.[51]

D. Transit Pricing and Fare Payment Innovations

A major objective of most of the innovative strategies discussed above has been to achieve more efficient utilization of existing transportation resources. Pricing strategies, applied alone or in combination with physical or operational strategies, can potentially play an important role in meeting this objective by controlling the volume, pattern, and composition of traffic. Through the application of transit pricing incentives such as fare reductions or fare payment innovations, the attractiveness of transit relative to auto can

49. Federal Highway Administration, U.S. Dep't of Transportation, Nationwide Personal Transportation Study—Report No. 1: Automobile Occupancy (H. Strate ed. 1972).

50. Service and Methods Report, *supra* note 19, at 169-183.

51. In Minneapolis, for example, seven multi-employer sites are involved in the demonstration, and a private third-party broker leases out "seed vans" to get the vanpools started. In the Marin County demonstration, ridesharing promotion is handled by the Golden Gate Bridge and Transportation District, which has provided special incentives through differential pricing of bridge tolls.

be enhanced, thereby inducing auto users to travel by transit. Similarly, the application of auto pricing disincentives such as fees for using congested roadways and parking surcharges can reduce the attractiveness of auto relative to transit and may induce a shift to high occupancy modes. Consequently, the ability of the transportation system to accommodate traffic can be increased without capital investment.

Many of the Transportation System Management plans currently being proposed by cities do not include pricing strategies because local staffs, for the most part, lack technical familiarity with these concepts. Fare reductions have been implemented under local initiative in the past, and limited experimentation with fare elimination has occurred (*i.e.*, free-ride days, free-fare downtown zones), but relatively little is known about the magnitude of impacts of these strategies.[52] Moreover, in the case of pricing disincentives, the barriers to innovation include not only inadequate knowledge and experience, but also considerable skepticism as to the political feasibility of the strategies. Title II of the National Mass Transportation Assistance Act of 1974, provided for the "research and development, establishment and operation of demonstration projects to determine the feasibility of fare-free transit."[53] UMTA incorporated this concept into a broader spectrum of pricing policies, and embarked on a major research and development program to advance the state of knowledge about these techniques and to disseminate the information widely to local officials and planners.[54]

In recent years, it has been suggested that elimination of fares on urban transit systems, on either a restricted or unrestricted basis, could contribute to urban revitalization in a number of ways.[55] The increased ridership resulting from free fare could reduce urban congestion and pollution and might enhance the public's image of transit. In addition, a free transit system would improve the mobility of downtown residents, who tend to be more elderly, low-income, and auto-dependent than the general population. Finally, a free transit system would make downtown more accessible to area residents and workers and might therefore help strengthen the declining retail sector. Although interest had existed in the fare-free transit concept for many years, only limited locally-initiated experimentation has occurred. These projects were generally very restrictive in nature and/or of short duration. Without knowledge of the actual benefits of a free-fare sys-

52. URBAN MASS TRANSPORTATION ADMINISTRATION, U.S. DEP'T OF TRANSPORTATION, LOW FARE AND FREE-FARE TRANSIT: SOME RECENT APPLICATIONS BY U.S. TRANSIT SYSTEMS (the Urban Institute ed. 1977).

53. 49 U.S.C. § 1601, *et seq.* (1964).

54. URBAN MASS TRANSPORTATION ADMINISTRATION, U.S. DEP'T OF TRANSPORTATION, REPORT TO CONGRESS CONCERNING THE DEMONSTRATION OF FARE-FREE MASS TRANSPORTATION (1975).

55. *See, e.g.*, U. ERNST, POTENTIAL CONTRIBUTIONS OF SHORT-TERM TRANSIT POLICIES TO DOWNTOWN REVITALIZATION: A PRELIMINARY ASSESSMENT (1978).

tem (and the magnitude of potential disbenefits such as joy-riding and vandalism), operators were unwilling to accept the loss in revenue which would result. The SMD Program is currently sponsoring the operation and evaluation of four fare-free demonstrations.[56] In Albany, New York, and Knoxville, Tennessee, fares are eliminated in off-peak periods in the downtown area. In Denver, Colorado, and Trenton, New Jersey, fares are eliminated on the entire transit system during non-commuting hours. These projects are being thoroughly evaluated by TSC, and will provide information on the operational aspects of fare-free transit and impacts on ridership, mobility, revenues, traffic congestion, and retail sales.

During the 1960's, when exact change requirements were instituted on most U.S. transit systems, many operators began to sell prepaid tickets, passes, and tokens to their riders. Although these prepayment programs were originally designed to mitigate the inconvenience to passengers of requiring exact change, in recent years operators have begun to consider them as marketing tools. In a recent TSC-sponsored study[57] it was found that more than 80% of all U.S. transit operators offer one or more types of prepaid fare instruments. Operators allege that transit fare prepayment programs confer many benefits, including increased ridership and revenue, improved cash flow and heightened public awareness of the transit system. However, the study concluded that little quantitative evidence existed to validate these operator claims.

The impact of increased usage of prepaid instruments on transit ridership and operator economics is currently being evaluated in the SMD Program. Marketing promotions of transit passes and tickets are being conducted in four demonstration cities (Austin, Texas, Phoenix, Arizona, Sacramento, California, and Jacksonville, Florida).[58] The findings from these projects will assist transit operators in designing well-balanced, rational prepayment programs for their areas.

The SMD Program is also studying the feasibility of instituting other fare payment innovations which can improve operating efficiency.[59] One of these is credit card fare post-payment, which employs a machine readable credit card and automated recording equipment at the transit stop or in the vehicle which can read the card and store information about the trip. The system could be used to improve record-keeping and information management as well as to increase patronage, since deferred payment may induce increased usage of transit. Credit card post-payment has been used in several demonstrations designed for the elderly and handicapped; the SMD

56. SERVICE AND METHODS REPORT, *supra* note 19, at 106-122.

57. TRANSPORTATION SYSTEMS CENTER, U.S. DEP'T OF TRANSPORTATION, TRANSIT FARE PREPAYMENT (the Huron River Group, Inc. ed. 1976).

58. SERVICE AND METHODS REPORT, *supra* note 19, at 92-102.

59. *Id.* at 102-106.

Program plans to implement the concept on a systemwide basis. Another fare payment concept which is being studied for implementation in the United States is self-service fare collection, which is common in Europe. The SMD Program has sponsored a study of the potential of these systems for application in the U.S.[60] In the near future, system requirements will be specified, and candidate cities will be identified.

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 transit and other ridesharing arrangements. Only by the application of specific disincentives to the low occupancy automobile and the introduction of tangible and visible public transportation improvements can significant increases in transit ridership be obtained. Proposed auto pricing schemes can be divided into two categories: those affecting vehicles on the road and those affecting parking. Auto pricing schemes are particularly attractive policy instruments because, unlike transit fare elimination, no revenue loss is generated. In fact, the fees which are collected from auto drivers might be used to improve or subsidize transit service.

Despite widespread interest in the potential impacts of the concept, auto pricing disincentives have not yet been implemented in an American city because of formidable political and legal barriers. Any policy which exacts a user fee tends to be unpopular, and when the policy also infringes on citizens' freedom to operate their automobiles at will, implementation becomes very difficult. A variety of legal questions have yet to be resolved. For example, flexibility in introducing taxes or surcharges at municipal parking lots may be limited by the terms of the bonding agreements made when the lots were constructed. The SMD Program is interested in implementing and evaluating a variety of pricing disincentive demonstrations. To that end, a large-scale research effort was undertaken to refine the concepts and to establish procedural guidelines for implementing them.[61] In addition, potential demonstration sites were actively solicited. As a result of these efforts, a parking pricing demonstration, the first of its kind, will be implemented in Madison, Wisconsin, this year.[62] It is anticipated that the

60. URBAN MASS TRANSPORTATION ADMINISTRATION, U.S. DEPT OF TRANSPORTATION, SELF SERVICE FARE COLLECTION—REVIEW OF LEGAL AND LABOR CONSTRAINTS ON U.S. IMPLEMENTATION (the MITRE Corporation ed. 1979).

61. This research effort is being conducted by the Urban Institute. To date, a number of working papers have been produced, including K. BHATT, J. EIGEN & R. HIGGINS, IMPLEMENTATION PROCEDURES FOR PRICING URBAN ROADS (1976); and K. BHATT & M. BEESLEY, PLANNING AND IMPLEMENTING A ROAD PRICING AND TRANSPORTATION IMPROVEMENT PACKAGE (1975).

62. F. SPEILBERG, TRANSPORTATION IMPROVEMENT IN MADISON, WISCONSIN (1978).

project will demonstrate pricing disincentives to be politically feasible—thus interesting other cities in future application of the concepts.

E. Special User Group Services

The term special user groups generally refers to those persons who, because of age, income or physical disabilities do not have the use of an automobile and are therefore dependent on public transportation or special arrangements to meet their mobility needs. It is estimated that almost seven and a half million Americans have trouble with or cannot use regular public transit because of age or a handicap.[63]

Public transit's inability to be responsive to all the travel needs of these market segments has promoted several Federal initiatives to improve transportation opportunities and services available to them. The Urban Mass Transportation Act of 1964 as amended in 1970 declares "the national policy that elderly and handicapped persons shall have the same right as other persons to utilize mass transportation facilities and services; that special efforts shall be made in the planning and design of mass transportation facilities and services so that the availability to elderly and handicapped persons of mass transportation which they can effectively utilize will be assured."[64]

More recently the Department of Transportation has been developing regulations to implement Section 504 of the Rehabilitation Act of 1973 which mandates that Federally funded programs be accessible to all handicapped persons.[65] Complementing these legislative initiatives are a variety of UMTA-sponsored R&D activities (mostly within the SMD Program) which have the dual objective of improving understanding of the characteristics and travel requirements of the elderly and handicapped, and developing, demonstrating and evaluating various innovative service concepts. A major concern is to identify strategies which are effective in alleviating the physical and economic barriers to travel, and yet are compatable with the financial ability of local communities.

One area of SMD Program emphasis has been to improve the efficiency with which existing transportation resources are used to serve the needs of special user groups. The existing network of social service agency transportation is fragmented, duplicative, and often inefficient. Typically, each agency services its own clients with separate vehicles, staffs, facilities, and budgets. There is little coordination among agencies in a region to deliver service in an efficient manner. One agency may lack the

63. Grey Advertising, Inc., Summary Report of Data from National Survey of Transportation Handicapped People 8 (1978) [hereinafter cited as Survey of Handicapped].

64. 49 U.S.C. § 1612(a) (1970).

65. 29 U.S.C. § 794 (1970).

resources to provide any transportation for its clients while a neighboring agency has excess vehicle capacity. In most cases, client demand for service exceeds supply, and limitations on service must be imposed.

Coordination of these disparate agency resources has been viewed as a promising means of achieving more cost-effective services for special user groups. However, there are formidable institutional barriers to such coordination, the foremost being agency skepticism about the feasbility and benefits of entering into coordination schemes. The SMD Program has attempted to narrow the knowledge and experience gap in this area by sponsoring demonstrations involving a variety of approaches to service coordination. Projects in diverse locations such as Naugatuck Valley, Connecticut, Mercer County, New Jersey, and Pittsburgh, Pennsylvania, are providing a wealth of experience regarding institutional and operational issues, as well as quantitative data on the impacts of coordination on service quality, costs, and travel behavior.[66]

Another concept designed to improve the quality and utilization of transportation services for special user groups is the user-side subsidy concept. Under this approach, eligible individuals are provided with transportation tickets or vouchers at reduced prices. Transportation providers accept these vouchers as payment for services and then redeem them at face value from the public agency. Since the decision of which provider to use rests with the passenger, the subsidy mechanism is expected to stimulate transportation providers to improve the quality of service offered these groups. Through a carefully designed set of demonstrations in four sites (Danville, Illinois, Montgomery, Alabama, Kinston, North Carolina, and Lawrence, Massachusetts), the SMD Program is obtaining an extensive body of information on the feasibility, costs, and impacts of this innovative technique in a variety of local contexts, involving fixed-route transit and shared ride taxi operations.[67] With respect to service innovations, the SMD Program has sponsored demonstrations of two major types: specialized demand responsive services and wheelchair-accessible fixed-route bus service. Projects in Portland, Oregon, Baton Rouge, Louisiana, and the Lower East Side in New York City, as well as many of the agency transportation coordination and user-side subsidy projects, have provided useful information for planners and local decisionmakers regarding the operational characteristics, costs, and impacts of a wide range of specialized demand

66. SERVICE AND METHODS REPORT, *supra* note 19, at 236-245.

67. D. Kendall, A Comparison of Findings from Projects Employing User-Side Subsidies for Taxi and Bus Travel (1979) [paper prepared for distribution at the UMTA Regional Seminars on Interim and Specialized Transportation for Handicapped and Elderly Persons, August 1979]. For a summary of findings presented in this paper, *see* SERVICE AND METHODS REPORT, *supra* note 19 at 209-236.

responsive service options.[68] In the case of wheelchair-accessible bus service, SMD Program efforts have focused on special evaluations of several locally initiated projects and two demonstrations in Palm Beach County, Florida, and Champaign-Urbana, Illinois.[69] The projects collectively offer considerable variations in terms of their use of retrofitted vs. new buses, the deployment of lift-equipped buses, and local operating environments. Given the recent legislative initiatives regarding fully accessible services, the findings from TSC's evaluations of these projects will be particularly relevant to transit properties and local officials across the country.

The final area of Federal R&D emphasis with respect to special user group service improvements is basic research which both draws upon and guides the demonstration evaluation effort. A recent TSC study[70] used data from a variety of SMD projects to examine the travel preferences, perceived barriers, and resultant travel choices made by elderly and handicapped persons. One of the more significant findings of the study was that while fully accessible public transportation would provide substantial benefits for a small subgroup of the target population, its overall impact on tripmaking and other dimensions of mobility is likely to be small.[71] The SMD Program has also sponsored major research to determine the size and characteristics of the elderly and handicapped population.[72] One particularly useful output for planners and operators is the extensive statistical information on trip frequencies, and geographic and temporal variations in travel patterns.

V. Conclusion

The number and diversity of innovative services and methods currently being demonstrated and evaluated in the United States reflects the commitment of the Federal government to improve public transportation through research and development. It is recognized, however, that no single set of transportation strategies will be universally applicable in all U.S. cities. Consequently, the Federal role has been to encourage local areas to decide for themselves which strategies would be most suitable for their needs. The multiplicity of service and methods demonstrations is designed to test each strategy in a variety of settings, thereby providing local transit operators, planners, and policymakers with the necessary information to select those strategies which best address their specific needs.

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68. Service and Methods Report, *supra* note 19, at 195-209.

69. *Id.* at 246-262.

70. Transportation Systems Center, U.S. Dep't of Transportation, Recent Evidence from UMTA's Service and Methods Demonstration Program Concerning the Travel Behavior of the Elderly and the Handicapped 161 (B. Spear, E. Page, H. Slavin & C. Hendrickson ed. 1978).

71. *Id.* at 45-46.

72. Survey of Handicapped, *supra* note 63.

The discussion of particular services and methods presented in Section IV also illustrates the varied state of knowledge about specific strategies. In some areas, such as traffic management, it is possible to make some definitive statements regarding the feasibility of implementation and ranges of effectiveness for particular strategies. In other areas, such as transit operations, we are on the verge of major evaluation efforts which are likely to produce definitive results in the near future. In still other areas, such as auto pricing disincentives, we must currently rely on findings from other nations which have more experience in the implementation and operation of these strategies.

Clearly, the opportunity and need for international cooperation exists in urban transportation service and methods research. Urban transportation in the United States has already benefited considerably from the results of innovative projects in other nations. Conversely, findings from current and future service and methods implementations in the United States should be useful elsewhere in the world. This transfer of information should be encouraged through cooperative research efforts and more extensive dissemination of demonstration results.