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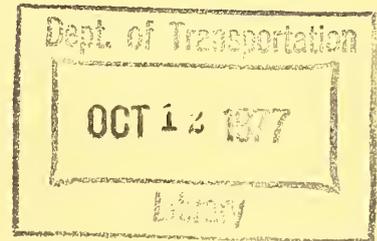
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UMTA/TSC Project Evaluation Series

Evaluation of Service and Methods Demonstration Projects: Philosophy and Approach

**Interim Report
May 1977**



Service and Methods Demonstration Program



**U.S. DEPARTMENT OF TRANSPORTATION
Transportation Systems Center**

Prepared for

**Urban Mass Transportation Administration
Office of Transportation Management
and Demonstrations**

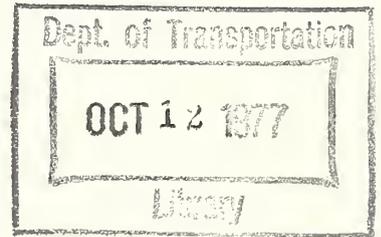
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16. Abstract This document contains a summary description of the philosophy and technical approach underlying the evaluation of Service and Methods Demonstration projects. It describes the supply-demand framework for performing urban transportation impact evaluation and the application of this framework to the following demonstration topics: background and setting; project implementation and operations; level of service (supply) changes; travel behavior (demand) changes; operator impacts and productivity; and non-travel impacts.			
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METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol What You Know Multiply by To Find Symbol

LENGTH

in inches
ft feet
yd yards
mi miles

cm centimeters
m meters
km kilometers

AREA

in² square inches
ft² square feet
yd² square yards
mi² square miles
acres acres

cm² square centimeters
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ha hectares

MASS (weight)

oz ounces
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 (2000 lb)

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t tonnes

VOLUME

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pt pints
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ft³ cubic feet
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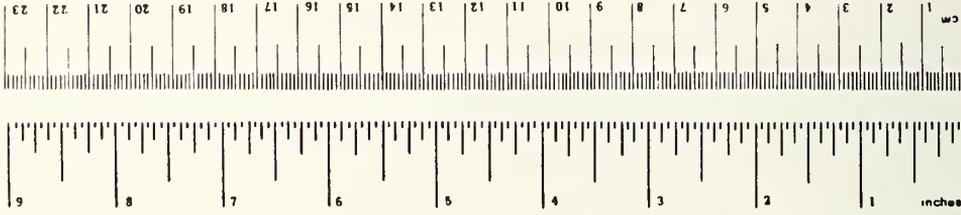
TEMPERATURE (exact)

Fahrenheit temperature

Celsius temperature

°C

5/9 (after subtracting 32)



Approximate Conversions from Metric Measures

Symbol When You Know Multiply by To Find Symbol

LENGTH

mm millimeters
cm centimeters
m meters
km kilometers

inches
feet
yards
miles

AREA

cm² square centimeters
m² square meters
km² square kilometers
ha hectares (10,000 m²)

square inches
square yards
square miles
acres

MASS (weight)

g grams
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t tonnes (1000 kg)

ounces
pounds
short tons

VOLUME

ml milliliters
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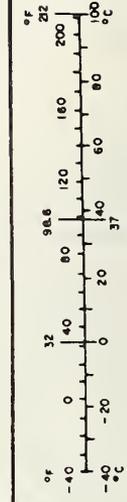
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Celsius temperature

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Fahrenheit temperature

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Preface

This document contains a summary description of the philosophy and technical approach underlying the evaluation program that TSC conducts for UMTA's Office of Service and Methods Demonstrations. Much of the material included herein was initially prepared for the Service and Methods Demonstration Program FY76 Annual Report. This document has been published and distributed separately for review and comment by a wide range of analysts and planners with expertise in areas and issues related to evaluation. The contents are intended to serve as the basis for forthcoming versions of the report, Evaluation Guidelines for Service and Methods Demonstrations. Until a revised version of the Guidelines is completed, this document, along with the existing version of the Guidelines and other written material furnished by TSC, will provide direction for conducting Service and Methods Demonstration project evaluations.

Table of Contents

<u>Section</u>	<u>Page</u>
1. INTRODUCTION	1
2. EVALUATION PHILOSOPHY	3
3. EVALUATION PROCESS AND METHODOLOGY DEVELOPMENT	5
4. ANALYTICAL FRAMEWORK FOR SMD EVALUATIONS	7
5. CONTENT OF DEMONSTRATION EVALUATIONS	9
5.1 Demonstration Background and Objectives	9
5.2 Demonstration Setting	9
5.3 Demonstration Implementation and Operations	10
5.4 Level-of-Service (Supply) Changes	11
5.5 Travel Behavior (Demand) Changes	12
5.6 Operator Impacts and Productivity	13
5.7 Non-Travel Impacts	14
5.8 Summary	15

1. INTRODUCTION

UMTA's Service and Methods Demonstration (SMD) Program has the objective of improving existing transit operations by sponsoring the development and implementation of new techniques and services on a nationwide basis. These innovations, which rely on existing transit technology, are intended to produce short range improvements in the quality and quantity of public transportation. Frequently this requires a combination of modal improvements, integrated and coordinated in order to supply a variety of transportation services for various users, trip purposes, and travel patterns. The program also aims to reduce institutional and regulatory friction that so often blocks innovation. Further it seeks to achieve a more efficient balance of travel demand among modes, times of day, and geographic areas. The use of physical and operational techniques to increase the capacity of existing facilities is also being demonstrated and evaluated in the program.

The UMTA Service and Methods Demonstration Program pursues demonstration projects and studies in four major program areas: traffic management, paratransit, service for transit dependents, and price and service improvements.

Traffic Management emphasizes priority treatment for transit and other high occupancy vehicles to expedite peak period movement of passengers. Types of projects include exclusive busways, reserved lanes on freeways, arterials, and city streets; signal preemption, transit malls, and auto restricted zones.

Paratransit includes a broad range of services that occupy the transportation spectrum between conventional transit and the private auto, i.e., dial-a-ride, jitney, vanpools, taxis, subscription buses, and other forms of ride sharing. The main intent is to provide improved service and to increase vehicle occupancy.

Service for Transit Dependents seeks to develop specialized services that will address the needs of the transit dependent person--the elderly, handicapped, young, and poor. Included are novel methods to improve inner city circulation, "reverse" commuting, specialized equipment for elderly and handicapped transportation, subscription services, demand-responsive services, and user side subsidies.

Price and Service Improvements seek to increase transit patronage and reduce auto usage through the exploration of a

variety of price-related (i.e., economic) incentives, disincentives, and service improvements.

The SMD Program has established five major objectives listed below which would be clearly indicative of improved transportation services and which could be attained through conduct of the demonstrations:

Reduce travel time by transit

Increase the area coverage of transit service

Improve the reliability of transit service

Increase the productivity of transit vehicles

Improve the mobility of transit dependents.

These objectives are subject to modification or augmentation as national and local priorities and needs change.

A crucial aspect of the Service and Methods Demonstration Program is the performance of technically sound and objective evaluations of the individual demonstration projects. 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. At present, TSC has full technical and programmatic responsibility for a program of demonstration evaluation. 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.

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. In addition to their specific utility to the SMD Program, the demonstration evaluations also provide increased knowledge essential for improved urban transportation planning and national policy formulation.

This paper describes the philosophy and approach underlying SMD evaluations. The contents include a discussion of the following: (1) an outline of the SMD evaluation philosophy; (2) a description of the evaluation process and current methodology development; (3) an analytic framework for conducting SMD evaluations; and (4) a detailed description of specific elements within the SMD evaluation framework.

2. EVALUATION PHILOSOPHY

The SMD evaluations are structured around three basic questions:

What changes were made to the transportation system?

What were the impacts of these transportation changes?

Why did these impacts occur?

As will be explained in the following sections, these questions are addressed 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 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. Each evaluation is built around the basic analytical framework described in the next section, with emphasis placed on using state-of-the-art data collection and analysis techniques which are consistent from the standpoint of efficiency, accuracy, and output.

This stress on consistency does not, however, preclude recognition of the unique learning potential within each demonstration. Since demonstrations vary in terms of objectives, relevant issues, complexity content, and context, the scope and emphasis of each evaluation must be 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. Only under special circumstances (e.g., a major transportation change in a large area or corridor) is an analysis conducted of longer-run changes such as land use changes (e.g., employment and residential location).

Whatever the mix of short and long-run impacts examined, strong attempts are made in the design and conduct of demonstration evaluations to monitor the presence of, and isolate the effects of, exogenous (i.e., non-demonstration-related) factors such as an economic recession, fuel shortage, or change to other parts of the transportation system. Demonstration evaluation planning generally takes place well in advance of demonstration implementation to permit measurement of key variables of interest before, during, and after the project begins. In addition to the application of before-after experimental designs, evaluations can involve the monitoring of a control group or area, as well as the test group or area.¹ For example, the analysis of travelers' behavioral response to a new or improved transportation service typically includes non-users as well as users.

¹A comprehensive discussion of various experimental design approaches can be found in Charles River Associates, Measurement of the Effects of Transportation Changes, September 1972, Chapter 4, and in Donald T. Campbell and Julian C. Stanley, Experimental and Quasi-Experimental Designs for Research.

3. EVALUATION PROCESS AND METHODOLOGY DEVELOPMENT

As stated earlier, TSC has responsibility for coordinating the evaluation planning and implementation process to foster consistency in the output of individual project evaluations. TSC's functions include: (1) establishing standardized evaluation procedures to be applied in all demonstration evaluations; (2) specifying the desired output and scope of individual evaluations and providing close technical supervision of a team of contractors who perform the evaluations; (3) developing improved methodology for demonstration evaluation; and (4) devising and implementing strategies for cross-cutting analysis of demonstrations.

The report Evaluation Guidelines for Service and Methods Demonstration Projects² represents initial efforts on the part of TSC to structure the evaluation process. This document describes the basic time-sequenced process to be followed in planning and conducting an evaluation and the nature of the liaisons among the various organizations involved in the demonstration (UMTA, TSC, evaluation contractor, grantee, other local organizations). It also contains definitions of measures to be used for level-of-service and impact assessment (with major concentration on the five SMD Program objectives), recommended data collection and analysis procedures for specific measures, and guidelines regarding survey and statistical methodology. This document is intended to undergo periodic updating to reflect actual evaluation experience and refinements in evaluation philosophy and techniques.

The demonstration evaluation process has two major components, evaluation planning and evaluation performance. In general, the planning phase begins with the preparation (usually by TSC) of an Evaluation Framework which describes (1) pertinent information on the project and its settings; (2) SMD Program and relevant national and/or local objectives addressed; (3) key questions or issues to be examined; and (4) recommended scope, focus, and approach for the evaluation. The Evaluation Framework then serves as the basis (along with the general Evaluation Guidelines) for the

²Heaton, Carla, Chester McCall and Robert Waksman. Evaluation Guidelines for Service and Methods Demonstration Projects, Report No. UMTA-MA-06-0049-76-16, February, 1976.

development of an Evaluation Plan (generally prepared by an evaluation contractor). The latter document specifies in detail the proposed evaluation design and analysis framework, data requirements, data collection methodology, analysis techniques, and technical management plan and resources necessary to evaluate the demonstration's impacts and its potential applicability to other locales.

The active phase of the evaluation involves collection and analysis of data relative to transportation and socioeconomic impacts and preparation of various types of evaluation reports. Data collection is usually performed by the demonstration grant recipient as part of the demonstration. TSC and/or an evaluation contractor is responsible for providing technical guidance to the grantee regarding data collection requirements and methodology as well as for monitoring all of the data collection activities carried out by the grant recipient. Analysis of the data, synthesis of findings for transferability, and preparation of various evaluation reports is the responsibility of TSC and the evaluation contractors. These reports and the results contained therein serve as the basis for the Service and Methods Demonstration Annual Report and are used in a variety of cross-cutting analyses. Techniques are currently being developed and applied for comparing demonstration results across sites, both within and across demonstration service concepts. The results obtained should serve 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.

Owing to the technical difficulty of performing evaluations of projects which take place in real-world, dynamic settings and the absence of a ready-to-use conceptual framework or methodology for evaluation, the SMD Program provides a unique and challenging opportunity to develop and apply innovative evaluation techniques. 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 novel data collection and analysis techniques which have potentially broad application within the program. This methodology development evolves through formal analytical studies, which may have a broader focus than demonstration evaluation, and through informal efforts spurred by deficiencies in existing methodology. As the results of these efforts become available, an appropriate approach will be selected, incorporated into the

Evaluation Guidelines, and then applied to ongoing and future SMD projects.

4. ANALYTICAL FRAMEWORK FOR SMD EVALUATIONS

The body of theory and analytical techniques which has evolved for urban transportation systems planning and analysis has largely been concerned with before-the-fact comparison of prospective transportation and socioeconomic impacts of alternative transportation systems.³ A conceptual framework and format for evaluation has been developed which is specifically appropriate for performing evaluations of transit demonstration projects. It is designed to permit determination of cause and effect relationships and contributions of innovative elements of an operating transit system. This framework, based on principles of transportation supply and demand analysis, not only enhances the consistency and comparability of evaluations, but also permits a comprehensive assessment of project feasibility and impacts. Moreover, as will be seen, this framework is consistent in emphasis with the SMD Program objectives involving travel time, coverage, reliability, productivity, and transit dependent service.

Figure 1 depicts the basic supply-demand framework of transportation change which should be applied to SMD evaluations. 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 levels of supply and demand which differ from the

³See for example, Measurement of the Effects of Transportation Changes, op. cit., Chapter 3 and Marvin Manheim, Fundamentals of Transportation Systems Analysis, 1974.

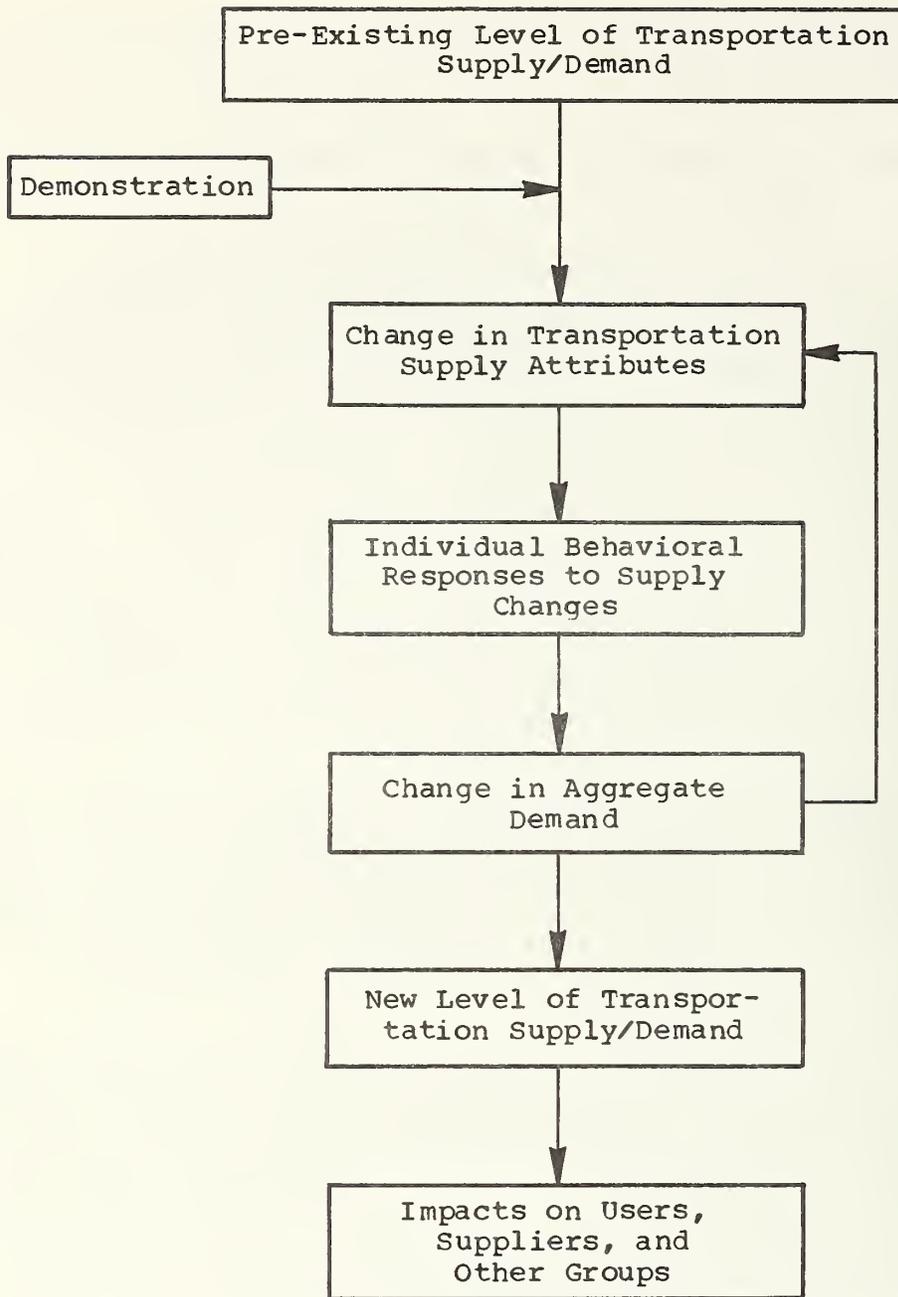


FIGURE 1. SUPPLY/DEMAND FRAMEWORK FOR DEMONSTRATION EVALUATION

pre-demonstration levels. 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.

5. CONTENT OF DEMONSTRATION EVALUATIONS

In order to enhance the consistency of the SMD evaluations, a standardized approach for evaluations has been developed. This standardized approach involves a detailed description of the demonstration background, objectives, setting, implementation process, and operations as well as an analysis of supply and demand changes and the impact of these changes on users, suppliers, and other groups of interest. The components of demonstration evaluations are discussed below, in the order in which they should appear in a final evaluation report.

5.1 Demonstration Background and Objectives

Demonstration evaluation reports begin with a description of the significant factors and events leading up to the grant application, for instance, prior transit innovations or planning studies which underscored the need for the demonstration service concept. In addition, there is a discussion of the various local and national objectives and issues addressed by the project, which in turn form the basis for the evaluation. It should be noted that local objectives or rationale for the demonstration do not always coincide with the SMD Program objectives or with the major issues of national importance, in that they may be related to specific problems within the site or a specific performance criterion. The evaluation must be tailored to produce generalizable knowledge from the local experience.

5.2 Demonstration Setting

An understanding of the demonstration site is crucial not only for the purpose of understanding the outcome of the demonstration but also for enhancing the transferability of

the demonstration. The demographic composition of the service area--for example, population density, employment density, age composition, auto ownership--may be an important determinant of the acceptance and use of the demonstration service. Moreover, it is necessary to predict the applicability of the concept for other potential sites. Similarly, the transportation characteristics of the area prior to the demonstration--i.e., supply of transportation by mode and provider, travel patterns, institutional factors--must be understood to provide a basis for comparison with the situation after the demonstration is implemented and to furnish insight into the demonstration outcome. Most important, there must be continual awareness throughout the evaluation process of exogenous changes or other site-specific factors relevant to demonstration implementation, operations, or outcome.

5.3 Demonstration Implementation and Operations

A lucid documentation of the planning/implementation process and operations is needed to understand the viability, impacts, and transferability of the demonstration concept. This description may include preparatory steps such as personnel training and regulatory changes as well as the overall phasing and management of the project. 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, 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. The SMD projects, as documented in evaluation reports, thus provide an opportunity for improving the state-of-the-art of transportation planning and transportation systems management.

There is recognition of the fact that no two locales will "activate" a particular concept or technique in the same manner. In other words, differences in implementation and operational procedures will result in a range of concept applications. Because of these subtle differences, and also because of the fact that it is useful to plan variations of a given concept or technique, the SMD Program sometimes funds several applications in order to ascertain the

viability and impacts of the concept or technique under different circumstances. However, even when there is only one demonstration funded in a particular category, a key aspect of the demonstration evaluation is to carefully document the factors specific to that application--namely, project background, site characteristics, implementation process, and operations.

5.4 Level-of-Service (Supply) Changes

The analysis of level-of-service changes involves portraying in specific, quantitative terms, the effects of the demonstration project on the urban transportation system as perceived by potential users. 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 coverage, travel time, and reliability--three of the five Program objectives.

Coverage is a service attribute which refers to the accessibility of travelers to the system. Spatial coverage improvements can occur as a result of transit service expansion or new service within an area not previously served by public transportation or by the replacement of a fixed-route service with a door-to-door demand-responsive service. Temporal coverage improvements can be achieved through expanded time periods of service operation or increased frequency of operation within the same time period. Because of the somewhat innovative and complex methods of increasing 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 quantitative measures to express coverage changes.

Travel time improvements can be made through traffic management techniques such as reserved bus lanes and operational changes involving equipment, schedules, or dispatching. Since it is known that users perceive different elements of a door-to-door trip differently, the analysis of travel time changes entails segmentation of time savings into components such as access time, wait time, ride time, and transfer time.

Service reliability improvements may come about from some of the same techniques as result in travel time savings, as well as from specific innovations designed to reduce the variability of one or more travel time components. The analysis of reliability changes has proved to be highly complex and difficult. This is due to the paucity of identifiable measures to quantify such changes, the difficulty of ascertaining which aspects of service affect reliability, and the fact that the concept of reliability varies across modes. In response to this problem, an analytical study is underway to identify an appropriate conceptual/analytical framework for dealing with reliability changes.

Over and above ascertaining the effect of a demonstration on the three SMD objectives, as relevant, the evaluations of SMD projects also examine qualitative level-of-service attributes such as safety, convenience, and vehicle amenities. 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.

5.5 Travel Behavior (Demand) Changes

In response to changes in the level of service provided by the transportation system, individuals within the service area are apt to alter their travel choices in some fashion--e.g., make a given trip by a different travel mode or in a different time period, make a given type of trip to a different destination, make additional trips. The analysis of travel behavior changes involves measurement at the individual level and at the system level.

In terms of system level effects, it is useful to collect and analyze data continually before and throughout the demonstration on ridership, disaggregated by time-of-day, day-of-week, trip purpose, service type, and market group, as available. Moreover, 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, are useful indicators of the demonstration's effect on overall volume and flow of travel.

At the individual level, the analysis of travel behavior examines changes in trip length, destination choice, and trip frequency, all stratified by trip purpose. In general, travel and socioeconomic characteristics and attributes of non-users as well as users are analyzed in order to isolate the effects of the transportation and to gain insight into market penetration and usage statistics. Analysis of demand elasticities is also performed to understand the user's sensitivity to individual level-of-service attributes within or across modes.

5.6 Operator Impacts and Productivity

Changes in level of service and demand will have a combined effect on an operator's ability to serve the public in a satisfactory, yet economical manner. In providing service, the operator must be conscious of operating costs incurred and the effective use of available resources.

Analysis of operator impacts focuses on (1) the net costs of operations, (2) the utilization of vehicle capacity, and (3) the cost-effectiveness of transit services.

Cost analysis considers cost and revenue elements stratified by service type and by other factors (e.g., administrative, operating), where appropriate. Attention is also given to cost/revenue ratios and the impacts of operating strategies upon cost components.

Improvements in the utilization of vehicles can stem from better allocation of vehicles or from increased patronage. Analysis measures include a demand (user) element and a vehicle allocation element (e.g., passengers/vehicle hour). This set of measures is often referred to as "vehicle productivities," and improvement of transit vehicle productivity is one of the five Service and Methods Demonstration objectives. Vehicle productivities are segmented by service type, and also by vehicle type in cases where more than one vehicle is used to provide a particular service.

Improvements in the cost-effectiveness of providing service are frequently an important impact of demonstrations. Measures include a cost element and an operator element (e.g., cost/vehicle hour), usually

segmented by service type and time of day. In many cases, examination of cost-effectiveness data can indicate that cost savings can be achieved at a given service level through modification of service policies (e.g., by substituting a different vehicle during certain periods of the day).

Analysis of productivities and economics is not complete without consideration of factors which can explain resulting levels of productivities and efficiencies. Issues which are typically considered include management policies, driver work rules, vehicle failures, and the size of the service area.

5.7 Non-Travel Impacts

Analysis of travel behavior, productivities, and efficiency address direct impacts of the demonstration on users and operators. There are, however, broader impacts of the demonstration on these groups as well as extended effects on groups not directly involved in the demonstration services. These effects are often qualitative in nature, but should also be included in the analysis.

Transit dependent groups, particularly elderly and handicapped people, experience improvements in mobility, which in turn may imply increased participation in a wider range of social activities, increased access to medical care, and an improved sense of well-being and independence from others. Similarly, the young and the poor who lack access to an automobile may experience greater educational/recreational/employment opportunities coupled with a reduction in the cost of travel and less dependence on friends and relatives. Since improved service to the transit dependent is one of the five SMD objectives, efforts are underway to devise better means of evaluating these types of benefits.

Examples of extended effects include 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 (e.g., increase in retail sales). In addition, it is sometimes relevant to view the benefits of a user's increased independence from the standpoint of the person who formerly provided the transportation. For instance, instituting an annual pass for youth may free housewives from the task of chauffeuring children and allow them opportunities to pursue part-time employment.

5.8 Summary

Once user, operator, and non-travel impacts have been analyzed in detail, there is a summary section of the evaluation report which 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) and a discussion of the major evaluation issues which synthesize findings from the preceding sections. It is important to note that in this final stage of the evaluation process, both the degree to which objectives were satisfied and the reasons for these outcomes are essential in examining the potential of the service concept and the transferability of findings.



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