

HE  
18.5  
.A37  
no.  
DOT-  
TSC-  
UMTA-  
78-17

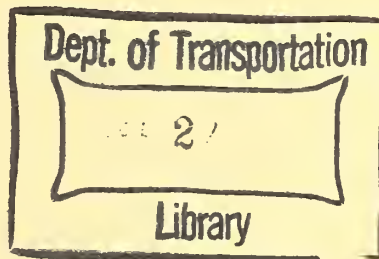
REPORT NO. UMTA-NJ-52-0001-78-1

✓  
Report

## UMTA/TSC Project Evaluation Series

# Trenton Free-Fare Demonstration Project

Evaluation Plan  
December 1978



## Service and Methods Demonstration Program



U.S. DEPARTMENT OF TRANSPORTATION  
Urban Mass Transportation Administration  
Research and Special Programs Administration  
Transportation Systems Center

NOTICE

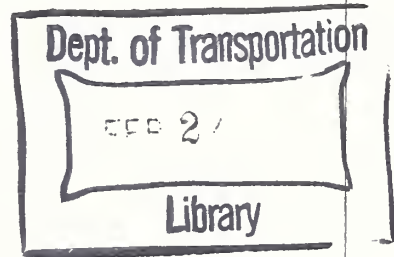
This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

NOTICE

The United States Government does not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

1451  
 no.  
 DOT-  
 TSC-  
 UMTA-

1. Report No. 78-17 UMTA-NJ-52-0001-78-1		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle TRENTON FREE-FARE DEMONSTRATION PROJECT				5. Report Date December 1978	
				6. Performing Organization Code	
7. Author(s) Robert Knight				8. Performing Organization Report No. DOT-TSC-UMTA-78-17	
9. Performing Organization Name and Address DeLew, Cather, and Company* 165 West Wacker Drive Chicago IL 60601				10. Work Unit No. (TRAIS) UM927/R9742	
				11. Contract or Grant No. DOT-TSC-1409	
12. Sponsoring Agency Name and Address U.S. Department of Transportation Urban Mass Transportation Administration Office of Trans. Planning Management and Demonstrations Washington DC 20590				13. Type of Report and Period Covered FINAL REPORT October 1977-February 1978	
				14. Sponsoring Agency Code	
15. Supplementary Notes *Under contract to:		U.S. Department of Transportation Research and Special Programs Administration Transportation Systems Center Cambridge MA 02142			
16. Abstract This report presents a plan for evaluating the impacts of a free-fare off-peak transit demonstration in Mercer County, New Jersey. Under the project, the New Jersey Department of Transportation and Mercer Metro (the transit property) will reduce off-peak fares in Trenton and surrounding areas in the country from fifteen cents to zero. The demonstration project is funded by the Urban Mass Transportation Administration as part of the Service and Methods Demonstration Program.  The evaluation plan describes the demonstration setting, the details of the project, the issues to be evaluated, the evaluation strategy, the data collection plan, and the techniques to be used in analyzing the results.					
17. Key Words Demonstration Project Free-Fare Transit Fare Reduction Off-Peak Fare-Free			18. Distribution Statement DOCUMENT IS AVAILABLE TO THE PUBLIC THROUGH THE NATIONAL TECHNICAL INFORMATION SERVICE SPRINGFIELD, VIRGINIA 22161		
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages 100	22. Price





## PREFACE

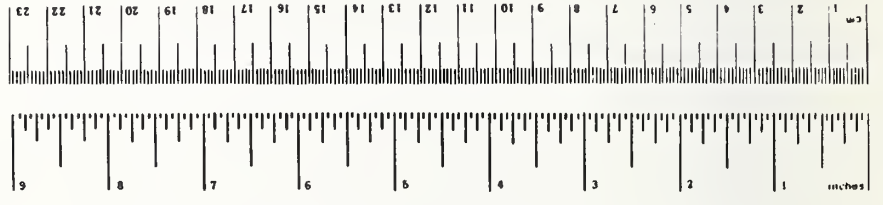
This document describes the approach to be used in evaluating the Trenton (New Jersey) off-peak Free-Fare Transit Demonstration Project. This demonstration is a part of the Urban Mass Transportation Administration's Service and Methods Demonstration Program. The project investigates the effects of off-peak systemwide fare elimination on transit operations and costs, ridership and other aspects of travel behavior, and public attitudes toward transit.

This evaluation plan was prepared by De Leuw, Cather & Company. Robert Knight (San Francisco), De Leuw's SMD Principal Investigator, is the principal author. David Connor (New York) is project manager for the Trenton study. This work is being done for the Transportation Systems Center (TSC) of the U.S. Department of Transportation under Contract No. DOT-TSC-1409 as part of the SMD Program. A.H. (Woody) Studenmund serves as TSC's evaluation monitor. Vince Milione is UMTA's project monitor for the Trenton demonstration. Ivan Dommasch is project coordinator for the local grantee, the New Jersey Department of Transportation.

Because of unavoidable delays in the selection of TSC's evaluation contractor, this plan's preparation by De Leuw, Cather could not begin until only shortly before extensive survey data collection had to begin. We therefore gratefully acknowledge the earlier evaluation design efforts made by the UMTA, TSC, and NJDOT staff members named above and NJDOT's data collection contractor, Garmen Associates. Their efforts aided greatly in the timely completion of the plan and the initial data collection activities.

# METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures				Approximate Conversions from Metric Measures			
Symbol	What You Know	Multiply by	To Find	Symbol	What You Know	Multiply by	To Find
<b>LENGTH</b>				<b>LENGTH</b>			
in	inches	2.5	centimeters	mm	millimeters	0.04	inches
ft	feet	30	centimeters	cm	centimeters	0.4	inches
yd	yards	0.9	meters	m	meters	3.3	feet
mi	miles	1.6	kilometers	km	kilometers	0.6	miles
<b>AREA</b>				<b>AREA</b>			
in <sup>2</sup>	square inches	6.5	square centimeters	cm <sup>2</sup>	square centimeters	0.16	square inches
ft <sup>2</sup>	square feet	0.09	square meters	m <sup>2</sup>	square meters	1.2	square yards
yd <sup>2</sup>	square yards	0.8	square meters	km <sup>2</sup>	square kilometers	0.4	square miles
mi <sup>2</sup>	square miles	2.6	square kilometers	ha	Hectares (10,000 m <sup>2</sup> )	2.5	acres
<b>MASS (weight)</b>				<b>MASS (weight)</b>			
oz	ounces	28	grams	g	grams	0.035	ounces
lb	pounds	0.45	kilograms	kg	kilograms	2.2	pounds
	short tons (2000 lb)	0.9	tonnes	t	tonnes (1000 kg)	1.1	short tons
<b>VOLUME</b>				<b>VOLUME</b>			
tsp	teaspoons	5	milliliters	ml	milliliters	0.03	fluid ounces
Tbsp	tablespoons	15	milliliters	l	liters	2.1	pints
fl oz	fluid ounces	30	milliliters	l	liters	1.06	quarts
c	cups	0.24	liters	l	liters	0.26	gallons
pt	pints	0.47	liters	m <sup>3</sup>	cubic meters	36	cubic feet
qt	quarts	0.95	liters	m <sup>3</sup>	cubic meters	1.3	cubic yards
gal	gallons	3.8	cubic meters				
ft <sup>3</sup>	cubic feet	0.03	cubic meters				
yd <sup>3</sup>	cubic yards	0.76	cubic meters				
<b>TEMPERATURE (exact)</b>				<b>TEMPERATURE (exact)</b>			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature



# CONTENTS

	<u>PAGE</u>
1. EXECUTIVE SUMMARY	1
2. INTRODUCTION	2
2.1 Demonstration Overview	2
2.1.1. Description	2
2.1.2. Objectives of the Demonstration	2
2.2 Organizational Roles in the Demonstration	4
2.3 The Evaluation Plan	4
3. THE DEMONSTRATION PROJECT	6
3.1 The Free-Fare Concept	6
3.2 The Trenton Demonstration	8
3.2.1. Program Scope	8
3.2.2. Operational Details	9
3.3 The Setting: Mercer County Characteristics	9
3.3.1. Geography	9
3.3.2. Population and Employment	9
3.3.3. Population Characteristics	11
3.4 Public Transit Service	11
3.4.1. Transit Suppliers	11
3.4.2. Transit Supply: Mercer Metro Service	12
3.4.3. Demand Patronage and Trip Characteristics	13
3.4.4. Cost of Service	14
4. ISSUES FOR EVALUATION	16
4.1 Overview and Organization	16
4.2 Travel Behavior	16
4.2.1. Major Concerns	16
4.2.2. Total Ridership Impact	18
4.2.3. Traveler Characteristics	20
4.2.4. Former Trip Characteristics	21
4.2.5. New Trip Characteristics	22
4.3 Transportation Supply and Costs	23
4.3.1. Major Concerns	23
4.3.2. Quality of Service	23
4.3.3. Transit Operations	24
4.3.4. Financial Impacts	25
4.4 Secondary Effects	26
4.4.1. Major Issues	26
4.4.2. Regional Economics	26
4.4.3. Public Attitudes	27
4.4.4. Environment	28
4.5 The Implementation Process	28

5.	EVALUATION APPROACH	30
5.1	Strategy and Organization	30
5.1.1.	General Approach	30
5.1.2.	Organization of this Chapter	31
5.2	Evaluation of Travel Behavior Responses	31
5.2.1.	Approach	31
5.2.2.	Evaluation of Total Ridership Impact	32
5.2.3.	Ridership Impact Prediction	36
5.2.4.	Evaluation of Changes in Traveler Characteristics	38
5.2.5.	Evaluation of Transit Trip Options	39
5.2.6.	Evaluation of New Trip Characteristics	39
5.3	Evaluation of Effects on Transportation Supply and Costs	39
5.3.1.	Approach	39
5.3.2.	Quality of Service	39
5.3.3.	Transit Operations	42
5.3.4.	Financial Impacts	43
5.4	Evaluation of Secondary Effects	43
5.4.1.	Approach	43
5.4.2.	Regional Economics	45
5.4.3.	Public Attitudes	45
5.4.4.	Environmental Impacts	46
5.5	Evaluation of the Implementation Process	46
6.	EVALUATION WORK PROGRAM	48
6.1	Overview	48
6.1.1.	Phase Organization	48
6.1.2.	Data Collection Activities	48
6.1.3.	Task Structure and Schedule	49
6.2.	Pre-Implementation Tasks	49
6.3	Interim Phase Tasks	59
6.4	Final Phase Tasks	61
	REFERENCES	65
	APPENDICES	69



## LIST OF ILLUSTRATIONS

<u>Figure</u>		<u>Page</u>
3.1	Location of Mercer County	10
3.2	Mercer County	10
6.1	Work Task Relationships	54
6.2	Evaluation Schedule	56
F.1	Task Flow	87

## LIST OF TABLES

<u>Table</u>		<u>Page</u>
3.1	Low Mobility Groups in Mercer County	11
3.2	Mercer Metro 1975 Weekday Ridership by Time of Day	14
4.1	Summary of Evaluation Issues	17
5.1	Evaluation Measures for Travel Behavior	34
5.2	Evaluation Measures for Transportation Supply and Costs	40
5.3	Evaluation Measures for Secondary Effects	44
5.4	Evaluation Measures for the Implementation Process	47
6.1	Evaluation Issues and Data Sources	50
6.2	Evaluation Work Tasks by Study Phase	52
6.3	Corner Count Hours by Day and Location	53



# 1 EXECUTIVE SUMMARY

The Urban Mass Transportation Administration (UMTA) has awarded a grant to the New Jersey Department of Transportation (NJDOT) to conduct a one-year trial of free public transit service during midday and evening hours. Mercer County, including Trenton, the New Jersey State Capital, is the site of this demonstration. Mercer Metro, the public transit authority serving the county, will operate the free service on all its city and county bus routes. The year of free off-peak bus service is to begin on March 1, 1978.

This is the first large-scale test of free transit to be conducted in this country. Prior experiments with free bus service have been limited to downtown areas or special classes of riders (such as elderly persons), or have been conducted on very small or special-purpose transit systems. The Mercer County test, commonly referred to as the "Trenton Free-Fare Demonstration", involves a public transit operation similar to those found in many medium-size urban areas across the country. The Mercer Metro fleet numbers some 96 full-size buses. There are no restrictions on who may travel free, nor are there any special enrollment or identification requirements. All countywide trips, including transfers, are free during the midday (10AM - 2PM) and evening (after 6) periods. Former fares during this period were from 15¢ to 25¢ plus 5¢ for transfers.

The evaluation will assess a wide variety of potential free-fare effects. The most important issue to be addressed is the size of the increase in off-peak bus use due to the fare elimination. Other key concerns include the size of the resulting reduction in auto travel; the degree to which the free service increases travel by the poor, elderly, young people, and others who lack access to autos; stimulation to downtown retail trade through increased off-peak shopping travel by bus; whether the quality, safety, speed and operating costs of transit service are improved or impaired; and the program's effect on the attitudes of the general population toward transit and free fares.

This evaluation plan discusses these and other issues in more detail, presents a coordinated approach to their assessment, and describes the evaluation work to be done in order to conduct that assessment. It involves a program of bus rider counts, interview surveys, and other data collection and analysis with emphasis on the separation of the effects of the free-fare program from those of concurrent "background" trends and events.

# 2 INTRODUCTION

## 2.1 DEMONSTRATION OVERVIEW

### 2.1.1. Description

The New Jersey Department of Transportation (NJDOT), in cooperation with the Urban Mass Transportation Administration (UMTA), Mercer County and the Mercer County Improvement Authority, is administering an Off-Peak Free-Fare Demonstration Project on the Mercer Metro bus system. The demonstration involves the implementation of a fare-free service on all intracounty routes from 10 AM to 2 PM and after 6 PM Monday through Saturday, and all day on Sundays and holidays. Currently, a systemwide half-fare program is in effect during these times, and a senior citizen half-fare program is in effect during slightly longer hours. The free-fare operation is now planned to last approximately one year, beginning in March 1978. A six- to twelve-month extension may be considered. No significant service improvements are contemplated as a part of the demonstration or during the demonstration period.

The major component of the project funding is a UMTA demonstration grant. Total project funding is \$625,000 with \$500,000 provided by UMTA and \$125,000 contributed by NJDOT. Approximately one-half of this money is being used to cover the anticipated revenue loss (\$332,000) due to 12 months of free fares, while the remaining portion is to be used for administration, data collection and marketing.

### 2.1.2. Objectives of the Demonstration

Of the five major objectives of the SMD Program, three are particularly applicable to the Trenton Free-Fare Demonstration:<sup>1</sup>

- o Reduce travel time by transit.
- o Increase the productivity of transit vehicles.
- o Improve the mobility of transit dependents.

However, these broad program objectives do not fully indicate the interest of the Federal and local sponsors. Beyond such general statements are several more explicit research issues for the Trenton project. The two major sponsors, UMTA and NJDOT, have somewhat different but complementary concerns.

---

<sup>1</sup>Abkowitz, Heaton and Slavin (1977)

NJDOT's concerns focus on explicit benefits of the demonstration for the Mercer County area. As stated in the original application to UMTA, these are as follows:<sup>2</sup>

1. To divert "choice" riders from their private autos to public bus transit.
2. To increase the mobility of urban residents, especially the elderly and low income families.
3. To increase the economic viability of the central city.
4. To reduce the rate of increase in vehicle miles of travel and its resultant problems.
5. (Secondary) To provide information concerning the cost of operating and maintaining such a system and the benefits, both quantifiable and non-quantifiable, that will be of value to future determinations by the decision makers as to the value of free-fare systems and the sources of potential funds.

For NJDOT's purposes, this evaluation is to assess the demonstration's achievement of each of these objectives and to present results in a form appropriate for guidance of local decision making.

UMTA's main concerns, based on the statements of UMTA and TSC representatives, are similar but emphasize transferability to other areas:

1. To what extent can free fares increase transit use?
2. Are many of these new transit trips diverted from automobiles?
3. Does a free-fare system significantly increase the mobility of a region's disadvantaged population?
4. Are there any transit operating cost savings or vehicle utilization increases associated with a free-fare system?
5. Is there a shift of retail shopping to areas well served by bus, such as the central business district or other shopping centers?

In addition, both sponsors have a variety of secondary concerns. Later sections (in Chapter 3) of this document expand on all these objectives and concerns to derive more detailed issues to which the evaluation is designed to respond.

---

<sup>2</sup>NJDOT (1976)

## 2.2. ORGANIZATIONAL ROLES IN THE DEMONSTRATION

The Trenton project is funded primarily by a Service and Methods Demonstration (SMD) program grant from the Urban Mass Transportation Administration (UMTA) of the U.S. Department of Transportation. The grant recipient is the New Jersey Department of Transportation (NJDOT). The local public transit agency involved is Mercer Metro, a division of the Mercer County Improvement Authority. The Transportation Systems Center (TSC) of the U.S. Department of Transportation is responsible to UMTA for evaluation of the project. De Leuw, Cather & Company is acting as contractor to TSC for the evaluation.

General evaluation-related responsibilities of these organizations in the project are as follows:

UMTA	Specifies evaluation issues of national interest
NJDOT	Specifies issues of local interest; provides most data for the evaluation (generally through its data contractor, Garmen Associates); keeps TSC and DCO informed of demonstration activities
Mercer Metro	Operates transit demonstration; provides operations and management record data to and through NJDOT
TSC	Manages evaluation program; coordinates between UMTA/NJDOT and DCO; specifies issues of planning-methodological interest and provides evaluation guidelines; authorizes and monitors all De Leuw, Cather work
De Leuw, Cather	Designs and carries out evaluation, reporting to TSC.

## 2.3 THE EVALUATION PLAN

As with all SMD projects, the Trenton Free-Fare demonstration is intended as a model for possible use elsewhere across the country as well as for further policy and program development in Mercer County. To provide a reliable basis for such decision making, a technically sound and objective evaluation is necessary. This Evaluation Plan describes the approach to be used in the Trenton Free-Fare project to meet this requirement.



The next chapter describes the demonstration project. It begins with a general discussion of the free-fare concept as background for the Trenton case, and goes on to provide details of the Trenton operation. Brief descriptions of the Trenton (Mercer County) setting and of the Mercer Metro transit system are also included.

In Chapter Four, some key issues for the evaluation are derived from these elements plus the objectives already described.

Chapter Five outlines the evaluation approach. After an initial description of the overall strategy, the four main topic areas are discussed in turn: implementation process, transportation supply changes, travel behavior responses, and secondary effects. Within each of these topic areas, the relevant issues, measures, data and analysis are described.

Chapter Six presents the work program. This is organized by project stage: pre-implementation period, interim monitoring period, and the final phase of data collection and analysis. Within each stage, each major evaluation work task is outlined. The overall data collection program is also described, and a task organization and schedule are presented.

Following a list of relevant free-fare literature, seven appendices are to be found. These display the various data collection instruments already employed (Appendices A-E), outline a related research effort of the National Bureau of Standards in which this project's data are to be used (F), and describe the De Leuw, Cather evaluation staffing and management approach (G).

# 3 THE DEMONSTRATION PROJECT

## 3.1. THE FREE-FARE CONCEPT

Over the last several decades, American urban transit fare policy has moved far from its original approach, wherein the transit supplier (typically a private entrepreneur) tried to price the service to cover all costs plus a return on his investment and risk. As cost pressures increased, these private operators gave way to public transit agencies which operated without the expectation of profit, but with hopes of covering at least the operating portions of their costs through the farebox. Even this goal proved unattainable as costs continued to rise and ridership to decline. With each fare increase, patronage and revenue fell even faster.

Despite urban transit's growing inability to recoup its costs from its patrons, the nation's urban centers continued to depend on it. For many of the poor, elderly, handicapped and young, transit was - and is - essential for even minimal access to needed services and opportunities. The very structure of the typical city, with its dense employment core, required public transit to prevent intolerable radial roadway and downtown street traffic congestion during commute hours. This pattern continues today, with both employment and downtown shopping largely dependent on transit access.

Because of these continuing and irreducible needs for urban transit service, public subsidies began to appear - first, for capital investments, then for operating costs. In the past decade, such subsidies have assumed the role of transit's primary source of funds; the farebox now typically covers as little as one-third or even less of the costs of service. Even at the present high level of subsidy, however, transit authorities face mounting deficits. The large increases in Federal subsidies since the mid-1960's have helped to hold the line against further fare increases in many cities, and transit ridership has halted its long decline and begun to inch upwards.

Against this historical backdrop, the concept of free transit - that is, transit supported entirely by means other than fares - can be seen as a logical extension of a pattern of increasing subsidy which began a long time ago. We now subsidize about two-thirds of transit costs; to cover the remaining one-third is not so much a radical departure as it is the final step along a familiar path. However, there is still a major difference between the free-fare concept and the fare subsidy programs to date: Even in the most recent past, the policy has been to use subsidies to prevent fare increases, but not to actually reduce fares in most cases.



There is some precedent for cash fare reduction, although very little for complete elimination of fares.<sup>1</sup> In recent years many transit agencies have experimented with various kinds of fare reductions. The usual result is a small to moderate rise in patronage but a net loss in revenue.<sup>2</sup> Many observers anticipate that the effect of free fares on ridership will be similar to that observed for similar-size reductions in fare which results in a nominal fare (5-15¢) rather than zero. However, we have no experience with zero fares with which to verify this contention. Other observers suggest that a zero fare may introduce wholly different subjective factors into the traveler's choice, beyond the actual amount of savings. The resulting hypothesis is that increases in ridership may be far greater than that which might be expected from the results of non-zero fare reduction studies. This is an appealing but unproven contention.

There is some justification for limiting free rides to the off-peak period. From a practical viewpoint, obviously the loss in revenue would be much smaller than for all-day free service. From a somewhat more conceptual vantage, since transit systems are sized to handle peak-period loads, there is substantial excess off-peak capacity which could be utilized at very low marginal cost. If no additional buses are put into service, in fact, the marginal operating cost of serving more riders is virtually zero. Finally, if off-peak free fares were to entice some peak-period riders to change to off-peak travel, it might even be possible to reduce overall fleet size and hence reduce total operating costs despite carrying more passengers. Clearly, there would still be the same or larger revenue loss. Without actual free-fare experience, however, the net financial impact is unknown, just as is the ridership change.

Certainly the free-fare concept is a contentious one.<sup>3</sup> The current national mood seems to be in favor of reducing taxes rather than increasing support for public services (such as free transit). Thus there may be strong public opposition, making the necessary political support difficult to assemble. Other approaches may in fact serve public objectives better; for example, the funds required to support free bus fares may have greater effect on mobility and traffic reduction if directed instead to expansion of bus service, paratransit, promotion of commuter pooling, or research on automobile energy-saving technology.

---

<sup>1</sup>See Goodwin (1973), Kemp (1974), and Goodman and Green (1977)

<sup>2</sup>See for example Donnelly (1976) and Goodman and Green (1977)

<sup>3</sup>See the references at the end of this report for more information. Some of the arguments against free-fare transit are presented well by Schneider (1968, 1969) and Kraft (1973). Among those writing in favor of the concept are Abrams (1971), Aleshire (1971), Elliott (1972), Scheiner (1974, 1975, 1976), Scheiner and Starling (1974), and Greenspan (1976).

At the same time, free transit - particularly in off-peak periods - would undeniably respond to some important social objectives. Proponents believe that it would increase the mobility of the poor and others without autos, reduce traffic and its environmental problems, and help to revitalize central business districts, among other benefits. However, our lack of knowledge concerning its actual effects renders us unable to judge it properly. In view of the importance of the social problems it seeks to help solve and its potential for some success, the free-fare concept deserves a careful test. In 1974, the U.S. Congress authorized expenditures (under Title II of the National Mass Transportation Assistance Act) for the ". . . research and development, establishment, and operation of demonstration projects to determine the feasibility of fare-free urban mass transportation." In submitting the first annual report to the Congress concerning such a program, UMTA argued that:

". . . the overriding objective of publicly-funded demonstrations should be to learn; that is, to provide definitive answers about the costs and the efficacy of fare cuts in achieving their objectives . . . This can only be achieved if a strong emphasis is placed on matters of experimental design." <sup>1</sup>

## 3.2 THE TRENTON DEMONSTRATION

### 3.2.1. Program Scope

The "Trenton Free-Fare" demonstration involves a one-year elimination of all midday and evening fares on the public transit system of Mercer County, New Jersey. It is to begin March 1, 1978. Although the demonstration is typically referred to as the "Trenton Free-Fare" program, taking the name of the county's largest city (and state capital), the fare elimination is effective on all the bus routes throughout Mercer County. The transit authority, Mercer Metro, also has a few routes which extend to special destinations outside the county; these account for only a small number of trips and are not included in the free-fare experiment.

The off-peak fare to be eliminated is 15¢ for most trips. Transfers, now 5¢, will be free. The longest intracounty trips have fares of 20¢ and 25¢, which will also be eliminated. These are off-peak half-fares, in force since 1971. Peak-period fares are respectively 30¢, 40¢ and 50¢. The free-fare period involved is shorter than the period usually defined as "off-peak" on other systems; it includes the time segments from 10 AM to 2 PM and from 6 PM until the close of the day's service (between 10 PM and 1 AM on most routes, earlier on others). This period is the same as the system's prior half-fare service period.

The off-peak free fares will be in effect Monday through Saturday. On Sundays, all bus service will be free the entire day.

---

<sup>1</sup>U.S. Department of Transportation (1975)

### 3.2.2. Operational Details

All riders are eligible to participate. No prior registration is required, and no identification cards are to be used.

Boarding is to be allowed through the front door only. This is to ensure safety, at the loss of some boarding time savings which might be achieved by using both doors for entry. Both doors will continue to be used for exiting.

In order to allow a more accurate evaluation of the program's effects, no other changes in service are to be made during the demonstration period. The only new service which may be provided is additional "trailing" buses closely following others to handle overloads on any routes which become patronized beyond their existing capacity.

Prospective patrons are to be informed of the program through an intensive advertising campaign. This campaign, designed and directed by a marketing consultant firm, will begin during the month before start of the free service and continue (at a declining intensity) throughout the demonstration. It is to utilize existing mass media and is designed to reach virtually all county residents.

## 3.3 THE SETTING: MERCER COUNTY CHARACTERISTICS

### 3.3.1. Geography

Mercer County is located in New Jersey directly between Philadelphia and New York (Figure 3.1). Covering some 226 square miles, the county is approximately 12 x 20 miles in size. Its major city, Trenton, lies on one edge of the county on the Delaware River, across from Pennsylvania. The countryside is generally flat or rolling, without mountainous terrain or other major natural obstacles to internal circulation. The county's roadway system is well developed, with high-speed access to all parts of the county. Trenton is also on the main Amtrak rail line between New York and Philadelphia.

### 3.3.2. Population and Employment

Mercer County population in 1970 was approximately 304,000, up some 14 percent since 1960. Trenton, which is the capital of New Jersey as well as the county's largest city, had some 104,000 residents, a loss of about 8.3 percent during the same period. Other urbanized centers include the municipalities of Hamilton (80,000), Ewing (35,000), Princeton (26,000), and several smaller towns (Figure 3.2).

Because of the state capital, governmental employment is an important component of the economy. Educational services, including Princeton University, constitute another major employment sector. In addition, the county has a long history of diversified manufacturing.

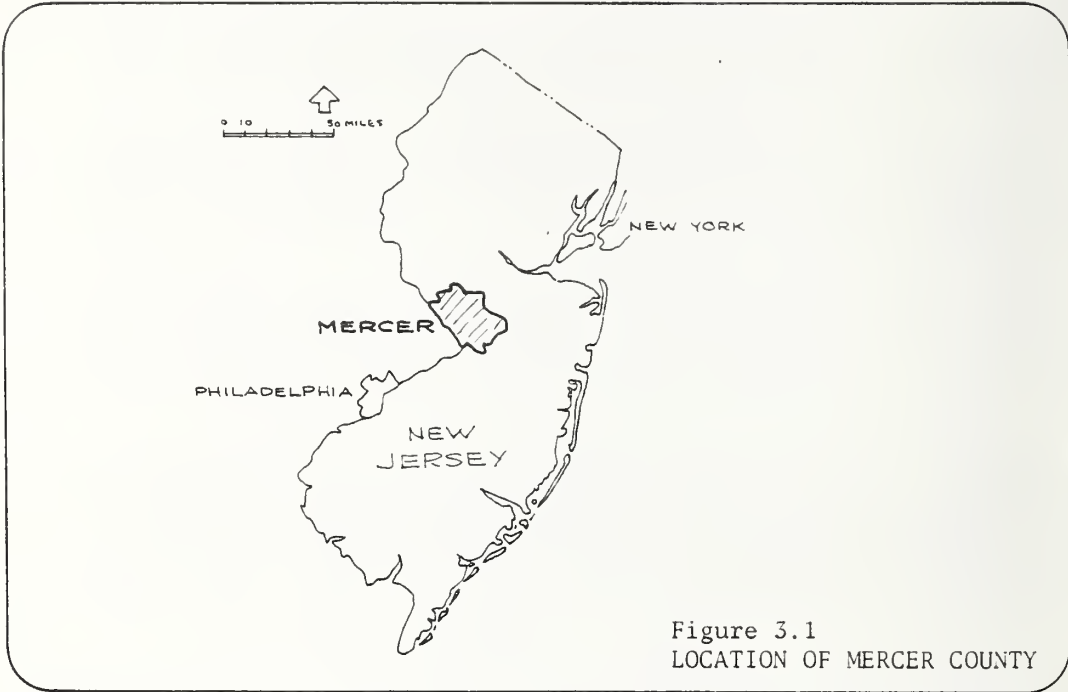


Figure 3.1  
LOCATION OF MERCER COUNTY

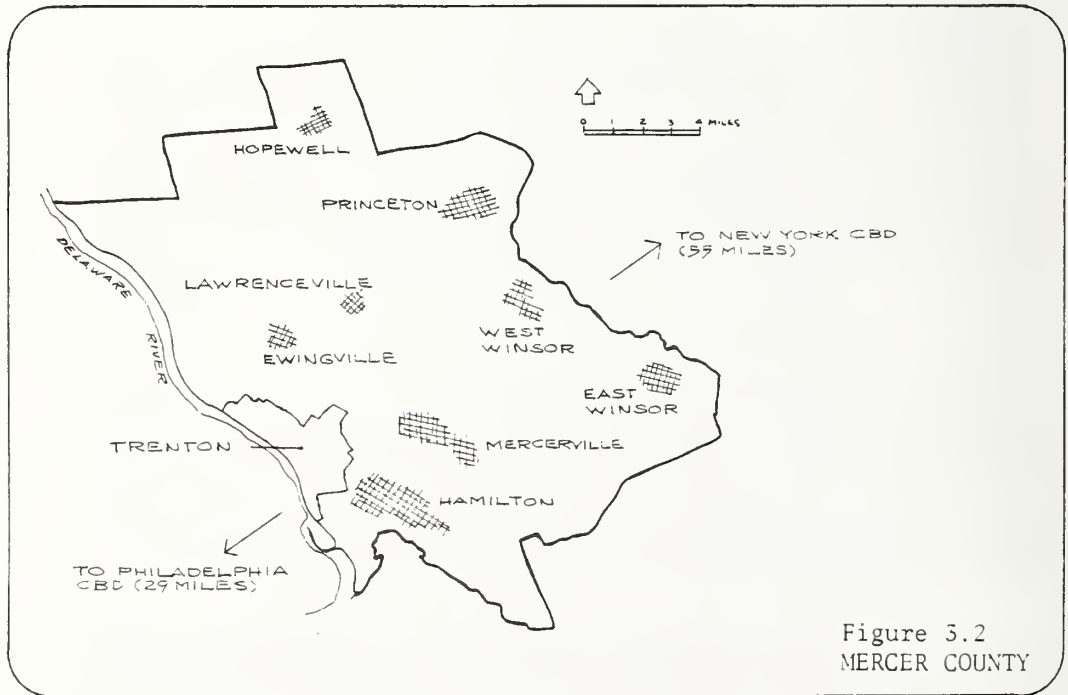


Figure 3.2  
MERCER COUNTY

### 3.3.3. Population Characteristics

Trenton is experiencing many of the typical problems of older north-eastern cities. Many jobs, retail trade activity, and most of the more affluent population have gradually shifted from the city to the more attractive suburban areas of the county. Left behind are a disproportionate number of the county's poor, elderly, and others without access to automobiles, leaving Trenton with a large low-mobility population.

Table 3.1 shows the incidence of these low-mobility groups. Based on 1970 Census data, almost 13 percent of the city's population was below the poverty level, compared to only 3.4 percent elsewhere in the county. Over 12 percent were elderly, and 3.1 percent were under 18. Most striking, however, is Trenton's incidence of carless households: 35 percent of all occupied housing units in the city had no auto available in 1970.

Table 3.1

#### LOW MOBILITY GROUPS IN MERCER COUNTY

	<u>Percent of Totals (Numbers) by Location</u>		
	Trenton	Other Mercer County	Total
Senior Citizens (65+ years old)	12.2%	8.4%	9.7% (29,603)
Youths (less than 18 years old)	31.0	31.8	31.5 (95,889)
Families below poverty level	12.7	3.4	6.4 (4,875)
Households with no auto	35.2	11.0	17.4 (16,294)

Source: 1970 U.S. Census

### 3.4 PUBLIC TRANSIT SERVICE

#### 3.4.1. Transit Suppliers

Mercer Metro is the county's only provider of conventional fixed-route urban public transit, and covers the entire county. Several private bus companies offer intercounty and interstate service, but do not compete directly with Mercer Metro. Taxi service is also available, primarily in Trenton, and some limited special-purpose transportation



(e.g., for handicapped persons) is also offered by social service groups. Trenton is also served by Amtrak main-line passenger trains to New York and Philadelphia.

Mercer Metro, which assumed the operations of the privately-owned Capital Transit Company in 1969, is an agency of the county. It is technically a division of the Mercer County Improvement Authority, but operates essentially independently. In addition to farebox revenue, its main sources of funds are the State of New Jersey (New Jersey Department of Transportation) and the Federal government. State assistance has included the purchase of new buses for Mercer Metro's use under a token lease arrangement.

### 3.4.2. Transit Supply: Mercer Metro Service

#### Equipment

Mercer Metro currently operates a fleet of 96 buses. Some 70 of these are used regularly in peak-period service; 45 are used in off-peak service. Some 21 of these buses have been added to the fleet in the past year.

#### Route Structure

There are sixteen regular routes. Twelve of these provide general service within the city and county, and one provides regular shuttle service in the Trenton CBD - State Capital area. The remaining three serve destinations outside the county: one to Fort Dix and McGuire Air Force Base, plus some intracounty service; another to Asbury Park, New Jersey; and a third to New Jersey shore resorts during the summer. These out-of-county destinations are not included in the free-fare experiment.

#### Geographical Coverage

Excluding the three routes extending outside the county, the system is some 280 route-miles in length. In 1975, nearly 3 million vehicle-miles of service were provided, most of it over these intracounty routes.

Approximately 65 percent of the county's population lives within 0.4 km ( $\frac{1}{4}$  mile) of a bus route. Within the city of Trenton, almost all points fall within the 0.4 km transit coverage zone. The system also provides service to all senior citizen housing, all hospitals and nursing homes, all regional shopping centers, and most of the county's major employment sites.

### Hours of Service and Headways

Maximum operating hours extend from 5:05 AM to 12:55 AM Mondays through Fridays and 6:30 AM through 11:45 PM on Sundays and holidays. Most routes operate somewhat fewer hours. Fourteen of the sixteen routes operate on Saturdays; nine routes operate on Sundays and holidays. Weekday peak-period headways average 30 minutes, while in daytime off-peak periods buses operate on 30- and 60-minute headways. Evening service is further reduced to 1- and 2-hour headways. Saturday service is about the same on most lines as on weekdays. All Sunday/holiday services have headways of 1 hour or more all day.

### Fares

Transit base fares are 30¢ with additional zone charges on a few very long trips. However, because of two special half-fare programs, the 30¢ is essentially a peak-period fare. One of these programs is for senior citizens (65 and older) who pay half fare between 9:30 AM and 4:00 PM and after 7:00 PM Monday through Friday, as well as all day Saturday, Sunday and holidays. The second program is a comprehensive half-fare program for all riders between 10 AM and 2 PM and after 6 PM Monday through Saturday, plus all day Sunday and holidays. Transfers cost 5¢ for all riders at all times. The fare on the State Complex Shuttle route is 10¢ for all except senior citizens, who pay 5¢.

### 3.4.3. Demand Patronage and Trip Characteristics

#### Ridership

In 1975, the last year for which data were available at this writing, Mercer Metro carried some 5,980,000 passengers. As yet incomplete data for 1977 indicate ridership of about 6,500,000, or an upward trend of about four percent per year over the past two years. Current weekday ridership averages between 23,000 and 24,000 trips, continuing the same fairly stable pattern. The use of transfers is currently just under one million per year, or about one for each six to seven riders.

#### Peak vs. Off-Peak

Mercer Metro data, based on a 1975 survey, indicate that mid-day (10 AM - 2 PM) ridership was about 26% of the daily total, or slightly higher than the industry average (Table 3.2). Ridership after 6 PM was about 6%, for a total of about a third of the daily ridership occurring in the upcoming free-fare period.

Table 3.2

## MERCER METRO 1975 WEEKDAY RIDERSHIP BY TIME OF DAY

	Riders	Percent
Before 10 AM	7,374	32
10 AM to 2 PM	5,837	26
2 PM to 6 PM	8,227	36
After 6 PM	<u>1,356</u>	<u>6</u>
TOTAL	22,794	100

Source: Mercer Metro records cited in Trenton/Mercer Transit Development Study, Technical Memorandum #1, October 1976

#### Trip Purposes

According to the recent Trenton/Mercer Transit Development Study, in 1975 some forty-nine percent of all trips were work-oriented. Eleven percent were for other business purposes, 17 percent for shopping, 14 percent for school, and the remaining 9 percent for recreation and other purposes. These purposes were not divided in the study by peak and off-peak times.

#### Trip Lengths

According to Mercer Metro data, average trip lengths by route were from 1.43 miles to 4.75 miles. The systemwide average (in 1975) was 2.54 miles.

#### Rider Characteristics

The same study found that transit captives, those with no automobile readily available as an alternative for that particular journey, constituted 86 percent of all riders. Sixty-five percent of all riders were found to use transit on a regular daily basis.

#### 3.4.4. Cost of Service

Total 1975 operating expenses for Mercer Metro were \$5,739,082. Forty-six percent, or \$1,729,838 of this amount, was derived from farebox revenues. This proportion has apparently declined slightly since then, although more recent data were not readily available.



Based on the reported 5,980,000 passenger-trips in 1975, average operating cost per person-trip was just under 63¢. At 46 percent farebox revenue, the average cash fare was about 29¢ including transfers. Subsidy costs were therefore about 34¢ per passenger.

Reported average trip lengths (2.54 miles), when combined with patronage and operating cost figures, yield a unit cost-effectiveness ratio of about 25¢ in operating costs per passenger-mile. The reported 1975 vehicle mileage of 2,940,000 leads to an operating cost of about 31¢ per vehicle-mile.

# 4 ISSUES FOR EVALUATION

## 4.1 OVERVIEW AND ORGANIZATION

In earlier chapters the objectives of UMTA and the local sponsors were described, the free-fare concept was discussed, and details of the Trenton setting and this experiment were provided. Taken together, these elements provide a basis for defining the specific issues which should and can be addressed in the Trenton demonstration. This chapter is a derivation of those issues.

In such an experiment, many issues are involved. These differ both in their importance (to UMTA and NJDOT) and in their specific topic or type of concern. To simplify their presentation the following grouping of issue topics is used here:

- a. Travel Behavior  
(traveler response to the free-fare program)
- b. Secondary Effects  
(public attitudes, regional economics, environmental concerns)
- c. Transportation Supply and Costs  
(quality of service, effects on supplier, public costs)
- d. The Implementation Process  
(administrative problems and opportunities encountered).

Each of these groups of issues forms a separate section in this chapter. For each, the most important one or two issues are presented first and discussed in greatest detail. Issues of lesser import, but still of substantial local or Federal concern, are then enumerated and discussed. Table 4.1 summarizes the issue topics within each category.

## 4.2 TRAVEL BEHAVIOR

### 4.2.1. Major Concerns

This general issue category is the focus of most interest in the Trenton project. In particular, ridership impact is the demonstration's central question:

*How much will off-peak transit ridership increase due to free fares?*

Table 4.1

SUMMARY OF EVALUATION ISSUES

---

- A. Travel Behavior
  - 1. Total Ridership Impact
    - a. Stabilized ridership gain
    - b. Initial ridership gain
    - c. Weekday/weekend ridership
    - d. Prediction of ridership impact
  - 2. Traveler Characteristics
    - a. Low-mobility persons
    - b. New bus users
    - c. Group ridership
  - 3. Former Trip Characteristics
    - a. Auto
    - b. New travel
    - c. Taxi
    - d. Time-of-day shift
    - e. Walk
  - 4. New Trip Characteristics
    - a. Fare savings
    - b. Length
    - c. Purpose
- B. Transportation Supply and Costs
  - 1. Quality of Service
    - a. Crowding
    - b. Crime and harassment
    - c. Travel time savings
  - 2. Transit Operations
    - a. Fleet requirements
    - b. Effects on drivers
    - c. Fare handling
    - d. Patronage estimation
  - 3. Financial Impacts
    - a. Revenue loss
    - b. Operating costs
- C. Secondary Effects
  - 1. Regional Economics
    - a. CBD revitalization
    - b. Shopping center patronage
  - 2. Public Attitudes
    - a. Support of general population
    - b. Attitudes of transit users
  - 3. Environment
    - a. Traffic congestion
    - b. Energy use and air pollution
- D. The Implementation Process
  - 1. Origination and Support
  - 2. Financing
  - 3. Inter-agency Coordination
  - 4. Planning and Marketing
  - 5. Operations Changes and Training
  - 6. Ongoing Administration
  - 7. Effects on Local Policies

Assuming that the ridership increase is substantial, two other general issues are of almost equal importance:

*Are many of these trips diverted from cars?*

*Are the region's transportation-poor citizens benefitting from the program?*

In addition to these major concerns, many other aspects of travel behavior are of lesser but still substantial interest. In the following paragraphs, all travel behavior issues are grouped for presentation as follows:

- o Total Ridership impact
- o Traveler characteristics
- o Former trip characteristics
- o New trip characteristics.

#### 4.2.2. Total Ridership Impact

##### Stabilized Ridership Gain

Of paramount interest in this demonstration is the total patronage increase attributable to the free-fare service (after a likely initial "novelty" or "curiosity" period). Virtually all other impacts are contingent on the degree to which total ridership increases. Predictions of this amount vary widely - from 10% to 50% - among the agency representatives involved. A conservative view seems most prudent in this case, since the fare savings for most trips is only 15¢ and price is only one of many factors which influence ridership. However, the appeal of a completely free and unrestricted public transit service may lead to ridership gains far in excess of what would be expected from the 15¢ fare savings. We simply have no experience with which to judge this effect, although its existence is perhaps the most important question to be studied in the Trenton experiment.

##### Initial Ridership Gains

It is possible that ridership will increase rapidly at first when the free-fare program begins, and then decline as the novelty wears off. This will likely end in establishment of a new stabilized growth trend at a somewhat higher level than the trend existing before the demonstration. The difference between these trends is the "stabilized" impact. However, we have no experience with which to forecast the actual dynamics of this initial ridership response, and thus

cannot anticipate when the new stabilized trend will be established. Consequently a study of the dynamics of response is needed so that the "novelty effect for later free-fare programs elsewhere can be predicted, and the other impacts of this initial period can be distinguished from longer-term effects.

#### Weekday/weekend Ridership

The Trenton experiment involves three distinctly different cases: first, the weekday off-peak situation; second, the Saturday off-peak, which has quite different demand characteristics; and finally, the entire Sunday service which differs substantially from the others both in the transit supply (much less) and in transit use (lowest) as well as in its all-day free service instead of limited midday and evening periods. The impact of free fares may differ substantially under these three conditions. Saturday is of particular interest since bus service is relatively good and trip rates in the midday and evening (free-fare) periods are high. Sunday is also of interest because of its all-day free service, despite the present limited service and patronage.

#### Prediction of Ridership Impact

For UMTA, gaining the ability to estimate the ridership effects of the free-fare approach in other cities is an important consideration. This can be approached at several different levels of detail and difficulty. Most simply, it may be assumed that the Trenton ridership gain is typical for other cities. However, since it is known that ridership varies according to the size of fare reduction, the nature of the trip involved, the transit-dependency of the individual traveler, and other factors, such a simple prediction may be highly inaccurate. Increasingly complex models may be developed to incorporate more and more of these "causal" factors, although at some point the cost and difficulty of such refinements outweighs the practical benefit of the marginal increase in predictive accuracy.

The Trenton experiment offers an opportunity for the initial steps in development of predictive tools for free-fare ridership impact. The National Bureau of Standards, in association with J.T. McLynn, has arranged with TSC to use the Trenton data for a test of its "fully competitive mode choice model" in prediction of the shift of travelers from auto to bus in response to the off-peak free fares. In addition to the NBS work, it should be possible to develop one or more models of lesser sophistication which also incorporate the generation of new travel, time shifts, and mode/destination changes. In particular, the sensitivity of the prediction to increases

in the complexity of such models can be assessed, as can changes in functional form. Such models can then be tested and improved in later free-fare trials elsewhere.

One option in addition to the use of standard socio-economic, price, and trip characteristics as predictors is to investigate the relationship between individuals' stated intentions to use the free-fare service (prior to implementation) and their actual behavior once the free service starts. This would be a useful test of the "market survey" approach to prediction of demand for such special services.

#### 4.2.3. Traveler Characteristics

##### Low-mobility Persons

One of the major objectives of the Trenton experiment is to improve the mobility of those population subgroups which now have the lowest opportunities to travel. These "transit-dependent" groups contrast with "choice" riders and include specifically the elderly, handicapped, young people, and other persons without access to cars. Consequently the degree to which this occurs is a major issue for evaluation. It has at least three important components. First, how many of the new trips induced by free fares are made by such persons? Second, does the use of the program by such persons constitute an important benefit to them? And finally, is the number of such persons taking advantage of the program a substantial proportion of all such persons in the transit service area? These findings provide indications of the distribution of free-fare benefits between target groups and others of lesser need, and also suggest the extent and importance of those benefits.

##### New Bus Users

It is of some use to know whether most new free-fare trips are being made by persons new to bus travel or by former bus users who are now simply traveling more by bus than before. This finding provides an indication of the power of the free-fare approach to broaden the ridership base in the community.

##### Group Ridership

The incidence of group travel may increase. Youth groups are one type. However, travel by family groups is of greater interest because of the single travel budget involved. For such groups the fare saving may be large enough to be a much more important trip-generation or mode-choice determinant.



#### 4.2.4. Former Trip Characteristics

##### Auto

One of the experiment's main objectives is to divert auto users to transit, hopefully thereby reducing traffic congestion and its attendant environmental problems of energy use and air pollution. Consequently the proportion of new free-fare bus trips which were formerly made by car is an important measure. Some auto diversion can be expected. However, relief from traffic congestion is improbable since most such congestion occurs in the peak period and there is little likelihood of much diversion from peak-period auto use to off-peak period bus use.

##### New Travel

In keeping with the sponsors' interest in improving mobility for population groups previously unable to satisfy their travel needs, another very important concern in this evaluation is the proportion of new free-fare bus trips which would not have been made at all without the free bus service. Because of the small actual fare saving, this proportion may be small. However, even this small savings may permit the widespread use of bus travel by children and elderly persons.

##### Taxi

UMTA is interested in information on the degree to which free transit may adversely affect taxi ridership, since many taxi patrons tend to be low-mobility persons by virtue of age, handicap or lack of a car. In general, it is felt that such impacts are probably of no consequence because of the vastly different service quality and price of taxis and buses; the two modes would be expected to appeal to two different travel market segments. However, some study of this issue is justified.

##### Time-of-Day Shift

It has been hypothesized that a substantial proportion of new off-peak free-fare riders may originate in the former peak-period traveler group. Such persons, however, would have to be both extremely fare-sensitive (in this case usually only 30¢ would be saved on each trip) and able to change their hour of travel. This would eliminate most commuters, especially since the two daily free-fare periods do not begin until 10 AM and 6 PM. However, some other trip types may permit such inter-temporal shifts, and some commuters might delay their home-bound trip to shop and travel home after six.

## Walk

Particularly in downtown shopping areas where walking is common and bus stops are frequent, a substantial number of free-fare trips may be substituted for former walk trips. Although this is a highly specialized issue, it may have some importance as a possible tool for downtown revitalization. In most documented prior cases of free "shopper's shuttle" downtown-area bus service, fare elimination has led to large patronage gains.<sup>1</sup>

### 4.2.5. New Trip Characteristics

#### Fare Savings

Although most free-fare trips will involve a 15¢ fare "saving", certain longer trips (e.g., Trenton-Princeton) involve fare eliminations of 20¢ and 25¢. These differences are small, but may permit a limited study of the differences in (arc) elasticity - that is, differences in proportions of patronage increase for trips with different fare savings. Because of the interference of other factors, however, the success of this study is problematic and should be given only limited effort.

#### Length

Apart from the implications for fare elasticity, differences in average trip length between prior off-peak and new free-fare trips are useful for the calculation of changes in passenger-miles of service rendered. This in turn is an important component of some measures of vehicle utilization and cost-effectiveness.

#### Purpose

Determination of changes in trip purposes attributable to free transit are useful indicators of the nature of the benefits of the service. For example, a substantial proportion of new trips may have no destination - that is, they may be joyriding by youths or a means of social contact for the elderly. Other possibilities include shopping, medical visits, and recreation as well as work travel. Interpretation of benefits by local policymakers would probably be very different if the dominant new trip purpose served were joyriding by kids than if it were shopping, medical, and other essential trips by elderly and other transit-dependents.

---

<sup>1</sup>Goodman and Green (1977)



## 4.3 TRANSPORTATION SUPPLY AND COSTS

### 4.3.1. Major Concerns

Effects of the free-fare experiment on the supply and cost of transportation services all depend on the experiment's effects on travel behavior, discussed in the previous section. If transit ridership increases substantially, many supply-side effects may appear. All of these essentially serve to amplify one central concern:

*Will the increase in ridership impair the functioning of the transit system?*

These potential effects may be grouped conveniently as follows:

- o Quality of service
- o Transit operations
- o Financial impacts .

Each of these is further subdivided and discussed in the following paragraphs. All, however, serve primarily to permit a comprehensive response to the central issue cited above.

### 4.3.2. Quality of Service

#### Crowding

Buses may become crowded during the off-peak period as a result of free service. Crowding may be a permanent condition, or may occur only during the first few weeks of "joyriding." This would be a degrading of the quality of service, and could lead to many other problems. However, increases in patronage would have to be very large for this problem to be significant, since at present the typical off-peak load factors are low. This suggests that crowding is unlikely to be a major long-term problem. At the same time, since its consequences could be severe, it remains an important issue.

#### Crime and Harassment

Crime and harassment of bus patrons are common concerns both to existing and potential bus users nationwide. Those who need bus service most, such as the elderly, handicapped, and children, are ironically most vulnerable to such threats. Although actual transit crime rates are usually low, many cities have problems with harassment such as noise and aggressive behavior by groups of youths on buses, even without free fares. Trenton is no exception. Concerns

over possible increases in such problems are reasonable. Moreover, the effect of such problems on the images of bus travel held by the general public could be extremely damaging, both in terms of attracting riders and strengthening local public financial support for transit.

#### Travel Time Savings

If the free-fare operation were to simplify the boarding procedure enough to allow a substantial reduction in bus time spent at stops, the accumulation of such savings might ease run time pressures. This could improve on-time reliability, or might even allow tightening of schedules such that trip times could be shortened. In the extreme, such savings might permit the same number of buses to cover more miles or greater frequency of service.

However, delays in boarding are caused by many factors in addition to fare collection. These include passengers' physical disabilities, narrow doors (one-at-a-time entry and exit), questions on destinations, requests for bus schedules, and holding the bus for late-arriving boarders. Probably only a few seconds could be saved by elimination of fares at even the busiest stops, accumulating over a run to no more than a minute or two. Consequently little effect should be expected even though the issue is certainly important enough to include in the evaluation. Measures should include both total stop times and stop times per boarding passenger, since the free-fare system may induce enough new ridership to offset any per-passenger time savings.

### 4.3.3. Transit Operations

#### Fleet Requirements

If crowding occurs, additional off-peak capacity may be required. Mercer Metro has agreed to add "trailers" (two buses running on the same schedule) where crowding becomes a problem. However, as noted earlier new demand is unlikely to be large enough to require more service. Conversely, no reductions in off-peak bus requirements are likely to result from any savings in boarding times. Finally, although some present peak-period riders may shift to the free-fare period no reductions in peak-period service are likely to be possible.

#### Effects on Drivers

Drivers will be relieved of fare payment monitoring during the free-fare period. At the same time, some new problems

may appear. Arguments may develop with passengers over the proper time to start and stop the free period, although Mercer Metro appears to have successfully met this problem in its earlier half-fare program. More likely problems for drivers are those of contending with larger numbers of riders. Safety on crowded buses and harassment from some riders are two such problems.

#### Fare Handling

Since no fares will be collected during the off-peak periods, the tasks of fare handling and counting will be reduced. However, since peak-period fares are still to be collected all the same tasks will still be required. Only the volume of money is somewhat reduced. This is unlikely to lead to significant economies.

#### Patronage Estimation

Mercer Metro now bases its daily ridership estimates on farebox revenue, using a fixed formula which includes adjustments for special fares and transfers. This formula will no longer be valid when off-peak and Sunday fares are removed. A new estimating procedure will be required, possibly requiring regular additional effort by Mercer Metro staff. Of interest in this evaluation is the way in which this problem is met, the accuracy of the resulting estimates, and the uses to which they are put. One result of such a study might be improved methods for patronage counts under free-fare service.

### 4.3.4. Financial Impacts

#### Revenue Loss

Of major interest to transit operators elsewhere is the amount of revenue lost in such a free-fare program. NJDOT and Mercer Metro have made an estimate of this loss for purposes of allocating the demonstration's costs among its sponsors. A check of this estimation methodology is required to assure its accuracy as much as possible, and the evaluation should include a report of this loss as a proportion of total farebox revenue.

#### Operating Costs

Unless additional bus-miles of service are required to handle the increased passenger loads, operating costs are likely to change only slightly. A small increase in total system operating cost is likely due to increased maintenance needs arising from the increased patronage. This may be so small as to be undetectable.

Many different measures are in use across the industry to assess the cost of transit service. These include total operating cost, cost per bus-hour or bus-mile, cost per passenger or passenger-mile, and similar measures substituting subsidy (cost of service minus farebox revenue) for operating cost. All of these are loosely categorized as cost-effectiveness or sometimes productivity (although productivity is also defined, however confusingly, as passengers or passenger trips per bus-mile or bus-hour). In this evaluation such misleading terminology as a "productivity increase" is to be avoided; the issue of concern is simply whether and by how much the transit authority's total need for subsidy support has increased because of free fares. Other unit measures are to be presented but are of relatively little import in this situation.

#### 4.4 SECONDARY EFFECTS

##### 4.4.1. Major Issues

If off-peak transit ridership grows substantially in response to the free service, a variety of higher-order effects may also occur. Those of major interest in this evaluation, along with the general issues of concern for each, are as follows:

- o Regional economics  
*Will free transit help to increase retail sales in downtown areas or in shopping centers served by bus?*
- o Public attitudes  
*Will the free transit program influence local public support for transit?*
- o Environment  
*Will free transit help to reduce traffic congestion, energy use and air pollution?*

##### 4.4.2. Regional Economics

###### CBD Revitalization

Both Federal and local sponsors wish to know whether the free bus service will draw more shoppers into the Trenton CBD because of its relatively high level of transit access. If this were to occur, it would indicate that free transit may be a useful tool to assist in downtown revitalization both in Trenton and elsewhere. Such a finding would help to justify both local public and private contributions to support a permanent free transit service. Because of limitations on access to retail sales data, only a general analysis is possible; however, this may be adequate for the desired purpose.

### Shopping Center Patronage

It has been suggested that free bus service may widen the range of shopping opportunities for central-city poor. In particular, their access to regional suburban shopping centers served by transit might be increased with free bus service. Thus bus travel between Trenton and selected outlying shopping centers may increase, although as in the CBD the effect on sales will be difficult to determine.

#### 4.4.3. Public Attitudes

##### Support of General Population

An important aspect of this demonstration is the degree to which it influences the attitudes of the general population toward public transit services. It is well established that the current trend nationwide is toward a tightening of local financial support for all public services, in response to economic pressures on the individual taxpayer. In the San Francisco Bay Area, for example, a recent law requires all transit services to cover at least one-third of their operating costs through fares in order to qualify for state subsidies. In such a fiscal climate, programs such as free bus service may not be well received by the tax-paying (and typically non-bus riding) public.

In Trenton the free-fare advertising campaign should improve Mercer Metro's visibility, since heretofore little marketing has been done. MM's image as a progressive public service may be enhanced, unless the free-fare concept itself proves to be unpopular. Local news media and other opinion leaders may be highly influential in this regard. Apart from the public's evaluation of Mercer Metro in general and the free-fare program in particular, their willingness to accept local taxes to support such services is perhaps the most meaningful indicator of attitudes. A comprehensive study of such attitudes is clearly an important component of the free-fare evaluation.

##### Attitudes of Transit Users

It is naturally to be expected that transit users will be pleased with the free service. However, two possibilities arise which may produce information of policy relevance. First, if substantial crowding, crime or harassment, or other service quality deterioration occurs, many patrons may find the free service to be a mixed blessing at best - particularly at a savings of only



15¢ per ride. Second, probing may detect a feeling among many patrons to the effect that the free service really is not a very important benefit to them. Such findings could well temper the enthusiasm of free-fare supporters among public leaders elsewhere, and are plausible enough to bear investigation.

#### 4.4.4. Environment

##### Traffic Congestion

Traffic is unlikely to improve substantially because of free off-peak bus service. As noted in an earlier section, this is because traffic congestion occurs primarily in the peak rather than the off-peak hours. In addition, even a very large proportional increase (say 50%) in bus usage, diverted largely from autos, would result in only a small decrease in traffic. However, documentation of the actual magnitude is useful and should be included in the evaluation.

##### Energy Use and Air Pollution

These are direct derivatives of the amount of traffic reduction described above. If traffic reduction is inconsequential, so also will be energy savings and air quality improvement. Nonetheless, the importance of these concerns as public objectives requires their inclusion. Little emphasis is required to satisfy this need in the evaluation.

#### 4.5 THE IMPLEMENTATION PROCESS

The implementation of the free-fare service in Mercer County involves a complex network of communications and transactions among UMTA, NJDOT, Mercer Metro and other local authorities. Evaluation requirements have added other actors, such as TSC, its evaluation contractor, and the state's contractor for data collection. A marketing consultant is also involved. Since most of these types of participants would be involved in creation of any similar service elsewhere (even if not an SMD experiment) it is useful to learn how they worked together to prepare for, start, and operate the Trenton experiment.

This is not a major topic of concern: Most of the transit industry's interest in the Trenton Free-Fare project will focus on the travel behavior response to the fare elimination. However, if the experiment does result in large patronage increases, transit authorities elsewhere may wish to attempt similar programs. If so, information on "how it was done" in Trenton will be a valuable guide. Since such information is rapidly lost unless a specific effort is made to record and preserve it, its inclusion in this evaluation is important.

The central issue in evaluation of the implementation process is straightforward:

*Which, if any, aspects of the implementation process went especially well or especially poorly?*

Some of the aspects for consideration include the origination and shepherding of the idea, the securing of both local and Federal financing, obtaining of required concurrences from various governmental agencies and others such as labor unions, planning of the new service, preparation for evaluation (whether for UMTA or for solely local purposes), marketing, transit personnel training, guidance of the experiment while in progress, and the derivation and use of its results.

Some subissues for specific investigation include the following:

Origination and Support: Was strong local political support present, or if not present, needed?

Financing: How was local financing arranged?

Inter-agency Coordination: Was required agency cooperation easily obtainable, or a substantial barrier to progress?

Ongoing Administration: How closely were project schedules kept? Was adequate time allowed for each administrative step?

Planning and Marketing: Did planning, management and marketing activities by local staff adversely affect other duties?

Operations Changes and Training: Was the operation of the existing service disrupted significantly?

Effects on Local Policies: Did the demonstration result in any lasting changes in local transit service or related public policies?

# 5 EVALUATION APPROACH

## 5.1. STRATEGY AND ORGANIZATION

### 5.1.1. General Approach

The evaluation strategy is based on the detailed breakdown of issues presented in the preceding chapter. With the issues to be evaluated now identified and grouped logically, the strategic task is to develop a means of responding to each issue satisfactorily while respecting their differing priorities and overall time and budgetary limitations.

Each of the four main issue categories established in Chapter Four is largely independent of the others, both in data collection and analysis requirements. Therefore each of the four is treated in a separate section in this chapter. However, the general study approach may be described as follows:

- o Two matched sets of surveys, before and during the free-fare program, to assess changes in bus rider characteristics, bus travel patterns, use of autos, and attitudes of the general public
- o Periodic monitoring of bus ridership, transit operational procedures and costs, retail sales, and the management of the experiment to secure perishable data and provide early findings
- o Application of adjustments to data to correct for effects of factors other than the free-fare program through development of historical transit ridership and cost data trends, comparison with other transit properties, scheduling of data collection to avoid weather and seasonal variations and unusual events, and monitoring of other relevant local trends and events
- o Computation of measures from the adjusted data to estimate specific effects of the experiment, each in response to an issue defined at the outset and using only those data and analytic techniques determined by the minimum precision required by that issue
- o Early analysis wherever possible to permit every possible simplification of the final cycle of data collection and analysis.



### 5.1.2. Organization of this Chapter

The remainder of this chapter is divided into four sections, each representing one of the main issue groups:

- a. Travel Behavior Responses
- b. Secondary Effects
- c. Transportation Supply Changes
- d. The Implementation Process.

Within each of these sections, the overall evaluation approach is described in general terms, and the appropriate measures, data requirements, and analysis for each issue (as identified in Chapter Four) are outlined in greater detail.

## 5.2. EVALUATION OF TRAVEL BEHAVIOR RESPONSES

### 5.2.1. Approach

Major concerns regarding the free-fare program's effect on travel behavior include the following:

- o Total bus ridership impact
- o Sources of new riders (especially autos and new trips)
- o Benefits to transit-dependent groups.

Total ridership impact is to be determined in two complementary ways: first, by comparison of two off-peak boarding counts done at a 12-month interval, one before and the other during the free-fare experiment; and second, through a longitudinal "ridership change index" developed from periodic corner counts before and throughout the experiment. Adjustments are to be made to the observed ridership change to remove the effects of events and background trends unrelated to the free-fare program.

Since transferability of total ridership results is an important concern of TSC and UMTA, two separate efforts are also proposed to develop predictive tools from the Trenton findings for possible use elsewhere. First, survey data are to be provided to the National Bureau of Standards to enable their testing of the NBS-McLynn "fully competitive mode choice model." This existing model will be used by NBS to predict the mode shift attributable to the free service, and its prediction will be verified by the results of the second survey.

In a second independent effort (which is proposed as an option for TSC to accept or reject after review of other early findings) a more general model for free-fare ridership prediction is to be developed from the results of the second survey. This model is to incorporate new travel (trip generation and mode/destination changes) and intermodal shifts of travelers in a direct estimation of transit ridership change, with standard socioeconomic and trip-descriptive parameters. Emphasis will be on simplicity of model structure.

Sources of new riders, benefits to transit-dependent groups, and most other travel behavior issues are to be addressed through the differences in distribution of responses to two systemwide on-board bus surveys, one before and the other during the free-fare experiment. At the same time, corresponding responses of self-identified "new riders because of the free-fare program" in the second survey will be tabulated as an independent means of assessment for comparison with the more aggregate "before/after" results.

The remainder of this travel behavior section outlines measures, data, and analytic approaches in more detail for each issue. Travel behavior measures to be derived in response to each issue are listed in Table 5.1.

#### 5.2.2. Evaluation of Total Ridership Impact

##### Primary Approach

The primary method for assessment of "stabilized" ridership impact (i.e., that occurring after the program is well established) is a direct comparison of off-peak systemwide passenger boarding counts before and after startup of the free-fare program. These two counts are to be 12 months apart to eliminate seasonal effects, and differences in weather and extraneous events are to be avoided as much as possible in the selection of survey days. The first survey was approximately four months before inauguration of free fares; the second will be eight months after startup.

##### Controls

Further adjustments to the counts are to be made for long-term prior trends in ridership due to factors other than the free-fare program. These adjustments will be based on an assembly and review of Mercer Metro patronage estimates for the survey month (October-November) for the five years preceding the experiment. This past trend will be normalized to a constant level of service (bus-miles). Further corrections for factors such as extended major strikes, unemployment variations, and weather differences will be made either directly or by regression, depending on the degree of such effects and the smoothness of the uncorrected trend.

### Secondary Approach

During the entire free-fare program, a separate total ridership estimation procedure will also be used. This is to provide a check on the primary method as well as to obtain information on the way in which ridership response changes with each passing month. This procedure is based on a relatively economical data set composed of corner counts (counts of riders on all buses passing certain fixed observation points) during the free-fare period. Data from Mercer Metro's regular quarterly counts will be used, plus some supplementary counts to provide more frequent and geographically diverse data.

From the count data, an index of ridership change will be derived. This index will be developed from a regression analysis of the historical relationship between Mercer Metro's existing corner counts and farebox-derived patronage estimates. Several functional forms will be tested; for example, one will involve the farebox patronage estimate as the dependent variable and each of the corner counts (by location) as the predictor set. The resulting relationship and early ridership estimates will be verified later through comparison with the second systemwide off-peak boarding count when those data become available, and adjustments made if required.

### Additional Controls

As with the systemwide boarding counts, the ridership change index will be adjusted to isolate the effect of the free-fare program from other forces which influence ridership. Similar methods will be used, and each temporal data point in the series will be adjusted separately.

### Comparison with Other Cities

In addition to those means of adjustment, available periodic ridership data from other Northeastern cities will be collected for comparison with Mercer Metro. Cities with transit service expansion and fare change histories similar to Mercer Metro's will be selected. Some candidates include Camden, N.J., Syracuse, N.Y., Scranton, PA, and Columbus, Ohio. Actual selection will depend on data review. Transit ridership trends from these cities will be used as an independent check on the control trend derived for Mercer Metro, as a means of increasing confidence in the Trenton adjustments.

Table 5.1  
EVALUATION MEASURES FOR TRAVEL BEHAVIOR

Issues	Measures	Sources
<u>A-1. Total Ridership Impact</u>		
a. Stabilized Ridership Gain	Trend-adjusted increase in total off-peak bus boardings	<ul style="list-style-type: none"> <li>a. On-board surveys before and during free-fare term</li> <li>b. Historical trend data on bus patronage traffic volumes, employment, etc.</li> </ul>
b. Initial Ridership Gain	Trend-adjusted increases in Ridership Index (RI = $f_n$ (bus rider volumes at selected points))	<ul style="list-style-type: none"> <li>a. Corner counts taken periodically during interim period</li> <li>b. Source (b) above</li> </ul>
c. Weekday/Weekend Ridership	Trend-adjusted increase in total off-peak bus boardings	<ul style="list-style-type: none"> <li>a. On-board surveys (by day of week)</li> <li>b. Corner counts (by day of week)</li> </ul>
d. Prediction of Ridership Impact	Dependent variable: Trend-adjusted increase in total off-peak bus boardings	<ul style="list-style-type: none"> <li>a. On-board surveys (by day of week)</li> <li>b. Corner counts</li> </ul>
	Predictors: Auto availability, population income and age structures, fare-decrease elasticities, trip length, purpose, and others to be determined	<ul style="list-style-type: none"> <li>a. Census, literature, on-board surveys, activity center surveys, random telephone survey</li> </ul>
<u>A-2. Traveler Characteristics</u>		
a. Low-Mobility Persons	<ul style="list-style-type: none"> <li>1. % of self-identified new users classifiable as low-mobility</li> <li>2. % change in proportion of low-mobility users</li> </ul>	<ul style="list-style-type: none"> <li>On-board surveys</li> <li>On-board surveys</li> </ul>
b. New Bus Users	<ul style="list-style-type: none"> <li>1. % of free-fare riders self-identified as non-users prior to free fares</li> </ul>	<ul style="list-style-type: none"> <li>On-board surveys</li> </ul>
c. Group Ridership	<ul style="list-style-type: none"> <li>1. Increase in number of groups by type</li> <li>2. Proportion of total ridership in groups</li> </ul>	<ul style="list-style-type: none"> <li>a. On-board surveys</li> <li>b. Driver interviews See a,b above</li> </ul>

## Issues

## Measures

## Sources

A-3. Former Trip Characteristics

a. Auto	% of new free-fare bus trips otherwise made by car	On-board survey during free-fare term
b. New Travel	% of new free-fare bus trips otherwise not made	On-board survey during free-fare term
c. Taxi	% of new free-fare bus trips otherwise made by taxi	On-board survey during free-fare term
d. Time-of-Day Shift	% of new free-fare bus trips otherwise made by bus in other time period	On-board survey during free-fare term
e. Walk	% of new free-fare bus trips otherwise made by walking (or bicycle, etc.)	On-board survey during free-fare term

A-4. New Trip Characteristics

a. Fare Savings	Distribution of new free-fare trips by former bus trip cost	On-board survey (O-D data)
b. Trip Length	Change in mean trip length between prior off-peak and new free-fare bus trips	On-board survey (O-D data)
c. Trip Purpose	Differences in distributions of purposes of new free-fare bus trips versus former off-peak bus trips	On-board survey (O-D data)



## Ridership Decline after Demonstration

The corner count program will be continued beyond the end of the free-fare demonstration for this purpose. The same methodology for data collection and analysis will be used as in the earlier use of corner counts for initial ridership impact estimation. A six-month extension with two additional counts is tentatively proposed, but could be further extended. These will be coordinated with Mercer Metro's quarterly counts. Results of this portion will be described in a separate memo report, since the project's Final Report is scheduled for earlier completion.

## Weekday/weekend Estimates

Both the boarding count and corner count methods of estimation will be used in separate analyses of weekday, Saturday, and Sunday ridership. The pre-implementation boarding count in November 1977 included all three days, as will the count twelve months later. The Mercer Metro corner counts are taken only on weekdays. However, supplementary weekend counts have been taken for the October 1977 set and are to be continued periodically throughout the year-long demonstration. At least one additional full set of corner counts will also be taken after the demonstration ends to investigate the degree of ridership loss which may occur.

### 5.2.3. Ridership Impact Prediction

#### NBS Model Test

As described earlier, the National Bureau of Standards is to use the Trenton data to test a predictive model of the free-fare program's effect on off-peak travel mode choice. NBS is to be provided with data from the November 1977 surveys of bus riders and auto travelers during the free-fare hours. They will use these data in their model to predict the November 1978 mode split. Verification will be provided by the 1978 survey and count data. Further details on the NBS experiment are given in Appendix F. Evaluation of the NBS results will be included in this project's findings.

#### Further Model Development

In addition to the NBS work, a separate attempt will be made to develop predictive instruments for the transit ridership impact of a free-fare program. The approach



to be used will begin with very simple models and progress through successive refinements to investigate the robustness of the original predictions.

The simplest model is one in which transit ridership change is predicted directly as a fixed percentage of the prior ridership (e.g.,  $\Delta R = 0.25 R_1$ ). In effect, such a model asserts that the only determinant of change is the subjective elimination of fares, irrespective of the actual fare savings, trip lengths, access times, trip purpose, traveler's incomes, access to autos or any other commonly accepted modal split determinants. The percentage increase in ridership could be taken directly from the Trenton before/after counts; with slightly more complexity it could be predicted earlier from a review and gross averaging of fare elasticities of demand observed for fare reductions elsewhere and tested against the Trenton results. Such a model may not be as trivial as it appears, since key policy decisions have been made on as little or less information before. The intent of this investigation is to indicate whether and how more sophisticated techniques can improve on the result of such a simple "model" in policy-relevant ways.

At the other end of the spectrum might be an elegant n-dimensional logit model of mode split, possibly even extended to include latent transit travel demand as a synthetic "mode" in order to cover the generation of new trips by the inducement of free transit. Results of interim steps will determine progress toward this extreme. However, the NBS mode split modeling experiment approaches this end of the spectrum; the TSC/De Leuw efforts are therefore intended primarily to explore other methods rather than duplicate the NBS work.

TSC/De Leuw efforts will concentrate on using the before/after changes in ridership and conventional predictors (e.g., trip impedance measures and socio-economic characteristics) plus a term for the subjective effect of zero fares to derive alternative models for verification elsewhere. Alternatively, if Denver free-fare data prove satisfactory and are available early enough, they may be used either to develop models earlier for testing in Trenton or to verify models developed with Trenton data.<sup>1</sup> Initial models will be of a multiple linear regression form; more complex functions will be tested as feasible.

---

<sup>1</sup>A one-month off-peak systemwide free-fare experiment is being conducted in February 1978 by the Regional Transportation District (RTD) in Denver. A limited data collection and analysis effort is underway by RTD, TSC and De Leuw, Cather.

## Stated vs. Revealed Travel Behavior

In the initial surveys of off-peak auto travelers in the general population, questions were asked concerning the respondent's willingness to use transit if it were free. The proportion of positive responses will be compared with the actual incidence of free transit use among a similar sample of the general population surveyed near the end of the free-fare period. Statistical significance of the aggregate difference in proportions (independent random samples) will be assessed.

### 5.2.4. Evaluation of Changes in Traveler Characteristics

All measures of traveler characteristics will be derived from the two on-board surveys. Measures are as shown in Table 5.1. All survey results will be expanded to correspond to the full off-peak bus user volumes as determined by boarding counts, adjusted for the effect of forces and trends unrelated to the demonstration (see Section 5.2.2).

#### Low Mobility Users

Changes in the number of trips made by low-mobility persons on the survey day will be derived directly from the adjusted data, and tested for statistical significance. Off-peak trip frequency responses will be used to convert these trip volumes to numbers of low-mobility persons taking advantage of the service. These will be reported both as absolute numbers and as a proportion of the county's low-mobility population (per census data).

#### New Users vs. Increased Trip Rates

New users, persons who did not use the transit system regularly before the free-fare program, are to be self-identified in the second on-board survey. The proportion of such new users in the total expanded rider population on the survey day, together with their self-reported frequency of off-peak bus use, provide the basis for direct derivation of the number of new riders versus former riders who are making more trips because of free fares.

#### Group Ridership

The analysis will focus on "affiliated" groups, i.e., those traveling on a single budget, such as families. Both in the before and after (or "during") on-board surveys, staff distributing questionnaires note group status on the forms and provide only one form to each group. In addition, respondents are asked how many people, if any, are traveling with them. The proportion of groups among the rider population will be compared statistically for the adjusted before and after cases.

### 5.2.5. Evaluation of Transit Trip Options

Respondents to the second on-board survey will be asked their most likely travel behavior for the present trip if the free fare had not existed. Options include auto, taxi, walk, bus at different time, no change, and make no trip. These proportions are to be reported directly.

### 5.2.6. Evaluation of New Trip Characteristics

Fare savings, trip lengths and purposes of trips induced by the free fare will be assessed in two ways. First, these characteristics of the trips of self-identified new riders will be reported directly, as proportions in each category (e.g., 15¢, 20¢ and 25¢ for fare savings). Second, the before and after distributions of the same measures for all respondents will be compared statistically. Selection of the appropriate statistical technique will depend on the distributions; discriminant analysis is the probable choice.

## 5.3. EVALUATION OF EFFECTS ON TRANSPORTATION SUPPLY AND COSTS

### 5.3.1. Approach

Transportation supply and cost issues require both quantitative and qualitative measures and analyses. Some measures involve Mercer Metro numeric data such as run times, on-board crime, fleet requirements, revenue loss and operating costs. Others require more subjective assessments based on sources such as driver and supervisor reports. Where such data or subjective information can be obtained periodically, results will be reported as trends; otherwise a before/after approach will be used.

As categorized both in the earlier discussion of issues and in Table 5.2's display of measures, the analytic operations will be described in this section under three groups:

- o Quality of service
- o Transit operations
- o Financial impacts.

### 5.3.2. Quality of Service

#### Crowding

Crowding will be assessed primarily through subjective reports of Mercer Metro drivers and their supervisors, using informal interviews. Data from periodic corner counts will also be used directly, since these are direct

Table 5.2  
EVALUATION MEASURES FOR TRANSPORTATION SUPPLY AND COSTS

Issue	Measures	Source
<u>B-1. Quality of Service</u>		
a. Crowding	1. Increase in % of buses with standees at selected points	Corner counts
	2. Perceived increase in	Driver interviews
b. Crime and Harassment	1. % change in reported crimes on board	Mercer Metro and police records
	2. Perceived increases in threats, noise, or rowdyism among passengers	Driver interviews, telephone follow-ups to on-board survey, local media Mercer Metro complaint files
c. Travel Time Savings	1. Change in mean boarding time per passenger	Boarding-timings and boarding counts
	2. Change in slack time at ends of bus runs	Bus schedules and interviews with Mercer Metro field supervisors
<u>B-2. Transit Operations</u>		
a. Fleet Requirements	Number of buses added to off-peak service	Mercer Metro
b. Effects on Drivers	Subjective appraisal of changes in working conditions	Driver interviews and direct observation
c. Fare Handling	Change in staff time required for fare handling	Mercer Metro
d. Patronage Estimation	1. Change in estimation procedure	Mercer Metro
	2. % difference between MM and De Leuw patronage estimates	Mercer Metro and bus boarding counts

Issue	Measures	Source
<u>B-3. Financial Impacts</u>		
a. Revenue Loss	1. % of difference between NJDOT and De Leuw revenue loss estimates	NJDOT demo application, on-board surveys and boarding counts
	2. Revenue loss as a % of total farebox revenue	Mercer Metro
b. Operating Costs	1. Costs of -increases in off-peak bus service (if any)	Mercer Metro
	2. Increases in fuel use, vandalism, and mechanical repair required for off-peak bus blocks	Mercer Metro



tallies of numbers of passengers on individual buses. Trends in Mercer Metro corner counts for specific bus blocks will be sampled and plotted to detect discontinuities at the start of the free-fare demonstration in contrast to prior values.

#### Crime and Harassment

Crime and harassment will also be assessed through driver reports. Local newspaper coverage will also be monitored to identify complaints, as will Mercer Metro's own receipt of passenger complaints. As available, formal statistics on crime on Mercer Metro buses will be obtained both from Mercer Metro and the local police. As with other measures, the reported incidence of such problems will be compared to past trends.

#### Travel Time Savings

Travel time savings are hypothesized to stem from savings in stop times due to possibly faster boarding with no fare payment. A sample of stop times will be compared between fare-paying and free-fare hours, normalized for numbers of boarders and the difference tested for statistical significance. Stop times will be defined as the time from door opening to the passage of the last boarder past the farebox, since in the initial timing of stops the open-door time was found to be an unreliable indicator of the actual boarding time. In addition to this measure, actual changes in end-to-end run times will be assessed through comparison of former run schedules with actual running time under free fares. As with most such measures involving comparison of mean differences between two independent (or matched) samples, statistical significance will be ascertained through a standard t-test.

### 5.3.3 Transit Operations

#### Fleet Requirements

Here the measure is simply the number of buses required for scheduled off-peak service. Any addition of buses to handle crowding will be reported directly. No statistical tests are appropriate.

#### Effects on Drivers

Effects on drivers will be assessed both by direct observation and through informal periodic interviews with a small sample of drivers. Effects of interest include difficulties with unruly passengers or crowds as well as elimination of fare-collection duties.



### Fare Handling

Fare handling effects will be assessed through review of changes in time required for daily fare counting and related Mercer Metro staff duties. No quantitative data will be collected other than Mercer Metro estimates.

### Patronage Estimation

Mercer Metro's development and use of a new patronage estimation method to handle free-fare period ridership will be observed and reported. The accuracy of corner count methods as an alternative to farebox formula or other approaches will be assessed (see 5.2.2); in addition, use of period boarding counts to augment farebox-formula estimates will be explored in cooperation with Mercer Metro.

## 5.3.4. Financial Impacts

### Revenue Loss

Revenue loss due to free fare will be estimated from the analysis of past ridership trends (5.2.2). This will be compared with NJDOT's linear regression estimation to verify or adjust the revenue loss figures now assumed.

### Operating Cost

Impacts on Mercer Metro operating costs will be drawn primarily from review of any specific increases in off-peak bus requirements, maintenance due to increased passenger loads, and fuel usage. Only minimal review of overall operating cost records will be conducted, since off-peak costs cannot readily be isolated from such records.

## 5.4 EVALUATION OF SECONDARY EFFECTS

### 5.4.1. Approach

Secondary or "indirect" effects of the free-fare demonstration include those on the region's economy (specifically retail trade distribution), public attitudes toward transit, and environmental impacts. The general approach to this group of issues is a cross-sectional before/after analysis, although periodic data and longitudinal analyses will be used where possible. Measures and data sources are to be as shown in Table 5.3.

Table 5.3  
EVALUATION MEASURES FOR SECONDARY EFFECTS

Issue	Measures	Source
<u>C-1. Regional Economics</u>		
a. CBD Revitalization	1. Trend-adjusted change in off-peak bus travel to Trenton Commons	On-board surveys and boarding counts
	2. Changes in retail sales in Trenton Commons	Trenton Commons Commission
	3. Change in % of shoppers arriving by bus	Activity-center interviews
b. Shopping Center	1. Trend-adjusted change in off-peak bus travel to Quaker Bridge Mall	On-board surveys and boarding counts
	2. Changes in retail sales at QBM	QBM operator
	3. Change in % of shoppers arriving by bus	Activity center interviews
<u>C-2. Public Attitudes</u>		
a. Support of General Population	Attitudes toward transit service, free-fare and taxation support	Random telephone surveys
b. Attitudes of Transit Users	Attitudes toward transit service, free-fare and taxation support	Telephone follow-ups to on-board surveys
<u>C-3. Environment</u>		
a. Traffic Congestion	VMT avoided by new use of free-fare transit	On-board surveys
b. Energy Use and Air	1. Gallons of gasoline saved through VMT reduction	On-board surveys, EPA gas mileage averages, and DVRPC travel mileage estimates
	2. % improvement in air quality indicators due to VMT reduction	On-board surveys, DVRPC mileage estimates, and EPA travel/emissions relationships

#### 5.4.2. Regional Economics

Both CBD revitalization and suburban shopping center use will be assessed in three ways. First, the (trend adjusted) on-board survey results before and during the free-fare period will be used to provide estimates of the increase in off-peak bus travel to downtown Trenton and several suburban shopping centers (e.g., Quaker Bridge Mall). This will be possible from the origin-destination coding of respondent's trips.

Second, an attempt will be made to collect data on retail sales trends in the Trenton CBD area (source: Trenton Commons Commission) and in at least one shopping center (tentatively Quaker Bridge Mall). Analysis methods will depend on the degree of cooperation obtained from data sources and the specificity and frequency of the data. Tentative plans are for trend adjustment to isolate free-fare effects similar to that done for total off-peak system ridership (see 5.2.2). Trend adjustment will involve direct comparisons with retail sales trends countywide and in other nearby areas as available.

The third approach makes use of data from the activity center interviews conducted in the Trenton Commons area and at Quaker Bridge Mall. The November 1977 random interview procedure will be reported in November 1978, and the proportions of shoppers arriving by bus will be compared for statistical significance (t-test) between the two periods.

#### 5.4.3. Public Attitudes

##### Support of General Population

The November 1977 random household telephone survey provided data on the attitudes of Mercer County residents toward transit service in general and free-fare service specifically, as well as willingness to be taxed for such services. These questions will be repeated in a November 1978 survey of similar design. The statistical significance of the before/after differences in attitudes will be determined and significant differences will be reported. Further questions concerning awareness of the free service and reasons for attitudes will also be included in the second survey. Reportage of such results is direct. Differences in attitude among different demographic and socio-economic groups, particularly income and age groups, will also be reported.

##### Attitude of Transit Users

The November 1977 telephone follow-up survey of a small sample of off-peak bus users will be repeated (with a new random sample) in November 1978 to assess changes in attitude toward the service. Additional questions concerning the importance of the free service and reasons

for stated attitudes will be included on this survey. Responses for pre-free fare riders and new users will be reported separately.

#### 5.4.4. Environmental Impacts

##### Traffic Congestion

The primary means for assessment of traffic congestion effects will be based on the results of the analysis of the proportion of new bus trips formerly (or alternatively) made by auto. The number of such trips will be adjusted by trip frequency, length, and a range of auto occupancy rates to produce an estimate of vehicle-miles of auto travel eliminated by the free-fare program. This travel volume will be reported as a proportion of the estimated daily off-peak VMT (vehicle-miles traveled) for the county, using estimates from the Delaware Valley Regional Planning Commission.

##### Energy Use and Air Pollution

The estimated savings in VMT will be the basis for assessment of these environmental effects. Energy use will be derived from VMT savings times EPA-estimated 1978 average auto gas mileage. Air pollution reduction will also make use of current EPA-approved relationships between pollutant emissions and predictors including trip length, time of day and VMT change.

### 5.5 EVALUATION OF THE IMPLEMENTATION PROCESS

This evaluation will be based on a program of continual contact with key actors in the Trenton implementation, including NJDOT and Mercer Metro representatives as well as city and county governmental officials. No quantitative data or formal surveys are to be involved. The primary intent of this effort is to document the process of implementation, with emphasis on the relevant issues enumerated earlier. These issues and the subjective "measures" and data sources are reviewed in Table 5.4.

The evaluation of the implementation, once documented, will be a subjective appraisal of the factors which were most influential in its conduct and interim results as well as its final outcome. Emphasis will be on transferability rather than praise or criticism.

Table 5.4  
EVALUATION MEASURES FOR THE IMPLEMENTATION PROCESS

Issue	Measures	Source
<u>D-1. Origination and Support</u>	Degree and nature of involvement of major local administrative and political figures in initiation of free-fare demonstration	NJDOT and Mercer Metro officials
<u>D-2. Financing</u>	Sources and procedures for local demo financing	NJDOT and Mercer Metro officials
<u>D-3. Inter-Agency Coordination</u>	<ol style="list-style-type: none"> <li>1. Degree of coordination required</li> <li>2. Difficulty of obtaining agreements</li> </ol>	<p>NJDOT and Mercer Metro officials</p> <p>NJDOT and Mercer Metro officials</p>
<u>D-4. Planning and Marketing</u>	<ol style="list-style-type: none"> <li>1. Hours of administrative staff time required</li> <li>2. Duties performed</li> </ol>	<p>NJDOT and Mercer Metro</p> <p>NJDOT and Mercer Metro</p>
<u>D-5. Operations Changes and Training</u>	<ol style="list-style-type: none"> <li>1. Time spent in training of transit staff</li> <li>2. Degree of change in transit staff duties</li> </ol>	<p>Mercer Metro</p> <p>Mercer Metro</p>
<u>D-6. Ongoing Administration</u>	<ol style="list-style-type: none"> <li>1. Reasons for (lack of) adherence to original schedule</li> <li>2. Staff time required</li> <li>3. Adequacy of planning</li> </ol>	<p>NJDOT and Mercer Metro</p> <p>NJDOT and Mercer Metro</p> <p>NJDOT and Mercer Metro</p>
<u>D-7. Effects on Local Policies</u>	<ol style="list-style-type: none"> <li>1. Change in local transit service after demo</li> <li>2. Local public and private financial support for free-fare continuation</li> </ol>	<p>Mercer Metro</p> <p>Mercer Metro, NJDOT, local media and public officials</p>



# 6 EVALUATION WORK PROGRAM

## 6.1 OVERVIEW

### 6.1.1. Phase Organization

The Trenton evaluation work program is divided into three time phases corresponding to the major data collection and analysis efforts. These phases are as follows:

1. Pre-Implementation. Tasks associated with the collection of the November 1977 pre-implementation survey data set, including design and monitoring of the NJDOT survey work. (Note: Some of the work was completed under a separate initial Technical Task Directive for Evaluation Plan preparation and initial coordination activities.)
2. Interim. Tasks associated with non-survey data collection and all analysis conducted during the one-year period between the two main survey data sets (November 1977 and 1978), including corner counts, initial analysis of first surveys, ridership estimates and controls, process documentation, predictive model experiments, quality of service assessments, and data development for secondary impact assessments.
3. Final. Tasks associated with the second wave of surveys, continued monitoring of other data sources, all remaining analysis, and final report preparation.

This chapter presents first a general inventory of data collection requirements imposed by the evaluation approach, a listing of tasks, and the evaluation schedule. The remainder of the chapter describes each task in more detail. As of this writing, the pre-implementation phase is complete and the interim phase is underway. Consequently, this chapter provides relatively little description of pre-implementation activities. Full documentation of these and all other tasks will be provided in the Final Report.

### 6.1.2. Data Collection Activities

The rationale for the work program is based largely on the project's data collection needs and uses. The many issues addressed in this evaluation require a wide variety of data, which in turn demand several different types of data collection activities. These data collection activities are identified in the listings of issues, measures and data



sources in Tables 5.1 - 5.4. To provide a clearer view of the roles of the different data collection activities, Table 6.1 indicates the relationship between these activities and the issues which depend on each of them for their evaluation data and measures.

### 6.1.3. Task Structure and Schedule

Major separable tasks to be conducted in each of the three evaluation phases are listed in Table 6.2. These tasks respond both to the analyses described in Chapter 5 and the resulting data collection activities. The major relationships among tasks are depicted in Figure 6.1. Numbers shown on each block in the figure are task identification numbers, and are used for reference in the remaining sections of this chapter.

The target schedule for all evaluation tasks is shown in Figure 6.2. This schedule, though subject to change, is based on expected data availabilities and analytic effort requirements with continuous involvement of key staff. Under this schedule, the draft Final Report is expected to be completed by May 1979, some two months after conclusion of the 12-month demonstration Project completion is anticipated for July-August 1979.

## 6.2. PRE-IMPLEMENTATION TASKS

### Task 1: Corner Counts I

Concurrent with the first on-board survey, an initial set of corner counts of bus ridership was conducted in mid-November 1977 by NJDOT's data collection contractor, Garmen Associates. The standard procedure used by transit authorities is for curbside personnel to count riders on passing buses. However, earlier corner count experiments using this procedure indicated that the available survey personnel could not duplicate the accuracy of the experienced counters employed by Mercer Metro and other transit authorities. Consequently a revised count program was developed using fewer count locations than originally planned and also physically stopping all buses at the count locations, where a counter would board and count patrons. This proved to be accurate and caused minimal disruption to transit service. The tally sheet form is shown in Appendix E.

Resulting count locations and times were as shown in Table 6.3. All were within the city of Trenton, corresponding where possible with Mercer Metro's quarterly count locations. All riders on all buses passing the survey points (both directions, where streets are two-way) were counted.

Table 6.1

EVALUATION ISSUES AND DATA SOURCES<sup>1</sup>

Issues <sup>2</sup>	Sources	On-board Surveys	Activity Center Interviews	Telephone Follow-ups	Random Telephone Surveys	Boarding Counts	Corner Counts	Timing of Bus Boarding
A-1.a.	Stabilized ridership gain					P	s	
b.	Initial ridership gain						P	
c.	Weekday/weekend gain					P	s	
d.	Predictive models	P	P	s	P	P	s	
2.a.	Low-mobility persons	P						
b.	New bus users	P						
c.	Group ridership	P						
3.a.	Auto trip option	P						
b.	New trip generation	P						
c.	Taxi option	P						
d.	Time-of-day shift	P						
e.	Walk option	P						
4.a.	Fare savings	P						
b.	Trip length	P						
c.	Purpose	P						
B-1.a.	Crowding			s			s	
b.	Crime/harassment			s				
c.	Travel time savings							P
2.a.	Fleet requirements							s
b.	Effects on drivers							
c.	Fare handling							
d.	Patronage estimation	s				s		
3.a.	Revenue loss							
b.	Operating costs							
C-1.a.	CBD revitalization	P	s			s		
b.	Shopping center use	P	s			s	s	
2.a.	Support of general pop.				P			
b.	Attitudes of bus users			P	s			
3.a.	Traffic congestion	P						
b.	Energy/air pollution	P						
D-1/7	All "Process" issues							

<sup>1</sup>P = primary sources

s = secondary contributing sources

<sup>2</sup>Numbers at left refer to issue identification numbers per Table 4.1.

Mercer Metro Records	Bus/Driver/Supv. Interviews	Retail Sales Data	APTA Transit Ridership Data	Background Trend Data (varied sources)	Direct Field Observation	NJ DOT Staff and Records	Local Media
P P			S S	S S			
	S			S S S S S S S S S			
S S	P P S			S	S S		S
S S	P P P P				S	S	
		S S		S S			S
	S				S	P	S

Table 6.2

## EVALUATION WORK TASKS BY STUDY PHASE

Task Number	Phase and Task
	<u>Pre-Implementation Phase</u>
1	Corner Counts I
2	Boarding Counts I
3	On-Board Survey I
4	Activity Center Survey I
5	Telephone Follow-up Survey I
6	Random Telephone Survey I
7	Bus Boarding Timings I
	<u>Interim Phase</u>
8	Corner Counts II
9	Background Trend Analysis I
10	Survey Data Set-up and Review
11	Bus Boarding Timings II
12	Interim Ridership Assessment
13	Ridership Modeling I
14	Secondary Effects Analysis I (retail sales)
15	Supply/Cost Analysis I
16	Implementation Process Evaluation I
	<u>Final Phase</u>
17	Background Trend Analysis II
18	Boarding Counts II
19	On-Board Survey II
20	Activity Center Survey II
21	Telephone Follow-up Survey II
22	Random Telephone Survey II
23	Post-Demo Ridership Evaluation
24	Travel Behavior Analysis
25	Ridership Modeling II
26	Secondary Effects Analysis II
27	Supply/Cost Analysis II
28	Implementation Process Evaluation II
29	Final Report

Table 6.3

CORNER COUNT HOURS BY DAY AND LOCATION

Count Location	Weekday	Saturday	Sunday
State & Calhoun	all day	-	-
State & Clinton	all day	free-fare hours	10AM - 6PM
Brunswick & Olden	all day	free-fare hours	10AM - 6PM

Data from Mercer Metro's quarterly weekday corner counts (4 locations) for October were also obtained for comparison.

Evaluation responsibilities included specification of the procedure and monitoring of field operations.

Task 2: Boarding Counts I

During November 1977 on-board surveys, the number of persons boarding each surveyed bus (50% of all buses during the free-fare period) was recorded by an observer on the bus who also assisted with the on-board interview. Observers were also placed on the remaining (non-surveyed) buses to count boardings, with the result that a 100% off-peak boarding count was obtained. Boardings were recorded by bus stop. The form used is shown in Appendix E. These counts were taken on weekdays, Saturdays and Sundays. Evaluation activities consisted of design of the procedure (in cooperation with NJDOT/Garmen) and monitoring of the field work to assess the quality of the data.

Task 3: On-Board Survey I

Self-administered questionnaires were distributed to all riders on approximately 50% of the bus runs in the free-fare period. The resulting survey data are identified to the level of route/block/day/AM or PM. Approximate response rates were 38% (weekdays), 45% (Saturdays), and 49% (Sundays). The survey questionnaire form is shown in Appendix A.

Evaluator responsibilities included survey sampling and content specification, assistance on design of forms and field procedures, monitoring of field work, and specification of coding detail and format. As with all surveys, machine-readable data are to be provided by NJDOT.

Task 4: Activity Center Survey I

The activity center surveys were conducted by personal interview at the Trenton Commons (CBD), the Quaker Bridge Mall (QEM) and the Mercer Medical

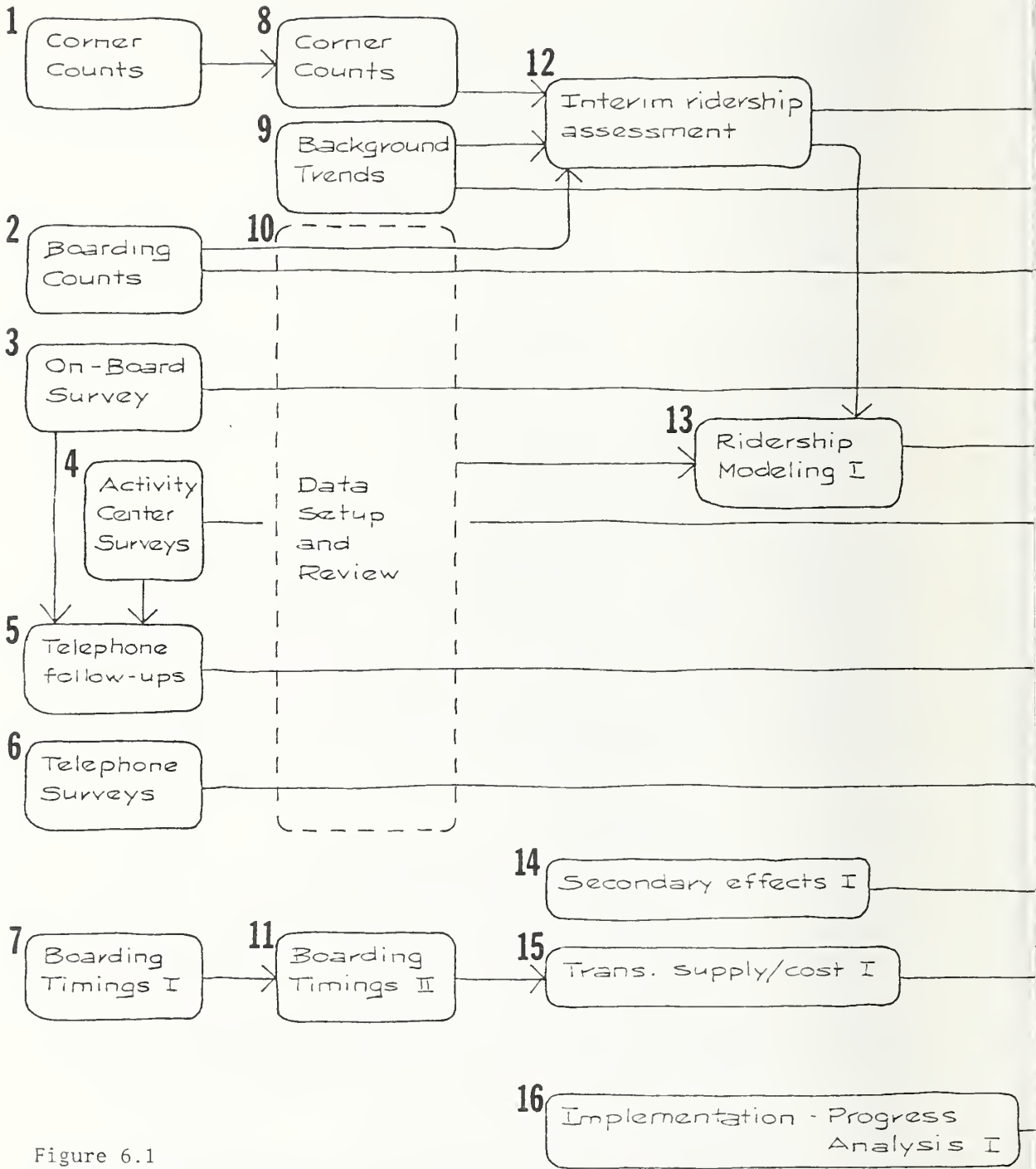


Figure 6.1  
WORK TASK RELATIONSHIPS



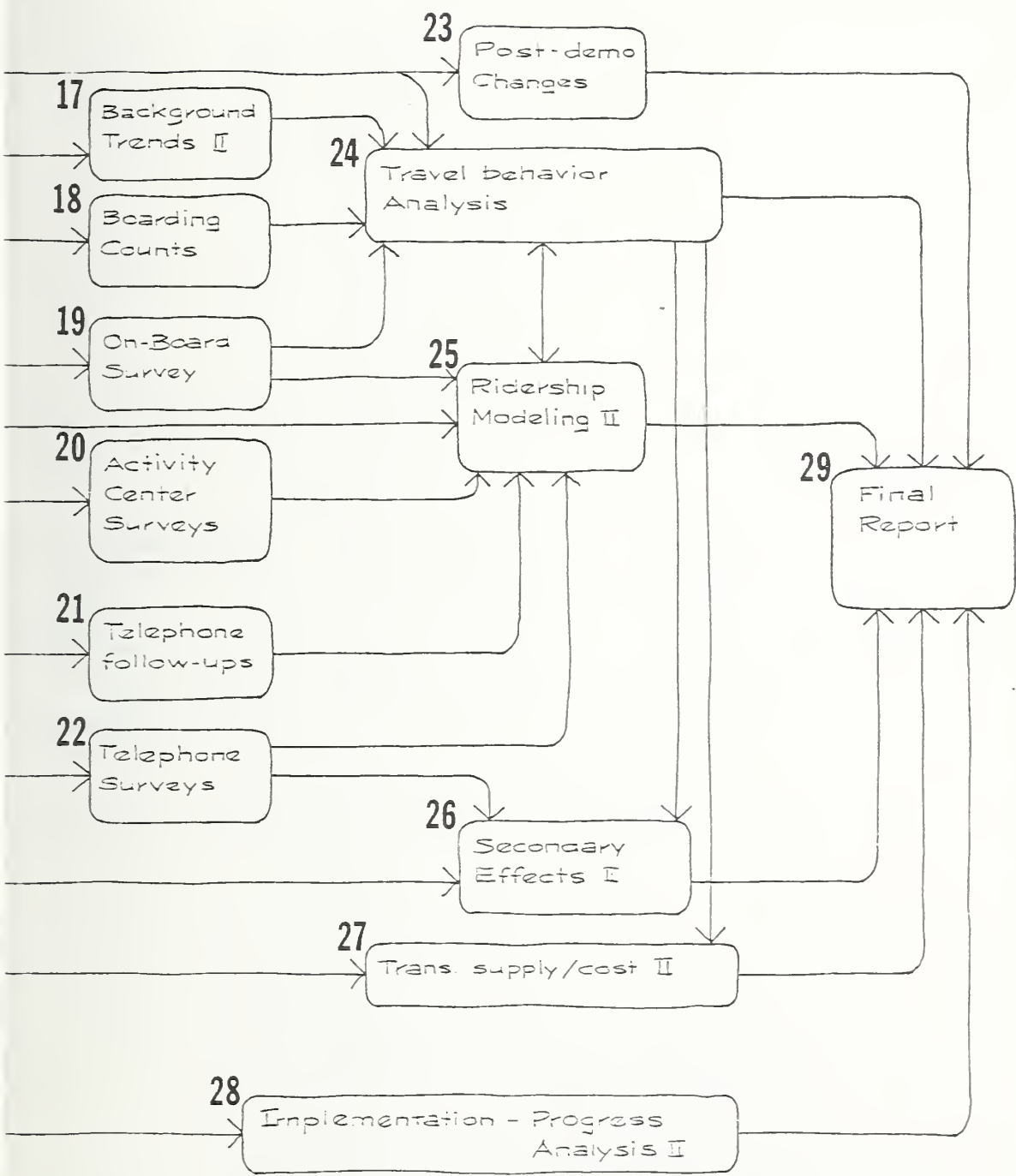
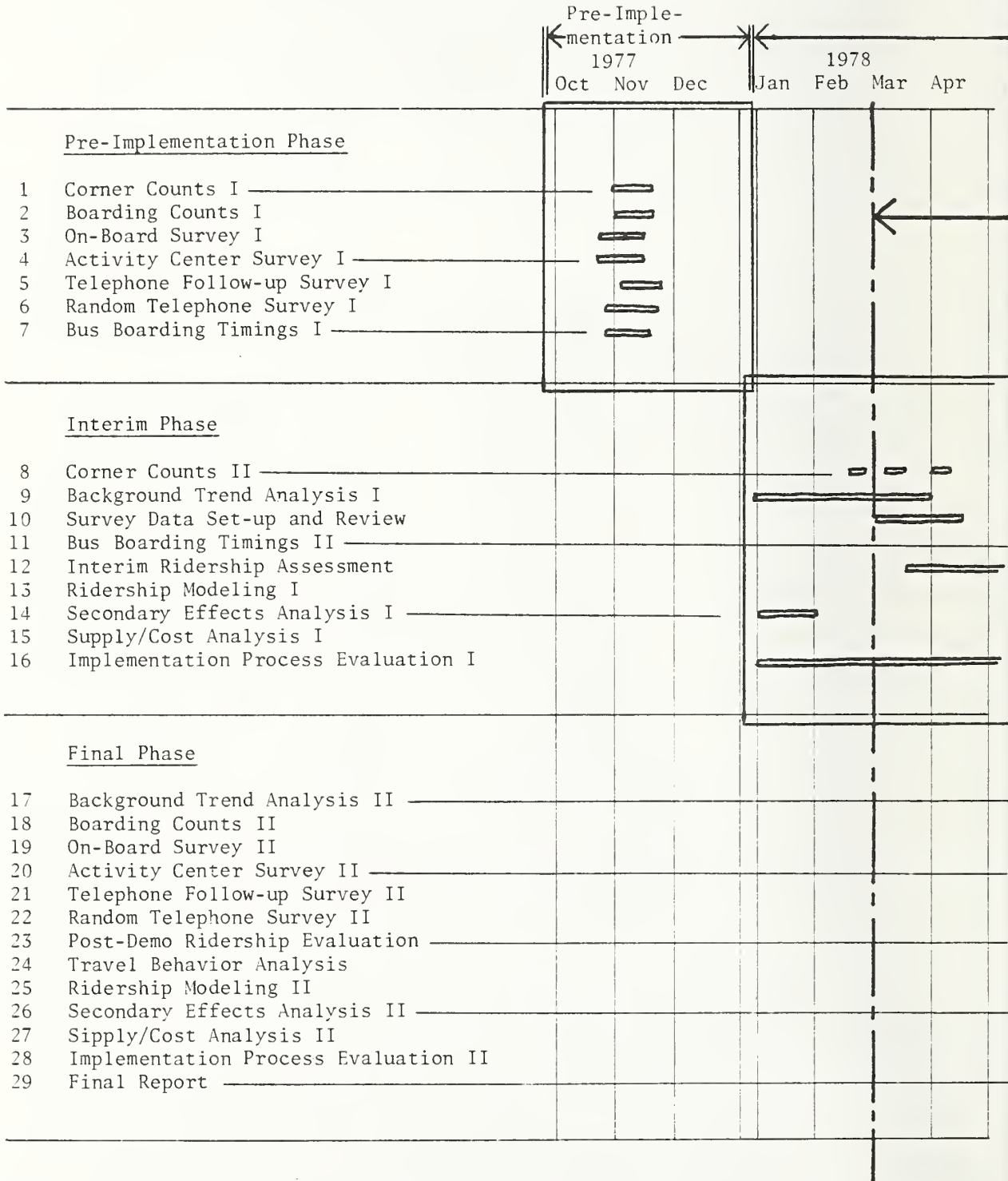


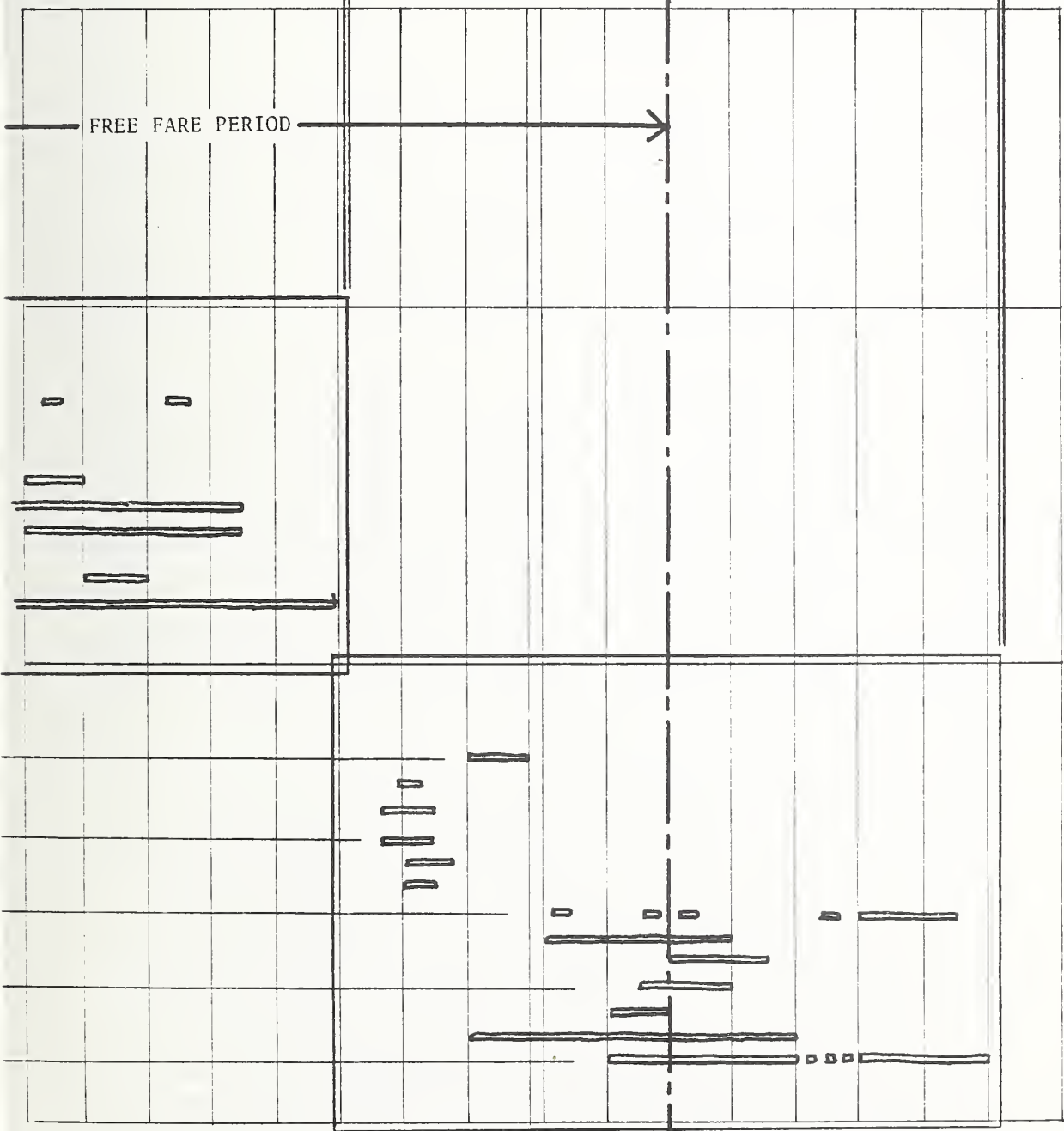
Figure 6.2  
EVALUATION SCHEDULE



Interim Phase —————> |<————— Final Phase —————> |<

1978 1979

May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug



Center (MMC). Weekday interviews were done at all three locations and Saturday interviews were also conducted at QBM and CBD. Telephone numbers for follow-up were solicited from all respondents, who were selected at random within minimal constraints of a balance by age group and sex. Some 565 responses were obtained, with 291 respondents also volunteering telephone numbers. As with other surveys, evaluator duties included content and sample specification, assistance on form design, field monitoring and coding specification. The interview form is displayed in Appendix B.

#### Task 5: Telephone Follow-up Survey I

Telephone follow-up surveys were conducted within two weeks after the initial contract for a sample of 150 on-board survey respondents and 50 activity-center respondents. Both samples were drawn from the respondents who had supplied their phone numbers and names. The on-board sample was drawn at random within each route and was proportional to route ridership. The activity center sample was drawn at random for each location, proportional to the number of responses at each.

Content of the telephone follow-ups emphasized attitudinal information. The follow-up interview form is shown in Appendix D.

#### Task 6: Random Telephone Survey I

A random telephone survey was completed on November 18, in parallel with the on-board survey. The telephone survey's objectives were to gain attitudinal information from the general population and to complete the NBS 500-unit sample of persons who made an off-peak auto trip on the survey day. 603 calls were attempted, of which 253 were invalid (no answer after 4 calls, disconnected number, refused, or incomplete response). Of the 350 completed surveys, 209 respondents had trips which satisfied NBS criteria. The remaining 141 were complete but had no auto trips in the transit free-fare period for the survey day. Since 291 responses suitable for NBS purposes were obtained from the activity center surveys, the 500-unit sample was obtained. This survey was conducted only for trips made on a weekday. The telephone survey form is shown in Appendix C.

#### Task 7: Bus Boarding Timings I

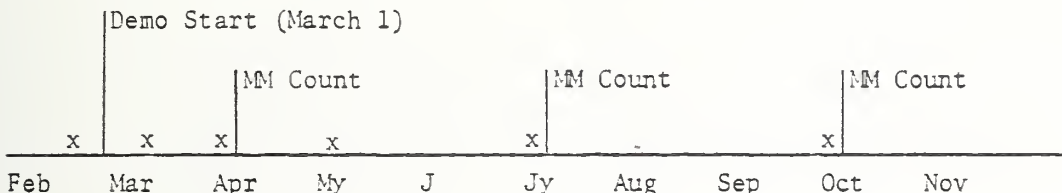
Concurrent with the on-board surveys, "open-door" times were clocked systemwide. Only a sample was required, since the intent was to compare typical boarding times under fare-payment conditions with times for boarding the same numbers of passengers after the fare elimination. However, since the data collection plan required a person on each bus not included in the on-board survey in order to obtain a 100% free-fare period boarding count, this person also routinely recorded all "open-door" times.

The number of persons alighting by the front door at each stop was also recorded to allow normalization of stop times by the total number of passengers passing through the front door in either direction, rather than only boarding. The data collection form is shown in Appendix E.

### 6.3 INTERIM PHASE TASKS

#### Task 8: Corner Counts II

The corner count procedure outlined in Task 1 is to be repeated six times during the interim period. Frequency of these counts will vary, in order to gain maximum information on the early-implementation period. The approximate intervals are to be as follows;



Precise dates are to be established as the program proceeds. Dates already set include the following:

- a. February 23-28, 1978
- b. March 5-9, 1978
- c. March 28 - April 2, 1978.

The initial interim-period counts will cover three days - a weekday, Saturday, and Sunday - as did the first count in November. Depending on the results of those counts, further counts may be eliminated for Saturdays or Sundays. The same three locations will be surveyed in all cases.

#### Task 9: Background Trend Analysis I

This task is to include the assembly of historical trend data on Mercer Metro ridership, similar data for other selected Northeastern cities, major weather shifts, overall travel volumes, employment, and other trends and factors which might affect transit ridership. These data are then to be reviewed to permit isolation of subsequent free-fare effects, as described in Chapter 5. In addition, the task includes the regression analysis of past Mercer Metro corner counts and farebox-based ridership estimates to develop an index of ridership change from later corner counts.

#### Task 10: Survey Data Setup and Review

This task involves the receipt of the machine-readable survey data from NJDOT, the preparation of SPSS titling and data files, tests of data quality, and initial familiarization runs. This activity is included as a separate task because of the number of data files and variables involved.



#### Task 11: Bus Boarding Times II

During Task 7, some doubts were raised concerning the validity of open-door time as an indicator of boarding time, since drivers sometimes left the door open substantially longer than actually needed for boarding. This task will therefore involve a sampling of approximately 50 boarding times both in the free-fare period and at other times. These will be normalized for number of boardings and alightings, and compared via a t-test to determine whether a significant time saving has occurred.

#### Task 12: Interim Ridership Assessment

This task is concerned with estimation of the changes in ridership attributable to free fares throughout the interim period. This effort will be based on the interim period's corner counts, which will be used as the basis for an interim indicator of systemwide ridership change per the relationship developed in Task 9. Adjustments to these ridership changes will be made to eliminate the effect of factors other than the free fares, again per results of Task 9.

#### Task 13: Ridership Modeling I

One portion of this task is the delivery of data to the National Bureau of Standards and the monitoring of their predictive mode-split model-testing efforts. The second portion consists of initial efforts to develop simple model structures for free-fare ridership impact prediction, including latent travel demand. These models are to be ready for calibration on the final phase survey data (see Section 5.2.3).

#### Task 14: Secondary Effects Analysis I

Secondary effects of free fares (Section 5.4) which can be studied during the interim study phase are largely limited to the retail trade issues. This task therefore involves the assembly of retail sales trend data as available from the Trenton Commons Commission and major shopping center operators, and the comparison of those trends with the early ridership impact estimates. However, the analysis cannot be completed until the final study phase (Task 26) since it is dependent on the more location-specific ridership estimates of the second wave of surveys. Consequently this task's major activity is coordination with public and private sources to attempt to obtain the required retail sales data, and the preparation of these data for later analysis.

#### Task 15: Supply/Cost Analysis I

Periodic interviews with Mercer Metro drivers and supervisors, field observation of on-board conditions, and review of transit cost and operations records are key elements of this task. Most transit supply and cost analyses (see Section 5.3) can be completed during this interim study period, based on such data collection efforts.



## Task 16: Implementation Process Evaluation 1

The evaluation of the implementation process actually continues throughout the study. During the interim period much of it will be completed, particularly the documentation and critique of the initial activities (see Sections 4.5 and 5.5 for more details on this analysis).

### 6.4 FINAL PHASE TASKS

## Task 17: Background Trend Analysis II

After the second wave of surveys, accurate systemwide free-fare ridership data will be available against which the earlier background trends and related ridership impact estimates can be checked. In addition, a full year of project involvement will have accumulated, with development of detailed data on the year's transit-relevant trends and events in addition to the free-fare transit service. This task therefore involves the refinement of earlier adjustments to transit ridership to isolate the effects of free fares (Section 5.2.2).

## Task 18: Boarding Counts II

In the Fall (late October - early November) of 1978, the free-fare period boarding counts of Task 2 will be repeated. It is hoped, however, to reduce the size of the counting effort. If analysis of the 1977 counts indicate no statistically significant difference between the 1977 boarding counts taken on the 50% of buses on which on-board surveys were done and the remaining buses, the 1978 boarding counts will be conducted only on 50% of all buses operating during the free-fare period. Otherwise procedures will be similar. Weekday, Saturday, and Sunday counts will be made.

## Task 19: On-Board Survey II

Concurrent with the 1978 boarding counts, a second on-board survey will be conducted during free-fare hours. Weekday, Saturday, and Sunday surveys will be included. The need for statistical significance in disaggregate analyses of the survey data will probably prevent any reduction of the scope of this program (50% of all buses surveyed), but such reductions will be made on a route-by-route basis if the 1977 data sets prove to be large enough. This task will include that determination. If the scope of the October survey can be reduced, the survey effort thus released will be put into a small on-board survey to be conducted in May. The purpose of this May survey will be to provide preliminary data for planning, analysis, and publicity needs.

Survey content will be similar to but not exactly the same as that of the 1977 survey. In particular, item wording will be adjusted as required to reflect the existence of the free-fare program. Questions will also be added to cover the issue of whether and how the respondent's trip would be made without free transit service. Telephone numbers for a telephone follow-up sample

will be requested directly on the form instead of relying on a verbal request as was done in the 1977 survey.

#### Task 20: Activity Center Survey II

A repeat of the Task 4 interview survey is tentatively planned for the fall of 1978. If, however, review of the Task 4 data indicates that statistically significant 1977-1978 changes in the proportion of bus users would have to be unrealistically large because of the sample characteristics, this task may be revised or eliminated. One possible revision is to eliminate one site (Mercer Medical Center) and any Sunday surveys, in order to concentrate the sample. Another is to simplify the survey procedure drastically in order to allow a much larger sample size, asking only about mode of travel to the activity center. These determinations will be part of this task.

#### Task 21: Telephone Follow-up Survey II

The telephone follow-up survey of Task 5 is to be repeated in fall 1978, immediately after the on-board and activity center surveys. A new independent sample is to be used. Pending review of the 1977 data, sample sizes are to be the same as those taken in 1977 (150 on-board and 50 activity center). It may be possible to eliminate the activity center follow-ups, depending on the 1977 data from the Task 6 random telephone survey.

Content of the telephone follow-ups is to be expanded beyond that of the 1977 surveys. Attitudes toward free-fare are to be probed more fully for reasons, as are reasons for not using the service (by activity center auto travelers).

#### Task 22: Random Telephone Survey III

This task is a repeat of the Task 6 survey in the pre-implementation phase, with an independent random sample. Sample size and design are unchanged. Content will vary similarly to that of the telephone follow-up surveys (Task 21).

#### Task 23: Post-Demo Ridership Evaluation

This task involves a continuation of the corner counts and Mercer Metro driver interviews beyond the end of the 12-month demonstration in order to ascertain the degree of ridership decline and related results (reduced crowding, etc.). Counts are to be conducted at four times after the second wave of surveys (Fall 1978), including the following:

- a. Early January 1979 (with Mercer Metro's quarterly count)
- b. Late February (Just prior to free-fare end)
- c. Early March (just after free-fare end)
- d. May (matching the May 1978 count).

Field procedures, count locations, and analysis are to be the same as those for earlier counts, continuing the practice of adjusting for the effects of

other trends and events. Informal interviews with bus drivers are to be used to verify these findings through actual observation. Results are to be reported in a separate memorandum in the event that the Final Report cannot be delayed for their inclusion.

#### Task 24: Travel Behavior Analysis

Completion of all elements of the travel behavior analysis (as outlined in Section 5.2) except ridership modeling is the subject of this task. This includes evaluation of total ridership impact, changes in traveler characteristics, and the characteristics of both new free-fare-induced bus trips and the trips which would have been made without free fares.

#### Task 25: Ridership Modeling II

This task includes the review and incorporation of the NBS mode-split model tests into the evaluation findings. Its primary effort, however, is in the application of the Fall 1978 survey and count results to the experimental ridership model structures developed earlier in Task 13. This work is described in Section 5.2.3.

#### Task 26: Secondary Effects Analysis II

Included here is the study's evaluation of public attitude changes and environmental impacts as well as completion of the retail sales analysis begun in Task 14. The approaches to these evaluations are described in Section 5.4.

#### Task 27: Supply/Cost Analysis II

Most of the evaluation of transportation supply and cost effects was to be completed during the interim study phase (Task 15). This task is the completion of that work through updating of the results and assisting Mercer Metro in development of a reliable free-fare patronage estimation technique.

#### Task 28: Implementation Process Evaluation II

This is the final phase continuation of Task 16. It consists of an update of the implementation's documentation and the derivation of conclusions on lessons in how to implement such programs for other transit operators. Of particular emphasis in this Task will be the addition of late information on any lasting changes in local transit service or policies as a result of the free-fare demonstration.

#### Task 29: Final Report

The Final Report will be organized based on SMD program guidelines and compatibility with other recent final evaluation reports from the program. An outline of the report will be submitted early in the final study phase. The draft version of the report will be submitted for review and revision made in accordance with the schedule shown in Section 6.1.3.



## REFERENCES

Abkowitz, Mark; Heaton, Carla; and Slavin, Howard, Evaluation of Service and Methods Demonstration Projects: Philosophy and Approach, UMTA-MA-06-0049-77-5, by the Transportation Systems Center for the Urban Mass Transportation Administration, May, 1977.

Abrams, Robert. "No More Tokenism -- the Case for Free Subways and Buses," New York, 4, No. 32, pp. 24-29, 1971.

Aleshire, Robert A. "Sure the Cost Would be High:But Offsetting Economic, Social, and Environmental Benefits Abound," Nation's Cities, 9, No. 12, pp. 25-28, 1971.

Aleshire, Robert A. "The Case for Free Transit," Current, 135, pp. 19-22, 1971.

Amalgamated Transit Union. "Position Paper on Fare-Free Transit," unpublished mimeograph, Washington, D.C.: Amalgamated Transit Union, 1975.

Amalgamated Transit Union. "A Solution: No-Fare Transit," In Transit, 83, No. 10 (special section).

Batty, M.; P.G. Hall and D.N.M. Starkie. "The Impact of Fares-Free Public Transport Upon Urban Residential Location," Proceedings of the Transportation Research Forum, Oxford, Indiana: Richard B. Cross Company, 15, pp. 347-353, 1974.

Baum, Herbert J. "Free Public Transport," Journal of Transport Economics and Policy, 7, pp. 3-19, 1973.

Brosch, David Charles, "The Rationale for and the Establishment of a No-Fare Mass Transit System in the Washington Metropolitan Area," unpublished student paper, Washington, D.C.: Howard University, 1975.

Caruolo, John B. and Robert P. Roess, "The Effect of Fare Reductions on Public Transit Ridership," New York, New York: Polytechnic Institute of New York, 1974.

Charles River Associates, Inc., "An Evaluation of Free Transit Service," Report 125-1, Cambridge, Massachusetts: Charles River Associates, Inc., 1968.

Daly, A.J., K.G. Rogers and A.W. Whitbread, "Estimating the Use of Free Bus Passes in Reading," Report C174, Reading, UK: Local Government Operational Research Unit, 1973.



Dillon, Robert W. and John A. Bailey, "Legal and Political Aspects of Free Transit in Major Metropolitan Areas," Evanston, Illinois: Northwestern University Transportation Center, 1970.

Domencich, Thomas A. and Gerald Kraft, Free Transit, Lexington, Massachusetts: D.C. Heath and Company, 1970.

Donnelly, E.P., "Preference Elasticities for Transit Fare Increases and Decreases by Demographic Groups," in Transportation Research Record 589, 1976.

Elliott, John M., "No-Fare: Key to the Transit Jam," American Federationist, 79, No. 8, pp. 9-15, 1972.

Goodman, Keith M. and Green, Melinda A., Low Fare and Fare-Free Transit: Some Recent Applications by U.S. Transit Systems. UMTA-DC-52-0002-77-1, by the Urban Institute for the Urban Mass Transportation Administration, February, 1977.

Goodwin, P.B., "Some Data on the Effects of Free Public Transport," Transportation Planning and Technology, 1, pp. 159-174, 1973.

Greenspan, H.P., "The Case for Prepaid Transit," Transit Journal, 1, No. 1, pp. 57-63, 1975.

Holland, D.K., A Review of Reports Relating to the Effect of Fare and Service Changes in Metropolitan Public Transportation Systems, Washington, D.C.: U.S. Department of Transportation, June, 1974.

Kemp, Michael A., "Reduced Fare and Fare-Free Urban Transit Services -- Some Case Studies," in UK Transport and Road Research Laboratory, pp. 37-54, 1974.

Kemp, Michael A., "The Consequences of Short Range Transit Improvements: An Overview of a Research Program," Working Paper No. 5050-5-1, Washington, D.C.: The Urban Institute, November, 1976.

Kemp, Michael A. and Cheslow, Melvyn D., "Transportation" in Gorham, William and Glazer, Nathan, editors, The Urban Predicament, pp. 281-356, Washington (D.C.), The Urban Institute, 1976.

Kraft, Gerald, "Free Transit Revisited," Public Policy, 21, pp. 79-105, 1975.

Kraft, Gerald and Domencich, Thomas, "Free Transit," in Edel, Matthew and Rothenberg, Jerome, Readings in Urban Economics, New York: The Macmillan Company, 1972.



Lovelock, Christopher and John Twichell, "No Fare and Low-Fare Transit: An Evaluation of Their Feasibility and Potential Impact in the San Francisco Bay Area," Berkeley, California: Metropolitan Transportation Commission, 1973.

Mercer County Improvement Authority, Annual Report to the Department of Public Utilities for the Year 1976, March 28, 1977.

Netzger, Dick, "The Case Against Low Subway Fares," New York Affairs 1, No. 3, pp. 14-25, 1974.

New Jersey Department of Transportation, "Application for Federal Assistance for the Mercer County Free Fare Demonstration," April, 1976.

Reish, Robert and Vasant H. Surti, "A Feasibility Study of Free Bus Service for a Street Corridor of Denver," Denver, Colorado: University of Colorado Center for Urban Transportation Studies, 1972.

Rhode Island Statewide Planning Program, "Evaluation of a 'No-Fare' System of Public Transit," Technical Paper 37, Providence, Rhode Island: Rhode Island Statewide Planning Program, 1973.

Rossetti, G. and C. Trani, "Rome Rapid Transport System Master Plan: Coordinated Public Transport," in Proceedings of a Symposium on Transportation and Environment, Southampton, UK: University of Southampton Department of Civil Engineering, 1973.

Scheiner, James I., "The Patronage Effects of Free Fare Transit," Traffic Quarterly, 29, pp. 19-27, 1975.

Scheiner, James I., "Exploding the Myths of Prepaid Transit," Transit Journal, 2, No. 1, pp. 57-64, 1976.

Scheiner, James I. and Grover Starling, "The Political Economy of Free-Fare Transit," Urban Affairs Quarterly, 10, pp. 170-184, 1974.

Schneider, Lewis M., "The Problem of Free Mass Transportation," Proceedings of the Transportation Research Forum, 9, (supplemental papers), Oxford, Indiana: Richard B. Cross Company, pp. 23-30, 1968.

Schneider, Lewis M., "The Fallacy of Free Transportation," Harvard Business Review, 47, pp. 83-87, 1969.

Spielberg, Frank, "Plan for a Demonstration of Off-Peak Fare-Free Bus Service in Mercer County, N.J.," Working Paper 5066-8-1, Washington, D.C.: The Urban Institute, February, 1977.

U.S. Department of Transportation, Report to Congress Concerning the Demonstration of Fare-Free Mass Transportation, Washington (D.C.): U.S. Department of Transportation Urban Mass Transportation Administration, 1975.

Wachs, Martin, "The Feasibility of Fare-Free Transit for Los Angeles," Los Angeles, California: University of California at Los Angeles, School of Architecture and Urban Planning, 1973.

Wall Street Journal, "A Free Ride for Transit," editorial, February 13, 1978, p. 7.

Waters, L. Leslie, "Free Transit - A Way Out of Traffic Jams," Business Horizons 2, 1959.

# APPENDICES

- A: On-Board Survey Questionnaire, Round 1 ("Before Demonstration") \*
- B: Activity Center Survey Form, Round 1
- C: Household Telephone Survey Form, Round 1
- D: Telephone Follow-up Survey Form, Round 1
- E: Field Data Forms
  - (1) Corner Counts
  - (2) On-Board Interview Control Count
  - (3) On-Board Timing Count
- F: Application of the Fully Competitive Mode Choice Model to the Off-Peak Fare Elimination Demonstration Project in Trenton, New Jersey (by National Bureau of Standards)
- G: Evaluation Management
- H: Report of Inventions

---

\* Note: All survey forms were developed by Garmen Associates, Inc., following content specifications by De Leuw, Cather.

APPENDIX A

**MERCER METRO BUS SURVEY**

sponsored by  
**New Jersey Department of Transportation**  
 in cooperation with  
**Urban Mass Transportation Administration**  
**Mercer County Improvement Authority**

OFFICE USE ONLY

GRP   
 AGE  C  E  O

Dear Rider:

Your answers to these few questions will help us plan for a future bus service in Mercer County. Please return this form with your answers before you get off.

1. I AM COMING FROM (CHECK ONE):  
 Home.....  Work.....  School.....  Shopping.....   
 Medical..  Recreational..  Social/Visiting..  Other(what?)..

2. THAT PLACE WAS AT \_\_\_\_\_ IN \_\_\_\_\_  
 (address or nearest corner) (city)

3. I GOT TO THIS BUS BY (CHECK ONE):  
 Walking.....  Driving a car..  Riding in a car..  Taxi..   
 Another Bus..  (What Route? \_\_\_\_\_) Other (What?) \_\_\_\_\_

4. I GOT ON THIS BUS AT \_\_\_\_\_ IN \_\_\_\_\_  
 (address or nearest corner) (city)

5. I WILL GET OFF THIS BUS AT \_\_\_\_\_ IN \_\_\_\_\_  
 (address or nearest corner) (city)

6. I AM NOW GOING TO (CHECK ONE):  
 Home.....  Work.....  School.....  Shopping.....   
 Medical..  Recreational..  Social/Visiting..  Other(What?)..

7. THIS WILL BE AT \_\_\_\_\_ IN \_\_\_\_\_  
 (address or nearest corner) (city)

8. I WILL GET THERE FROM THIS BUS BY (CHECK ONE):  
 Walking.....  Driving a car..  Riding in a car..  Taxi..   
 Another Bus..  (What Route? \_\_\_\_\_) Other (What?) \_\_\_\_\_

9. I WOULD HAVE MADE THIS TRIP EVEN IF THE BUS HAD NOT BEEN RUNNING: True..   
 False..

10. THE NUMBER OF CARS OWNED OR OPERATED BY MEMBERS OF MY HOUSEHOLD IS:  
 None..  1..  2..  3 Or More..

11. THE NUMBER OF PEOPLE IN MY HOUSEHOLD IS:  
 1..  2..  3..  4..  5..  6 Or More..

12. I AM (CHECK ONE): Male..  Female..

13. MY AGE IS (CHECK ONE):  
 16 Or Under..  17-24..  25-44..  45-64..  65 & Over..

14. THE NUMBER OF BUS TRIPS (ONE-WAY) I MAKE WHICH START BETWEEN 10:00 AM AND 2:00 PM OR AFTER 5:00 PM IS (CHECK ONE):  
 Less Than 2 Per Week..  2-5 Per Week.....   
 6-9 Per Week.....  10 Or More Per Week..

15. THE TOTAL ANNUAL INCOME OF ALL MEMBERS OF MY HOUSEHOLD IS (CHECK ONE):  
 \$ 0-\$5,000.....  \$5,001-\$10,000..  \$10,001-\$15,000..   
 \$15,001-\$25,000..  Over \$25,001....

THANK YOU FOR YOUR COOPERATION!

D/E  
 N

APPENDIX B

ACTIVITY CENTER INTERVIEW

OFFICE USE ONLY

Date \_\_\_\_\_  
Time of Interview \_\_\_\_\_

(Introduction: To be read by the interviewer)

WE ARE DOING A TRAVEL SURVEY FOR THE NEW JERSEY DEPARTMENT OF TRANSPORTATION. I WOULD LIKE TO TAKE A COUPLE OF MINUTES TO ASK YOU A FEW QUESTIONS ABOUT THE TRIP YOU JUST MADE.

1. HOW OFTEN DO YOU COME TO QBM / COM / HOSP (CHECK ONE):  
(circle one)

MORE THAN ONCE A WEEK.  ONCE EVERY 1-2 WEEKS...   
ONCE EVERY 3-4 WEEKS..  LESS THAN ONCE A MONTH..

2. HOW DID YOU GET HERE? (CHECK ONE):  
WALKED..  DROVE A CAR..  PASSENGER IN A CAR..   
BUS....  TAXI.....  OTHER(WHAT?)..... \_\_\_\_\_  
(If the answer is "BUS", Thank the respondent and end the interview.)

3. WHERE DID YOU COME FROM? (CHECK ONE):  
HOME.....  WORK.....  SCHOOL.....  SHOPPING.....   
MEDICAL..  RECREATIONAL..  SOCIAL/VISITING..  OTHER(WHAT?) \_\_\_\_\_

4. WHAT IS THE ADDRESS OR NEAREST STREET CORNER OF THAT PLACE?  
\_\_\_\_\_ IN \_\_\_\_\_  
(address or nearest corner) (city)

5. WHAT TIME DID YOU LEAVE THAT PLACE TO COME HERE? \_\_\_\_\_ AM/PM  
(CIRCLE ONE)

6. WHAT IS THE MAIN PURPOSE OF YOUR TRIP HERE? (CHECK ONE):  
WORK.....  SHOPPING.....  MEDICAL....   
RECREATIONAL..  SOCIAL/VISITING..  OTHER(WHAT?) \_\_\_\_\_

7. IF BUS SERVICE WERE FREE BETWEEN 10:00 AM AND 2:00 PM AND AFTER 6:00 PM ON WEEKDAYS AND SATURDAYS AND ALL DAY SUNDAY, DO YOU THINK YOU WOULD USE IT? (CHECK ONE):  
YES..  NO..  NOT SURE..   
(If the answer is "NO", skip to question #9.)

3. (If the answer to question #7 is "YES", ask the following):  
WOULD YOU USE THE BUS FOR: (CHECK ONE)

	YES	NO	UNSURE	HOW OFTEN PER WEEK?
TRIPS TO WORK OR SCHOOL	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
SHOPPING TRIPS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
OTHER TRIPS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____

9. HOW MANY PEOPLE, INCLUDING YOURSELF, ARE IN YOUR HOUSEHOLD? (CHECK ONE):  
1..  2..  3..  4..  5..  6 OR MORE..

10. HOW MANY CARS ARE OWNED OR OPERATED BY MEMBERS IN YOUR HOUSEHOLD? (CHECK ONE):  
NONE..  1..  2..  3 OR MORE..

11. (Show the respondent the card which has age categories on it.) WHICH OF THESE GROUPS INCLUDES YOUR AGE? (CHECK ONE):  
(a) 16 OR UNDER..  (b) 17-24..  (c) 25-44..  (d) 45-64..  (e) 65 AND OVER..

12. (Show the respondent the card which has income categories on it.) WHICH OF THESE GROUPS INCLUDES THE COMBINED ANNUAL INCOME OF ALL MEMBERS OF YOUR HOUSEHOLD? (CHECK ONE)  
(a) \$ 0-\$5,000.....  (b) \$5,001-\$10,000..  (c) \$10,001-\$15,000..   
(d) \$15,001-\$25,000..  (e) OVER \$25,001....

13. (Record whether the respondent is male or female.) MALE..  FEMALE..

14. WE MAY NEED ADDITIONAL INFORMATION ABOUT YOUR TRAVEL. MAY WE CONTACT YOU BY PHONE TO ASK ADDITIONAL QUESTIONS?  
WHAT IS YOUR TELEPHONE NUMBER.. \_\_\_\_\_ DAY..  EVENING..   
(area code)  
WHOM SHOULD WE ASK FOR (FIRST NAME): \_\_\_\_\_



# APPENDIX C

MERCER METRO FARE DEMONSTRATION  
TELEPHONE SURVEY

ADDRESS \_\_\_\_\_ Street \_\_\_\_\_ City \_\_\_\_\_

IS THIS \_\_\_\_\_ (telephone no.) \_\_\_\_\_

HELLO MR/MRS \_\_\_\_\_ MY NAME IS \_\_\_\_\_ (use full name)

I AM DOING A SURVEY FOR THE DEPARTMENT OF TRANSPORTATION. WE WOULD APPRECIATE YOUR HELP IN ANSWERING A FEW QUESTIONS ABOUT YOUR FAMILY'S TRAVEL.

FIRST, DO YOU LIVE IN MERCER COUNTY?  YES  NO  
 (If the answer is no, thank the person and end the interview)

1) WE ARE INTERESTED IN ONE-WAY TRIPS MADE YESTERDAY BETWEEN THE HOURS OF 10 AM AND 2 PM AND AFTER 5 PM. WE WOULD LIKE TO GET A LIST OF ALL TRIPS MADE BY ALL MEMBERS OF YOUR HOUSEHOLD DURING THOSE TIMES.  
 FIRST, YOURSELF, PLEASE TELL ME THE PURPOSE OF EACH TRIP AND HOW IT WAS MADE. (OTHER MEMBERS OF YOUR HOUSEHOLD?)  
 (If no trips were made by any members of the household, check the box and go to question #5)  None

PERSON	PLACE	PURPOSE AT DESTINATION					MEANS OF TRAVEL				
		WALK	WHEELCHAIR	WALKING	RECREATION	SCHOOL/WORK	WALK	AUTO-DRIVE	AUTO-DRIVE	BUS	OTHER
1											
2											
3											
4											
5											
6											
7											
8											
9											

(If more than nine trips are recorded use a supplemental sheet and check this box )  
 (select the proper trip and record the number. )

NOW WE NEED SOME DETAILED INFORMATION ABOUT ONE OF THE TRIPS YOU HAVE DESCRIBED. PLEASE ANSWER THE FOLLOWING QUESTIONS ABOUT THE TRIP WHICH WAS MADE:  
 BY \_\_\_\_\_ TO \_\_\_\_\_ BY \_\_\_\_\_  
 (person) (purpose) (means of travel)

2) ABOUT WHAT TIME DID THE TRIP BEGIN? \_\_\_\_\_ AM  PM

3) WHERE DID THE TRIP BEGIN?  
 \_\_\_\_\_ (address or street corner) IN \_\_\_\_\_ (city)

4) WHAT PLACE WAS THAT? WAS IT:  
 HOME  WORK  SCHOOL  SHOPPING  MEDICAL  
 RECREATION  SOCIAL  CHAUFFEURING  OTHER \_\_\_\_\_ (explain)

5) WHERE DID THE TRIP END?  
 \_\_\_\_\_ (address or street corner) IN \_\_\_\_\_ (city)

6) HOW MUCH DID YOU PAY FOR PARKING?  NOTHING  CENTS \_\_\_\_\_  
 OTHER \_\_\_\_\_ (explain)

AUTO (If "none", skip to question #9)

7) WOULD YOU HAVE MADE THIS TRIP IF THE BUS HAD NOT BEEN RUNNING?  YES  NO

8) WAS AN AUTO AVAILABLE TO YOU FOR THIS TRIP?  YES  NO

9) HOW FAR FROM YOUR HOME IS THE NEAREST MERCER METRO BUS STOP?  
 BLOCKS or  MILES (or fraction)  DON'T KNOW

10) HOW MUCH IS THE BASIC BUS FARE:  
 FOR COMMUTER HOURS \_\_\_\_\_  DON'T KNOW  
 FOR MIDDAY AND NIGHTTIME \_\_\_\_\_  DON'T KNOW

11) HOW MANY ONE-WAY BUS TRIPS ARE MADE BY MEMBERS OF YOUR HOUSEHOLD IN A TYPICAL WEEK?  
 NONE  PER WEEK  PER DAY

(If "none", skip to question #14)

1  
2-5  
6-35  
36-40  
41-47  
48-79  
80

7 1  
2-9  
10-11  
12-13  
14-15  
16-17  
18-19  
20-21  
22-23  
24-25  
26-27  
28  
29

31-34  
36-39  
41  
43-45  
48-50

52  
53  
55-58  
59-61  
62-63  
65-67

# APPENDIX C

MERCER METRO FREE FARE DEMONSTRATION  
TELEPHONE SURVEY (PAGE 2)

12) HOW MANY OF THESE ONE-WAY TRIPS DO YOU MAKE?  
 NONE     PER WEEK     PER DAY

13) HOW MANY OF THE ONE-WAY BUS TRIPS THAT YOU MAKE BEGIN:  
 BETWEEN 10 AM AND 2 PM ON WEEKDAYS & SATURDAYS?  
 AFTER 6 PM ON WEEKDAYS & SATURDAYS?  
 ANYTIME ON SUNDAYS?

# OF ONE-WAY BUS TRIPS		
NONE	PER WEEK	PER DAY

14) EVEN IF YOU DON'T USE THE BUS SYSTEM, WE WOULD LIKE TO KNOW HOW YOU FEEL ABOUT VARIOUS QUALITIES OF THE MERCER METRO BUS SERVICE.  
 ARE YOU SATISFIED OR DISSATISFIED WITH: (VERY OR SOMEWHAT?)

QUALITIES	VERY SATIS-FACTORY	SOME-WHAT SATIS-FACTORY	HALF AND HALF	WHAT AND UNSATIS-FACTORY	VERY UNSATIS-FACTORY	DON'T KNOW
COST OF BUS SERVICE						
BUS TRAVEL TIME						
COMFORT						
CONVENIENCE						
SAFETY FROM CRIME & ACCIDENT						

15) HOW SATISFIED ARE YOU THAT THE BUS SYSTEM IS MEETING THE PUBLIC TRANSPORTATION NEEDS OF MERCER COUNTY?  
 VERY SATISFIED     SOMEWHAT DISSATISFIED     DON'T KNOW  
 SOMEWHAT SATISFIED     VERY DISSATISFIED

16) SHOULD MORE, LESS OR THE SAME AMOUNT OF TAX MONEY BE USED TO SUPPORT THE MERCER METRO BUS SYSTEM?  
 MORE     LESS     THE SAME     DON'T KNOW

17) IF MERCER METRO BUS SERVICE WERE FREE BETWEEN 10 AM AND 2 PM AND AFTER 6 PM ON WEEKDAYS AND SATURDAYS, AND ALL DAY ON SUNDAY, DO YOU THINK YOU WOULD USE IT?  
 YES     NO     NOT SURE  
 (If no, skip to question #19)

18) WOULD YOU USE IT FOR:

	NO	NOT SURE	YES	# OF ONE-WAY TRIPS PER WEEK
TRIPS TO WORK OR SCHOOL				
SHOPPING TRIPS				
OTHER TRIPS				

19) WEDDAY AND EVENING FREE BUS SERVICE WOULD HAVE TO BE PAID FOR SOMEHOW. SUPPOSE THE ADDITIONAL TAX COST PER HOUSEHOLD WERE BETWEEN \$10 AND \$20 PER YEAR. DO YOU FAVOR OR OPPOSE PAYING THIS AMOUNT? (STRONGLY OR SOMEWHAT?)  
 STRONGLY FAVOR     SOMEWHAT FAVOR     NEITHER  
 STRONGLY OPPOSE     SOMEWHAT OPPOSE     DON'T KNOW

20) APART FROM THE QUESTION OF HOW TO FINANCE IT, HOW DO YOU FEEL ABOUT FREE BUS SERVICE DURING WEDDAY AND NIGHTTIME HOURS AND ALL DAY ON SUNDAY? DO YOU FAVOR OR OPPOSE IT? (STRONGLY OR SOMEWHAT?)  
 STRONGLY FAVOR     SOMEWHAT FAVOR     NEITHER  
 STRONGLY OPPOSE     SOMEWHAT OPPOSE     DON'T KNOW

21) FINALLY, IN ORDER TO COMPARE YOUR ANSWERS WITH THOSE OF OTHER PEOPLE BEING SURVEYED, WE NEED TO KNOW A FEW THINGS ABOUT YOUR HOUSEHOLD.

21) HOW MANY CARS ARE OWNED OR OPERATED BY MEMBERS OF YOUR HOUSEHOLD?   

22) WHAT IS THE TOTAL NUMBER OF PEOPLE INCLUDING YOURSELF IN YOUR HOUSEHOLD?   

23) PLEASE STOP ME WHEN I READ THE RANGE THAT INCLUDES YOUR AGE:  
 16 OR UNDER     17-24     25-44     45-64     65 OR OLDER

24) PLEASE STOP ME WHEN I READ THE RANGE THAT INCLUDES THE TOTAL ANNUAL INCOME OF ALL MEMBERS OF YOUR HOUSEHOLD.  
 UNDER \$5,000     \$5,001 - \$10,000     \$10,001 - \$15,000     \$15,001 - \$25,000     OVER \$25,000

AFTER WE LOOK AT THE SURVEY RESULTS, WE MAY NEED TO ASK SOME PEOPLE A FEW MORE QUESTIONS, SO THAT WE CAN TALK TO THE SAME PERSON AGAIN. WOULD YOU GIVE ME YOUR FIRST NAME PLEASE?  
 \_\_\_\_\_

THANK YOU.

25) DO NOT SEE, RECORD BY OBSERVATION:     Male     Female

26) DO NOT SEE, RECORD BY OBSERVATION:     Recontact Possible     No Recontact

# APPENDIX D

MERCER METRO FREE FARE DEMONSTRATION  
ACTIVITY CENTER/BUS FOLLOW-UP TELEPHONE SURVEY

IS THIS \_\_\_\_\_ ?  
(telephone no.)

MAY I SPEAK WITH \_\_\_\_\_ ?  
(contact name)      CB / day / time

MY NAME IS \_\_\_\_\_ WHEN WE RECENTLY INTERVIEWED YOU  
(use full name)

AT DBM/TC/MMC, ON THE BUS, YOU WERE KIND ENOUGH TO GIVE US YOUR NAME AND PHONE NUMBER. TO HELP COMPLETE OUR SURVEY FOR THE DEPARTMENT OF TRANSPORTATION, WE WOULD APPRECIATE YOUR HELP IN ANSWERING A FEW QUESTIONS ABOUT YOUR FAMILY'S TRAVEL.

FIRST, DO YOU LIVE IN MERCER COUNTY?     YES     NO

→ (if the answer is no, thank the person and end the interview)

1) WE ARE INTERESTED IN ONE-WAY TRIPS MADE YESTERDAY BETWEEN THE HOURS OF 10 AM AND 2 PM AND AFTER 6 PM. WE WOULD LIKE TO GET A LIST OF ALL TRIPS MADE BY ALL MEMBERS OF YOUR HOUSEHOLD DURING THOSE TIMES.

FIRST, YOURSELF. PLEASE TELL ME THE PURPOSE OF EACH TRIP AND HOW IT WAS MADE. (OTHER MEMBERS OF YOUR HOUSEHOLD?)

→ (if no trips were made by any members of the household, check the box and go to question #2)     None

PERSON	PLACE	PURPOSE OF DESTINATION						MEANS OF TRAVEL						
		NONE	WORK	SCHOOL	SHOPPING	RELIGION	ENTERTAINMENT	UNEMPLOYMENT	OTHER	WALK	BIKE	MOTORCYCLE	BUS	OTHER

→ (if more than nine trips are reported use a supplemental sheet and check this box)   

2) HOW FAR FROM YOUR HOME IS THE NEAREST MERCER METRO BUS STOP?  
 BLOCKS or  MILES (or fraction)     DON'T KNOW

3) HOW MUCH IS THE BASIC BUS FARE:  
FOR COMMUTER HOURS . . . . . ?     DON'T KNOW  
FOR MIDDAY AND NIGHTTIME . . . . . ?     DON'T KNOW

4) HOW MANY ONE-WAY BUS TRIPS ARE MADE BY MEMBERS OF YOUR HOUSEHOLD IN A TYPICAL WEEK?  
 NONE     PER WEEK     PER DAY  
→ (if "none", skip to question #7)

5) HOW MANY OF THESE ONE-WAY TRIPS DO YOU MAKE?  
 NONE     PER WEEK     PER DAY

6) HOW MANY OF THE ONE-WAY BUS TRIPS THAT YOU MAKE BEGIN:  
BETWEEN 10 AM AND 2 PM ON WEEKDAYS & SATURDAYS?  
AFTER 6 PM ON WEEKDAYS & SATURDAYS?  
ANYTIME ON SUNDAYS?

	# OF ONE-WAY BUS TRIPS		
	NONE	PER WEEK	PER DAY

INT.	DATE	TIME	RESULTS
1			
2			
3			
4			

<input type="checkbox"/> 1
<input type="checkbox"/> 2-9
<input type="checkbox"/> 10-13
<input type="checkbox"/> 14-18
<input type="checkbox"/> 19-25
<input type="checkbox"/> 26-37
<input type="checkbox"/> 38

<input type="checkbox"/> 39
<input type="checkbox"/> 40-41
<input type="checkbox"/> 42-43
<input type="checkbox"/> 44-45
<input type="checkbox"/> 46-47
<input type="checkbox"/> 48-49
<input type="checkbox"/> 50-51
<input type="checkbox"/> 52-53
<input type="checkbox"/> 54-55
<input type="checkbox"/> 56-57
<input type="checkbox"/> 58

<input type="checkbox"/> 59-61
<input type="checkbox"/> 62-63
<input type="checkbox"/> 64-65
<input type="checkbox"/> 66-68
<input type="checkbox"/> 69-71
<input type="checkbox"/> 72-74
<input type="checkbox"/> 75-77
<input type="checkbox"/> 78-80

APPENDIX D

MERCER METRO FREE FARE DEMONSTRATION

TELEPHONE SURVEY (PAGE 2)

7) EVEN IF YOU DON'T USE THE BUS SYSTEM, WE WOULD LIKE TO KNOW HOW YOU FEEL ABOUT VARIOUS QUALITIES OF THE MERCER METRO BUS SERVICE.

ARE YOU SATISFIED OR DISSATISFIED WITH: (VERY OR SOMEWHAT?)

QUALITIES	VERY SATISFACTORY	SOMEWHAT SATISFACTORY	HALF AND HALF	SOMEWHAT UNSATISFACTORY	VERY UNSATISFACTORY	DON'T KNOW
COST OF BUS SERVICE	_____	_____	_____	_____	_____	_____
BUS TRAVEL TIME	_____	_____	_____	_____	_____	_____
COMFORT	_____	_____	_____	_____	_____	_____
CONVENIENCE	_____	_____	_____	_____	_____	_____
SAFETY FROM CRIME & ACCIDENT	_____	_____	_____	_____	_____	_____

8) HOW SATISFIED ARE YOU THAT THE BUS SYSTEM IS MEETING THE PUBLIC TRANSPORTATION NEEDS OF MERCER COUNTY?

VERY SATISFIED       SOMEWHAT DISSATISFIED       DON'T KNOW  
 SOMEWHAT SATISFIED       VERY DISSATISFIED

9) SHOULD MORE, LESS OR THE SAME AMOUNT OF TAX MONEY BE USED TO SUPPORT THE MERCER METRO BUS SYSTEM?

MORE       LESS       THE SAME       DON'T KNOW

10) IF MERCER METRO BUS SERVICE WERE FREE BETWEEN 10 AM AND 2 PM AND AFTER 6 PM ON WEEKOAYS AND SATUROAYS, AND ALL DAY ON SUNDAY, DO YOU THINK YOU WOULD USE IT?

YES       NO       NOT SURE

→ (if no, skip to question #12)

11) WOULD YOU USE IT FOR:

	NO	NOT SURE	YES	# OF ONE-WAY TRIPS PER WEEK
TRIPS TO WORK OR SCHOOL	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
SHOPPING TRIPS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____
OTHER TRIPS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____

12) MIDDAY AND EVENING FREE BUS SERVICE WOULD HAVE TO BE PAID FOR SOMEHOW. SUPPOSE THE ADDITIONAL TAX COST PER HOUSEHOLD WERE BETWEEN \$10 AND \$20 PER YEAR. DO YOU FAVOR OR OPPOSE PAYING THIS AMOUNT? (STRONGLY OR SOMEWHAT?)

STRONGLY FAVOR       SOMEWHAT OPPOSE       NEITHER  
 SOMEWHAT FAVOR       STRONGLY OPPOSE       DON'T KNOW

13) APART FROM THE QUESTION OF HOW TO FINANCE IT, HOW DO YOU FEEL ABOUT FREE BUS SERVICE DURING MIDDAY AND NIGHTTIME HOURS AND ALL DAY ON SUNDAY?

DO YOU FAVOR OR OPPOSE IT? (STRONGLY OR SOMEWHAT?)

STRONGLY FAVOR       SOMEWHAT OPPOSE       NEITHER  
 SOMEWHAT FAVOR       STRONGLY OPPOSE       DON'T KNOW

FINALLY, IN ORDER TO COMPARE YOUR ANSWERS WITH THOSE OF OTHER PEOPLE BEING SURVEYED, WE NEED TO KNOW A FEW THINGS ABOUT YOUR HOUSEHOLD.

14) HOW MANY CARS ARE OWNED OR OPERATED BY MEMBERS OF YOUR HOUSEHOLD? . . . . .

15) WHAT IS THE TOTAL NUMBER OF PEOPLE INCLUDING YOURSELF IN YOUR HOUSEHOLD? . . . . .

16) PLEASE STOP ME WHEN I READ THE RANGE THAT INCLUDES YOUR AGE:

16 OR UNDER       17-24       25-44       45-64       65 OR OLDER

17) PLEASE STOP ME WHEN I READ THE RANGE THAT INCLUDES THE TOTAL ANNUAL INCOME OF ALL MEMBERS OF YOUR HOUSEHOLD.

UNDER \$5,000       \$10,001 - \$15,000  
 \$5,001 - \$10,000       \$15,001 - \$25,000       OVER \$25,001

THANK YOU.

18) (do not ask, record by observation)       Male       Female

19) (do not ask, record by observation)       Recontact Possible       No Recontact









APPLICATION OF THE FULLY COMPETITIVE MODE CHOICE MODEL TO THE OFF-PEAK  
FARE ELIMINATION DEMONSTRATION PROJECT IN TRENTON, NEW JERSEY\*

J.M. McLynn, DTM, Inc.  
and

R.E. Schofer, National Bureau of Standards

The Trenton, NJ, Off-peak Fare Elimination Demonstration Project is one part of that UMTA research and development program which is focused upon methodologies for determining fare policy. This particular project addresses the impacts of transit-fare elimination during off-peak travel period. It is likely to have significant impacts on the young, the old, and the disadvantaged.

The purpose of the work program presented herein is to demonstrate and evaluate the effectiveness of the Fully Competitive Mode Choice Model in forecasting the impacts of this type of off-peak fare change upon the existing set of urban trip makers. If the Fully Competitive Model is found to be effective in forecasting impacts of these types of transit system changes upon current tripmakers, then a tool is available for testing and fine-tuning system alternatives without the need for costly and time-consuming field trials. If existing tripmakers' reactions can be predicted by use of this model, and other econometric techniques can be assimilated to account for shifts in origin-destination patterns for induced travel, and to give some indication of regional impacts, then a significant advance will have been achieved towards the UMTA goal of developing a methodology for determining fare policy.

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

The National Bureau of Standards (NBS) suggests the following work plan for applying the Fully Competitive Mode Choice Model to the Off-Peak Fare Elimination Demonstration Project in Trenton, NJ. This plan will interact with all aspects of the demonstration project and its evaluation in a manner which avoids duplication of data collection and analysis efforts.

---

\* Reproduced from original manuscript supplied by the National Bureau of Standards

1. Obtain Data

The feasibility of applying existing modal choice models (calibrated elsewhere) to predict the results of the Mercer County demonstration project depends upon the availability and quality of data describing existing travel patterns. Thus, the initial step is that of obtaining and reviewing the data available through extant sources. Three possible data sources have been identified. These are:

1. Origin-destination (O-D) surveys and related data from the Delaware Valley Regional Planning Commission (DVRPC). Mercer County is included within the DVRPC jurisdiction for planning purposes. In the 1960's, DVRPC's predecessor agency conducted a typical O-D survey as part of its planning program. Contact will be made with DVRPC to determine if it is possible to extract, from the regional data base, travel impedance and socioeconomic data for Mercer County. If possible, a sample set of original trip records will also be obtained.

These data will be considered for use in establishing base rates of trip frequency and mode usage for areas having various socio-economic characteristics. A prime consideration in determining whether to use these data will be obsolescence.

2. Princeton University conducted surveys of Trenton/Mercer County transit riders as part of a 1973 effort related to the transit development program. These data will be reviewed and analyzed to determine transit trip rates for various areas such that DVRPC transit trip data base may be upgraded to reflect more recent conditions.
3. Simpson and Curtin (S&C) used both newly gathered and existing data to develop a binary choice logit model for projecting transit use. They produced an 8x8 trip table for the Trenton area.

The specific types of data being sought from these sources are those describing non-work trip rates, destination dispersion, travel times and travel costs. It is unclear at this time in what form the data will be obtained. It is expected that trip data will be on magnetic tape, although hard copy would also be useful. Similarly, although impedance data in the form of trip cost and time matrices would be usable, it will be desirable also to obtain the networks or other sources used in developing impedance estimates (i.e., maps and either link cards or networks on tape). These data are required to estimate the travel impedance of the "mode not used."

2. Comparison of Candidate Models

This task will consist of a review and comparison of the various (on-the shelf) mode choice models available that might be used to forecast the impact of the free-fare demonstration program in Mercer County N.J. Since a major model calibration may not be done as part of this study, it will be necessary either to use a choice model that has already been calibrated using Mercer County data or to "transfer" a calibrated model from another area. As far as is presently known, the only extant calibrated choice model for Mercer County is the two-dimensional logit modal choice model developed by Simpson and Curtin in 1975 (published in Transportation Engineering Journal, August 1976, pp. 525-536), which uses only time and cost variable and is free of either socio-economic variables or tripmaker stratifications. In the proposed study, both size of travel party and socio-economic variables are likely to be very important. More suitable and descriptive choice models are available from a number of cities including Denver, San Diego, Washington, D.C., and the Twin Cities. There are also existing models that have been calibrated using data from demonstration projects such as the Shirley Highway Express Bus Project.

Each of these models will be examined with respect to its transferability to the Mercer County area and the possibility that the model's data requirements can be met from existing available data and/or the data base that will be prepared as a part of the demonstration project. The models will also be assessed with respect to their ability to provide estimates of patronage impacts at the route, corridor, and service area levels of detail.

3. Select Model

After the candidate models have been described and compared with respect to their applicability to the Mercer County demonstration project, one (or possibly more) will be selected. The selection will be based primarily on the comparisons performed in Task 2, i.e., data availability and sensitivity to proposed system changes. However, consideration also will be given to the logical properties of the models. This is necessary since the model(s) will be "pushed to the limit" in the sense that proposed transit fares will be zero, and thus the application will be well outside the calibration range.

4. Aggregate and Format Selected Extant Data

Hand calibration, testing and further calibration/refinement/adjustment of the selected model(s) will utilize extant Mercer County transportation data which are to be assimilated from one or more sources. These uses of the assimilated Mercer County data are described in Tasks 5 through 7 below.

Prior to performing Tasks 5 through 7 it will be necessary to merge some data sets and to format them so that they are all compatible with the selected aggregation units.



Data items include trips by mode and by purpose, travel times and costs (and selected components thereof), and supportive socio-economic data. Where these data are incomplete, reasonable estimates will be prepared to augment the data set as required.

#### 5. Hand Calibration

In this task, the parameters of the chosen model(s) will be adjusted to Mercer County conditions using extant (Mercer County) data as obtained in Task 1 and aggregated/formated in Task 4.

In this task no attempt will be made to recalibrate the model in the usual sense: all that is implied is adjustment of the coefficients to match time/cost tradeoffs of the specific area, and available modal flow among districts or subregions.

The logit model was calibrated for the Mercer County region by Simpson and Curtin in the early 1970's. This calibration will be analyzed for indications of the Mercer County Regional average time/cost tradeoff for non-work travel. Parameters of the chosen model(s) will then be adjusted to reflect these tradeoffs.

In addition, modal flows among eight districts (preferably disaggregated by purpose) are available in the existing data. Socio-economic variables were not considered in the aforementioned two-dimensional logit mode choice model calibrated for Mercer County. It is believed that such variables (income and/or auto ownership levels) are extremely important in predicting the outcome of the free-fare demonstration project. Also, passenger-describing and impedance data among eight districts are available in the existing data. The chosen model(s) will be articulated using these data as inputs and the results will be analyzed together with exogenous and socio-economic data in order to find a feasible means of considering socio-economic variations in the population. This might be accomplished by stratification of travelers or by introduction of socio-economic variable into the model structure. A major impediment to this approach might be large variance (of the values) of the socio-economic variables within the eight districts.

#### 6. Test Model(s)

The model parameter adjustment cited in Task 5 must be examined as to how well they fit observed data. The model(s) will thus be hand operated to reproduce (aggregate) modal passenger flows among the eight districts of Trenton-Mercer County, NJ. These model results will be compared with modal trip tables prepared by Simpson and Curtin. Observed differences may be due to deficiencies in aggregation technique, the choice model(s) or both. Variations which can be attributed to aggregation methods will be noted for use in Task 11.

A prime criterion for evaluation of model performance at this stage is the presence of systematic biases in the modal choice model(s).

7. Refine Hand Calibration

In Task 5, two modifications in the selected mode choice model(s) were contemplated: adjusting coefficients to more closely reflect time/cost trade-offs observed in Mercer County; and developing means to account for socio-economic variations of travelers, either through adding variable(s) to the model(s) or through stratifying input traveler data. It is not likely that this can be accomplished sequentially: it is most probably an iterative process. Thus Tasks 6 and 7 are likely to be a process which will cycle several times before an acceptable calibration of the model choice model(s) is reached.

8. Specify Data

After selecting the model(s) and model structure to be used to estimate the effect of the Mercer County Free-Fare Demonstration Project, it will be possible to specify the data items describing traveler and transportation system characteristics which are necessary for application of the model. It is expected that the "before" surveys conducted for evaluation of the Demonstration Project will provide many of these data (e.g., transit usage, trip patterns, etc.), but that gaps may exist due to the limited nature of the data collection program.

These missing data elements will be discussed with the data collection and evaluation contractors (coordination will be effected through UMTA). Those items which cannot be obtained directly will be identified and a methodology for estimating these data will be developed.

Format and structure of specified data (on tape) will be carefully prepared and documented, for use by the data collection contractor in preparing a master data file for subsequent use in the application of the fully competitive model in Trenton/Mercer County, NJ. Adequate supervision will be provided to the data collection contractor to assure the quality of this tape. Specified positions in each individual record will contain blanks to be subsequently filled with data items prepared by NBS.

9. Analyze and Assimilate Supplemental Data

It is expected that the model application will be done using a level of geographic aggregation (zones) fine enough to permit identification of shifts in usage by neighborhood, socio-economic group, and individual bus lines or line groups (corridors). Thus computer-based application will be required.

This task involves review and analysis of input data prepared by the data collection contractor from the "before" data collection efforts, the assimilation of other supportive data by NBS, and the placement of these assimilated data into the proper fields on the master data file described in Task 8.

The analysis portion of this effort is focused on insuring that the data are reasonable and the data set required for model application is complete.



Other supportive data will be assimilated to provide those data items necessary as input in using the model choice model(s) for prediction, but not provided by the data collection contractor. Such items might include modal impedances and socio-economic data.

Transit travel times (including all components) will be derived either through schedule analysis or the creation of a network. Highway times will be derived from travel speeds and distances or through the use of a travel time contour map. Transit and highway cost matrices will be prepared using current cost data. Socio-economic data files, derived from Census estimates or local sources, will be aggregated or disaggregated as necessary and prepared for processing. All of these data will be transferred to the proper location on the master data file.

A final element of Task 9 is to aggregate the master data tape across modes for use as input to Task 11. Transit fares need not be updated, since zero fares can be most readily introduced by simple computer instruction.

#### 10. Recalibrate Fully Competitive Model

The master data file tape built from the "before" data collection effort, and augmented as in Task 9, will be used to recalibrate the fully competitive mode choice model with current year data from Trenton/Mercer County, NJ.

This calibration should consider three trip purposes: social or recreational trips, shopping trips, and medical-dental/eat trips. (If the number of non-home based transit trips is significant, it may be desirable to add this category as a fourth trip "purpose." Consideration should also be given to calibrating Central Business District (CBD) destined trips separately from non-CBD destined trips.

Note: The outcome of this project, application of the Fully Competitive Mode Choice Model to the Trenton, NJ Off-Peak Fare Elimination Demonstration, is not totally dependent on this recalibration task. The task is valuable in showing how much improvement in forecasting ability is brought about by using a mode choice model calibrated with current local data vs. a model calibrated elsewhere but fine-tuned with available local data. Since the recalibration is time consuming and relatively costly, it is suggested that the decision whether or not to proceed with this task be deferred until Tasks 5, 6, 7, have been completed.

#### 11. Estimate Demand

The mode choice model(s) adapted to the Mercer County scenario in Tasks 5, 6, 7 (and the mode choice model(s) fully recalibrated in Task 10) will be applied to forecast the outcome of the demonstration project using the data file prepared in Task 9.

## APPENDIX F

The output of this task will be zone to zone off-peak passenger travel by selected trip purpose and by mode of travel, as predicted by the mode choice model adapted to the Mercer County scenario in Tasks 5, 6, and 7 (and the mode choice model fully recalibrated in Task 10).

### 12. Summarize and Report Demand Estimates

Zone to zone transit trips (summarized across all purposes) will be aggregated by suitable time periods and allocated to bus routes and to corridors in a manner suitable for subsequent comparison with the observed results of the free-fare demonstration.

A report will be prepared, the primary goal of which is to clearly illustrate by example the application of the fully competitive mode choice mode to other potential users. This report will:

- a. Briefly describe the purpose and objectives of this application of the fully competitive mode choice model.
- b. Review and discuss model selection procedures.
- c. Describe selection and assimilation of the data set from available extant data. Identify deficiencies in this data base.
- d. Describe hand calibration procedures used to adapt on-the-shelf-models calibrated in other cities to the Mercer County Scenario.
- e. Present and discuss the predicted outcome of the Demonstration Project. Highlight modal shifts by bus line and traveler category as appropriate. Identify and discuss model sensitivities and the probable range of errors. Briefly discuss implications of these predicted modal shifts on the outcome of Demonstration Projects, and implications for changes in the Project (if any).
- f. If mode choice models were recalibrated using newly collected "before" data, describe and discuss calibration procedures and goodness of fit. Identify and discuss deficiencies in these data and their implications for the results. Compare coefficients derived from this calibration with hand adjusted coefficients. Explore and discuss the improvement attributable to recalibration (if any).

### 13. Compare Predicted Results with Observed Results

Observed data describing the results of the off-peak free-fare bus demonstration project will be available in the Spring of 1978; additional data will be available in the autumn of 1978. It will thus be possible to make early comparisons of model projections with initial traveler response, and later comparisons reflecting the longer-term response.

## APPENDIX F

Two types of travel pattern shifts will be of major interest: changes in transit mode usage and changes in destinations. Comparisons of observed and predicted results will be made by line, corridor, and area as desirable. The validity of the projections made with the fully competitive model will be reported for the hand calibrated models and for the models recalibrated (with "before" Mercer County data) if this recalibration is made. The improvement in prediction capability of complete recalibration over hand adjustment of coefficients will be analyzed and reported.

The aim of this effort is not to produce estimates of the effect of off-peak free-fare in Mercer County and then determine that the estimates have been correct. Rather, the aim is to demonstrate the use of the selected fully competitive model in the demonstration environment, and to assess the usefulness of such techniques in developing and implementing future demonstrations.

The comparison report, therefore, while documenting the conformance or discordance of the projections with the observed response, will also identify those factors which contributed to the success or failure of the projections (including exogenous factors), and analyze the effect which such variance would have in scoping the nature of future demonstrations or related data collection and analysis efforts.

Recommendations will be made, if appropriate, on research necessary to improve the quality of such projections, and the applicability of the modeling process to future demonstration projects will be analyzed.

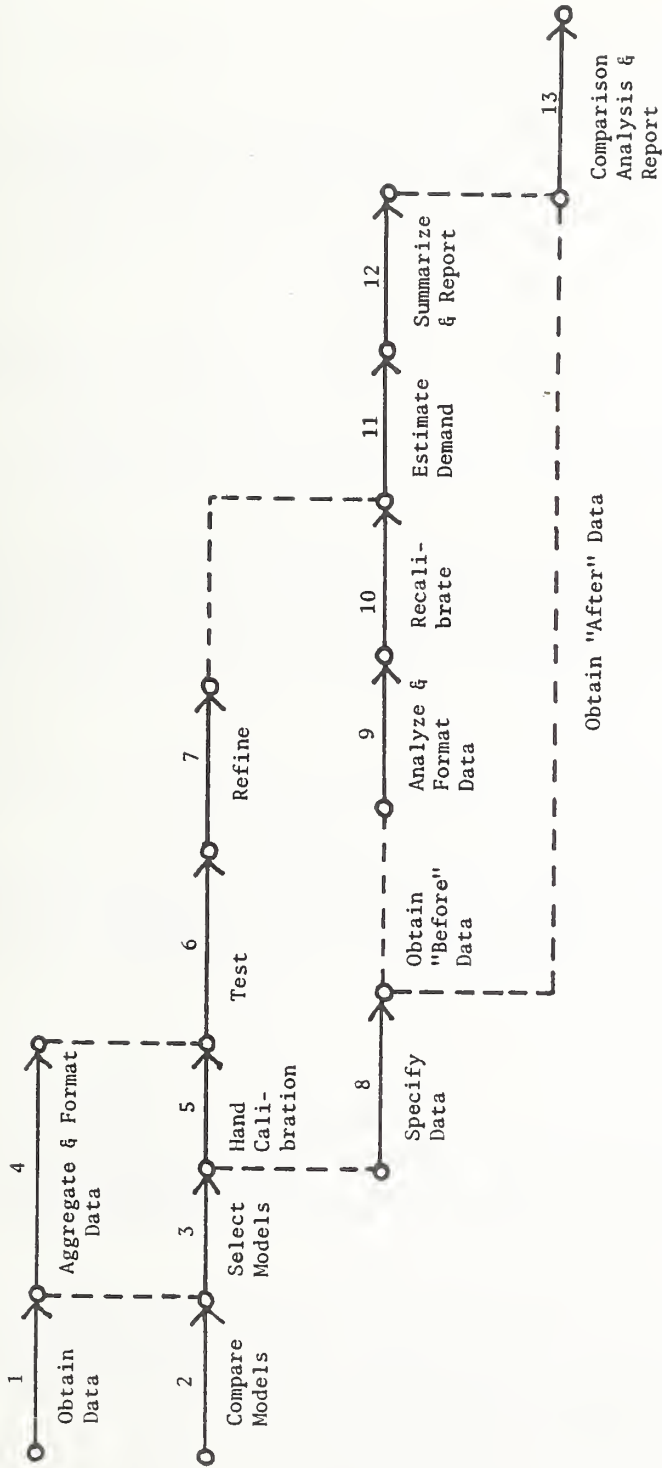


Figure F.1: TASK FLOW

Source: NBS

## APPENDIX G

### EVALUATION MANAGEMENT

This Appendix details the division and assignment of responsibilities for carrying out this Plan. It also specifies the lines of communication to be used to streamline the implementation as much as possible.

#### STAFFING

Bob Knight, as Principal Investigator for all SMD projects assigned to De Leuw, will monitor the progress of the demonstration. His primary concerns will be control of quality, cost, and fulfillment of the Evaluation Plan's intent. He will also participate in analysis and preparation of the Final Report.

Dave Connor of De Leuw's New York office is to be Project Manager. He will be supported as required by other New York personnel; active involvement in day-to-day affairs by personnel from other De Leuw offices is not planned. Dave is to have full authority to conduct the evaluation, subject only to periodic review and concurrence by the De Leuw Principal Investigator.

Ms. Sherrill Swan will review and advise on survey procedures and general analytic methods. Her status will be that of an in-house consultant and will not encroach on the authority of the Project Manager.

Jim Schmidt of SAGE Consultants, Ltd., Joe Schofer and David Rindskopf of Northwestern University, and Jim McLynn of DTM, Inc., will be on call as needed for specific advice and for review of all substantive products. Total level of effort for such assistance is not expected to exceed 150 hours.

#### RESPONSIBILITIES

Dave Connor is to be responsible for actual conduct of the evaluation and preparation of all reports. He has authority to act as De Leuw's representative in all dealings with TSC, and with TSC's permission also with UMTA, NJDOT, their data collection contractor (Garmen Associates), Mercer Metro and other local agencies.

Commensurate with his responsibilities, he is to make all decisions on the conduct of the valuation. These are final unless explicitly countermanded by TSC or De Leuw's Principal Investigator. He will seek guidance from TSC or the De Leuw PI whenever needed, and will comply with directives which result from their periodic reviews of progress.

Dave will initiate a telephone report, followed by a written progress report for TSC, to Knight at the end of each month in addition to all other contacts with them.



## APPENDIX G

Knight will review all activities, results and costs on the Trenton project at least monthly. He will also act as a technical resource on which Connor may draw. He will assist in interpretation of findings and development of reports. He will also be responsible for the final editing and production of the Final Report, in order to assure consistency and economy in all SMD report production.

The Firm's responsibilities as the Trenton evaluation contractor require definition to avoid conflict with those of NJDOT's data collection contractor. Our duties extend to the specification of all data content, development of draft survey instruments, sampling procedures, and data formatting specifications. The same holds for systematic observational data such as corner counts.

We are also responsible for actual collection of non-statistical and archive-type data such as opinions of individual bus supervisors, crime records, and bus operator's cost data.

We are responsible for monitoring the data collection work of others on TSC's behalf, in order to assure that agreed-on procedures are satisfactorily carried out and that misunderstandings are avoided. However, we are not responsible for the quality of the data and any controls required to assure that quality; this is a normal duty of the data collector.

### COMMUNICATIONS

Connor is to deal directly with TSC's technical representative (Woody Studenmund) in any technical matters requiring TSC involvement. He is to keep Knight informed of any substantive changes in the work program or evaluation objectives, for Knight's concurrence. However, except in cases of potentially major effect on the evaluation's scope or quality, he need not seek prior approval before dealing with TSC.

Connor is to deal with Knight on any matters relating to cost or contract administration. Knight will coordinate all dealings with Bob Nelson at TSC, for all projects including Trenton.

Knight and all consultants are available to TSC staff at any time on any matter. However, in general all communications from TSC on specifics of the Trenton project should go first to Connor.





REPORT OF INVENTIONS

This report presents a design for the evaluation of an off-peak free transit demonstration in Mercer County, New-Jersey. A diligent review of work performed under this task directive has revealed no significant innovations, discoveries or improvements of inventions. However, this evaluation design and its rationale will assist in understanding and evaluating the free-fare concept for potential use by transit authorities throughout the United States.



HE 18.5.A37 U.S. De  
no. DOT-TSC- Report  
UMTA-78-17

BORROWER

---

---

---

---

---

---

---

---

---

---

DOT LIBRARY



00009761

**U.S. DEPARTMENT OF TRANSPORTATION  
RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION**

TRANSPORTATION SYSTEMS CENTER  
KENDALL SQUARE, CAMBRIDGE, MA. 02142

OFFICIAL BUSINESS  
PENALTY FOR PRIVATE USE, \$300

POSTAGE AND FEES PAID  
U.S. DEPARTMENT OF TRANSPORTATION  
513

