



U.S. Department of
Transportation

Transit System Performance Evaluation and Service Change Manual

February 1981



TRANSIT SYSTEM
PERFORMANCE EVALUATION
AND
SERVICE CHANGE MANUAL

PREPARED BY
SIMPSON & CURTIN
A DIVISION OF BOOZ, ALLEN & HAMILTON INC.
AND
UNIVERSITY OF PENNSYLVANIA

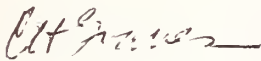
The preparation of this report has been financed in part through a grant from the U.S. Department of Transportation under provisions of the Urban Mass Transportation Act of 1964, as amended. The opinions, findings, and conclusions expressed in this publication are those of the author, and not necessarily those of the Pennsylvania Department of Transportation or the United States Department of Transportation, Urban Mass Transportation Administration.

FOREWORD

Service planning and evaluation is an important part of transit management. The Urban Mass Transportation Administration has long recognized its importance and has been funding, through the Section 8 Technical Studies Program, local studies to develop and use service planning and evaluation techniques.

This manual is the final product of a Section 8 funded study that was conducted for the Pennsylvania Department of Transportation. The purpose of the manual is to help transit operators develop a process for setting service objectives, evaluating performance and implementing fare and service changes. We believe that this report will be of value to transit operators who are interested in developing and improving their ongoing service evaluation process.

Additional copies of this report are available from National Technical Information Service (NTIS), Springfield, Virginia 22161. Please reference UMTA-PA-09-8003-82-1 on the request.



Charles H. Graves, Director
Office of Planning Assistance (UPM-10)
Urban Mass Transportation Administration
U.S. Department of Transportation
Washington, D. C. 20590



Alfonso B. Linhares, Director
Office of Technology Sharing (I-40)
Office of the Secretary
U.S. Department of Transportation
Washington, D. C. 20590

TABLE OF CONTENTS

INTRODUCTION
AND CASE STUDY

SECTION I:
SYSTEM OBJECTIVES

SECTION II:
EVALUATION CRITERIA
AND
PERFORMANCE GUIDELINES

SECTION III:
EVALUATION
METHODOLOGY

SECTION IV:
SERVICE CHANGES

SECTION V:
FARE CHANGES

TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION TO MANUAL AND CASE STUDY	1
SECTION I: SYSTEM OBJECTIVES	I-1
SECTION II: CRITERIA AND PERFORMANCE LEVEL GUIDELINES	II-1
SECTION III: EVALUATION METHODOLOGY	III-1
SECTION IV: SERVICE CHANGES	IV-1
SECTION V: FARE CHANGES	V-1

INTRODUCTION AND CASE STUDY

CONTENTS

INTRODUCTION TO MANUAL AND CASE STUDY

	<u>Page</u>
MANUAL ORGANIZATION	2
CASE STUDY	2
Profile of Hypothetical Transit Authority	3
Development of System Objectives	3
Identification of Criteria and Performance Levels	4
Service Changes	11
Fare Changes	14

LIST OF EXHIBITS

<u>Exhibit No.</u>		<u>Following Page</u>
1	Summary Profile of PATA	3
2	System Objectives of PATA	4
3	PATA Performance Level Targets	4
4	Allocation Formula Application PATA - Below Average Performing Routes	6
5	PATA - Operating Ratio Summary	6
6	General Ridership Growth Curve for New Bus Services	8
7	Checklist for Potential Route Improvements	9
8	PATA's Transit Route Alignments	11

INTRODUCTION TO MANUAL AND CASE STUDY

LIST OF EXHIBITS
(Continued)

<u>Exhibit No.</u>		<u>Following Page</u>
9	Array of Discrete Fare Change Actions for PATA	15
10	Impact of Discrete Actions - Increase Peak Adult Fare	15
11	Impact of Discrete Actions - Increase Off-Peak Adult Fare	15
12	Impact of Discrete Actions - Increase Student Fare	15
13	PATA Fare Change Alternatives	15

INTRODUCTION TO MANUAL

AND

CASE STUDY

This manual is a guide to help transit system managers in Pennsylvania make better use of their limited physical and financial resources. It details a process for setting objectives, evaluating performance, and implementing service and fare changes. The stress is on internal analysis - - to aid the transit system governing board and its management in deciding the level of performance they should meet, and making appropriate changes to achieve that performance. The process described in this manual can form the basis for a valuable ongoing performance evaluation process.

There has been a growing emphasis nationwide on transit properties developing their own performance evaluation systems. This has been recognized by the American Public Transit Association (APTA), as well as by the Urban Mass Transportation Administration (UMTA) and the Pennsylvania Department of Transportation (PennDOT), as an important element of internal management. While there has been considerable research at all levels, the only common finding is that there is no single definitive set of standards, so each system must define its own objectives and measure performance against them. It should be stressed, therefore, that this manual is not an attempt to impose standards, or to encourage transit systems to set up inflexible standards by which they can be "peer" ranked. The objectives and performance levels shown are in most cases advisory. It is encouraged that each system should, through its review process, decide its own short-term and long-term performance objectives and levels, and determine how they can best be monitored and used as management tools.

The manual provides many different performance objectives and service alternatives. Each performance objective and service alternative will not all be applicable for every system. Each transit property, through its management, must determine which parts of each section are pertinent. The key is to follow the process, beginning with objectives through to implementation of required service and fare changes. This assures that proposed service and fare changes are well thought out, aimed at priority performance objectives, and carefully implemented to achieve best results.

MANUAL ORGANIZATION

The manual is organized in five sections. The first (Section I) discusses formulation of "System Objectives." These objectives are basic to the entire process: anytime a performance measure is used, it should be related to a clearly stated objective. Only by determining the priorities of their specific system and community can transit managers focus their attention on performance criteria that work toward the most important local objectives.

Section II treats the setting of "Criteria and Performance Level Guidelines" to measure progress toward meeting objectives. The approach toward quantifying or measuring how well a system meets its objectives consists of three steps: (1) identification of criteria which address each objective; (2) determination of general industry practices and/or operating statistics which relate to the criteria; and (3) development of performance level guidelines based upon results of step 2.

After establishing desired performance levels that meet system objectives, Section III presents an "Evaluation Methodology" to check actual system performance. This section addresses the evaluation process steps by defining data and analysis tools needs, highlighting general corrective action approaches, and detailing the evaluation process and corrective action approaches for 13 key performance indicators.

Section IV defines the types of service changes that are available and details specific actions required to plan, evaluate and implement each category of change. It emphasizes the actions to be made for the following types of service changes:

- Scheduling,
- Frequency,
- Routing, and
- New Service.

The final section, Section V, deals with accomplishing fare-related changes and the resulting impact on revenue and ridership of specific fare change actions.

CASE STUDY

To facilitate use of this manual, the entire evaluation process is summarized in this section via a case study example. A hypothetical transit system was constructed and its performance evaluated using the process described in this manual.

Profile of Hypothetical Transit Authority

The Pennsylvania Transit Authority (PATA) is a hypothetical system and while similarities, whole or in part, to an actual system may exist, no representation of any individual system is intended or implied.

The urban area covered by PATA's services includes one hub city surrounded by one county and has a total population of 250,000 people. PATA's governing board is comprised of three city and three county representatives. The city and county share equally in the local capital and operating support of PATA. Exhibit 1 sets forth a profile of PATA's operations, employee, financial and certain key performance statistics.

PATA operates out of a single facility located in the city. It has 50 buses of which 44 are used in peak period service. It provides service to the urbanized area over 15 routes, operating about 1,000,000 vehicle miles and about 83,300 vehicle hours.

During the current fiscal year PATA has an operating expense budget of \$2,100,000. It expects to carry 2,600,000 riders, with total operating revenue amounting to \$1,000,000, which leaves PATA with a \$1,100,000 deficit. Of this deficit, Section 5 covers \$550,000, PennDOT covers \$366,000 and the city and county each pay \$92,000.

Development of System Objectives

It is important to determine the policy priorities of PATA against which its actual performance can be reviewed and to shape service and/or fare change recommendations for improving performance. Establishing a set of system objectives can set these policy priorities.

At PATA these system objectives were set by the process listed below:

- A special session of the PATA Board was convened to discuss system objectives. This session was held in January so as to set priorities for the next fiscal year beginning in July. The system objectives presented in Table I-1(1) through Table I-6 guided the discussions. The Board noted its priorities which included:

(1) Section I, Table 1.

EXHIBIT 1

SUMMARY PROFILE OF PATA

Operating Data

Fleet Size: 50 buses (40-35 foot and 10-40 foot)
Average Fleet Age: 8 years
Vehicle Usage: 44 buses peak and 30 buses midday
Number of Routes: 15
Annual Vehicle Miles: 1,000,000 miles
Annual Vehicle Hours: 83,300 hours
Peak Period Headways: 30 minutes
Off-Peak Headways: 60 minutes

Employee Data

Number of Operators - 56
Number of Mechanics - 15
Other Maintenance Employees - 5
Number of Administrative/Management Employees - 9

Financial Data

Total Expenses - \$2,100,000
Operating Revenue - \$1,000,000

Performance Statistics

Passengers Carried: 2,600,000
Fuel Consumption: 4.3 mpg
Operating Speed: 12 mph
Vehicle Accidents: 53 accidents
Miles Between Road Calls: 6,500 miles

- keep next year's ratio of revenue to expenses the same as this year's projection of 0.48 in order to be consistent with State guidelines and therefore maximize state funding.
- implement the capital improvement program which calls for ten replacement buses and two for service expansion;
- bring service into several new areas of the city and county that have requested it; and
- improve the performance and image of the system.

- Based on the general policy goals set by the PATA Board, the general manager established the set of system objectives set forth in Exhibit 2. These were reviewed by the Board at a second session where they adopted them as general policy with the understanding that specific details of meeting each objective were subject to their review before implementation.

Upon this signal from the Board to proceed, the manager utilized Section II of this manual to establish criteria and performance levels corresponding to the adopted objective categories.

Identification of Criteria and Performance Levels

For each objective category listed in Exhibit 2, the manager referred to the corresponding performance level guideline contained in Section II to determine specific performance measures. The performance of PATA was then determined for the specific measures for each objective category. A comparison of PATA's performance was then made to performance level guidelines associated with each objective. The manager found that generally PATA's performance compared favorably with the performance level guidelines, so for the most part the suggested guideline was adopted. With these targeted performance levels defined, (see Exhibit 3), the PATA manager called for the third Board session, where the performance levels were presented. The strategy that the manager proposed was to:

EXHIBIT 2

SYSTEM OBJECTIVES OF PATA

System Efficiency

- Stabilize system operating ratio.
- Maximize productivity of labor forces.

System Effectiveness

- Improve on-time performance.
- Increase coverage within service area.

System Utilization

- Maximize revenue passengers per vehicle hour.

Fare Policy

- Generate sufficient revenues to maintain financial stability of system.

Management

- Establish and maintain employee evaluation and training programs.

Marketing

- Improve awareness and image of transit system through marketing.

EXHIBIT 3

PATA PERFORMANCE LEVEL TARGETS

<u>Objectives</u>	<u>Performance Levels</u>
Stabilize system operating ratio (EFY-1). *	System at 0.48 with individual routes: 80% and better (0.38 and above) - okay 60% to 80% (0.29 to 0.38) - review below 60% (below 0.29) - adjust
Maximize productivity of labor forces (EFY-7).	a.) 3.5 buses/mechanic b.) Payroll to platform hour ratio of 1.2
Improve on-time performance (EFT-3).	a.) Peak - 90% on-time (0 to 5 minutes late) b.) Off-peak - 95% on-time (0 to 5 minutes late)
Increase coverage within service area (EFT-14).	a.) Provide service to developing areas while increasing miles and hours of service by no more than 8%
Maximize revenue passengers per vehicle hour (UTL-4).	a.) Systemwide - 30 passengers per vehicle hour b.) Individual routes: 80% and better (24 and above) okay 60% to 80% (18 to 24) - review below 60% (below 18) - adjust
Generate sufficient revenues to maintain financial stability of system (FRE-3).	Fares should be increased to maintain a 0.48 operating ratio.
Establish and maintain employee evaluation and training programs (MGT-3).	Evaluate all employees annually with training programs offered.
Improve awareness and image of transit system through marketing (MKT-4).	a.) Reduce number of valid complaints from 20 per month to 15 per month. b.) Increase the transit-related newspaper articles from two per month to three per month.

*EFY-1 and similar identifiers refer to service objectives discussed in more detail in Section II.

- Provide minimum service expansions (EFT-14) while reviewing the productivity of current routes (EFY-1 and UTL-4);
- Monitor employee utilization (EFY-7);
- Achieve stability in the operating ratio by increasing fares (FRE-3); and
- Improve system image through adherence to on-time performance (EFT-3), high employee morale (MGT-3), and focused transit awareness programs (MKT-4).

This strategy was approved by the Board. The manager was faced with the task of defining the program to implement the strategy.

Performance Evaluation

A detailed procedure described in Section III was used by PATA's manager for evaluating its categories of performance and associated target levels in six of the eight objective areas. The objective of increasing coverage within service area (EFT-14) resulted from external factors, especially requests of city and county officials to service a growing corridor where a 500,000 square foot shopping mall is soon to be opened. Therefore, evaluating PATA performance with respect to this objective is not required. What must be done is to accomplish the identified service change which is a topic covered in Section IV.

Generating sufficient revenues to maintain financial stability (FRE-3) and the associated performance level selected by PATA also require no evaluation of current performance. Rather, accomplishing the fare increase is the next step and that process is addressed in Section V.

Performance evaluations of PATA for the six remaining categories are treated herein.

Stabilize System Operating Ratio - Presently, the system operating ratio of PATA is at 0.48, and the goal of PATA is to maintain this level via a fare increase. However, individual route operating ratios have not been measured to determine their performance. PATA does obtain operating revenues on a route-by-route basis. In the past PATA identified its route costs based on a systemwide figure of \$2.10 per mile.

Utilizing Section III of this manual, beginning on page III-8, the manager decided to develop unit costs based on the cost allocation methodology. It was determined that PATA's expenses are more appropriately associated with measures of service output, namely vehicle miles, vehicle hours, and peak vehicles.

PATA reports to UMTA for Section 15 purposes in a Level C format. In Section III, Table III-5, the basis for allocating function and expense object classes to service output is defined. Using this allocation procedure, PATA's expenses to service output relationship was defined and is summarized below:

Miles	=	\$ 550,000	(26 percent)
Hours	=	1,220,000	(58 percent)
Peak vehicles	=	330,000	(16 percent)
		\$ 2,100,000	

The operating statistics for PATA are:

Vehicle miles	=	1,000,000
Vehicle hours	=	83,300
Peak vehicles	=	44

Unit cost factors are therefore:

$$U_M = \frac{\$550,000}{1,000,000} = \$0.55 \text{ per mile}$$

$$U_H = \frac{\$1,220,000}{83,300} = \$14.65 \text{ per hour}$$

$$U_{PV} = \frac{\$330,000}{44} = \$7,500 \text{ per peak vehicle}$$

PATA's cost allocation formula is:

$$C = \$0.55 \times M + \$14.65 \times H + \$7,500 \times PV$$

Applying this formula to the operating statistics of PATA's 15 routes (see Exhibit 4), the manager determined that two routes are marginal (see Exhibit 5) with operating ratios between 0.29 and 0.38 and, therefore, are candidates for review and potential improvements. Finally, one route has an operating ratio of 0.25, which specifies it for change.

Following the performance evaluation process contained in Section III to "Stabilize System Operating Ratios" (EFY-1),

EXHIBIT 4

ALLOCATION FORMULA APPLICATION

PATA - BELOW AVERAGE PERFORMING ROUTES

<u>Route</u>	<u>Peak Vehicles</u>	<u>Annual Vehicle Miles</u>	<u>Annual Vehicle Hours</u>
7	4	80,000	7,500
14	3	90,000	7,000
15*	2	70,000	6,000
Remainder	<u>35</u>	<u>760,000</u>	<u>62,800</u>
TOTAL	44	1,000,000	83,300

ROUTE COSTS

7	4 peak vehicles X \$7,500 per peak vehicle	=	\$ 30,000
	80,000 miles X \$0.55 per mile	=	44,000
	7,500 hours X \$14.65 per hour	=	<u>109,875</u>
	Total Route 7		\$183,875
14	3 peak vehicles X \$7,500 per peak vehicle	=	\$ 22,500
	90,000 miles X \$ 0.55 per mile	=	49,500
	7,000 hours X \$14.65 per hour	=	<u>102,550</u>
	Total Route 14		\$174,550
15	2 peak vehicles X \$7,500 per peak vehicle	=	\$ 15,000
	70,000 miles X \$0.55 per mile		38,500
	6,000 hours X \$14.65 per hour		<u>87,900</u>
	Total Route 15		\$141,400

* Operated only for six months. Statistics are twice six-month actuals

EXHIBIT 5

PATA - OPERATING RATIO SUMMARY

<u>Route</u>	<u>Passengers Carried</u>	<u>Operating Revenue</u>	<u>Formula Costs</u>	<u>Operating Ratio</u>
7	153,000	\$ 58,800	\$ 183,875	0.32
14	113,200	43,600	174,550	0.25
15	132,000*	50,900*	141,400	0.36
Remainder	<u>2,201,800</u>	<u>845,700</u>	<u>1,600,175</u>	<u>0.53</u>
TOTAL	2,600,000	\$1,000,000	\$2,100,000	0.48

* Annual estimates based on six-month actuals

the manager first set out to determine the cause for the problems; are they due to excessive costs or low revenues? He accomplished this by comparing the formula costs and operating revenues of routes 7, 14 and 15 with similar PATA routes. For routes 7 and 15, costs were found to be in line but revenues for both routes were below revenues achieved by other similar routes. The route comparison for route 14 indicated that excessive costs were the problem.

An evaluation for each route was then conducted as summarized below:

- Route 7 - The manager directed the PATA street supervisor to conduct an on-the-street evaluation of this route following the route profile process described in Table IV-3 of Section IV. The major findings from the evaluation were:
 - 1- Schedules of Route 7 are not coordinated with either Route 3 or Route 8 for which a large amount of transfer activity occurs.
 - 2- A survey of passengers waiting either to transfer from Route 7 to Route 3 or Route 8 or to board Route 7 on their outbound trip expressed dissatisfaction with lack of waiting accommodations. The low revenue generation on Route 7 appears due to the improper accommodation of transfers. Thus the manager directed his staff to follow the service change methodology set forth on pages IV-5 to IV-10 of Section IV to reduce the inconvenience associated with transferring. Following this procedure, a plan was developed which involved adjustments to the schedule of Route 7 as well as Route 3 and 8 to minimize the transfer wait. Also, store owners in the downtown transfer area and city officials were contacted and concurred with a plan to construct a downtown waiting shelter facility.
- Route 15 - This route is the newest route on the PATA system and has been operating for only six months. Its monthly passenger statistics have been increasing steadily since its establishment and are summarized below:

<u>Month</u>	<u>Ridership</u>
1	4,600
2	7,300
3	8,500
4	9,400
5	10,600
6	11,100
Six Month Total	51,500

The PATA staff projected that Route 15 would ultimately generate 176,000 riders or about 14,700 per month. For budgeting purposes they assumed that 75% of this total or 132,000 would be achieved in the first year of operation. However, a review of the six month actuals, while showing growth, left doubts in their minds.

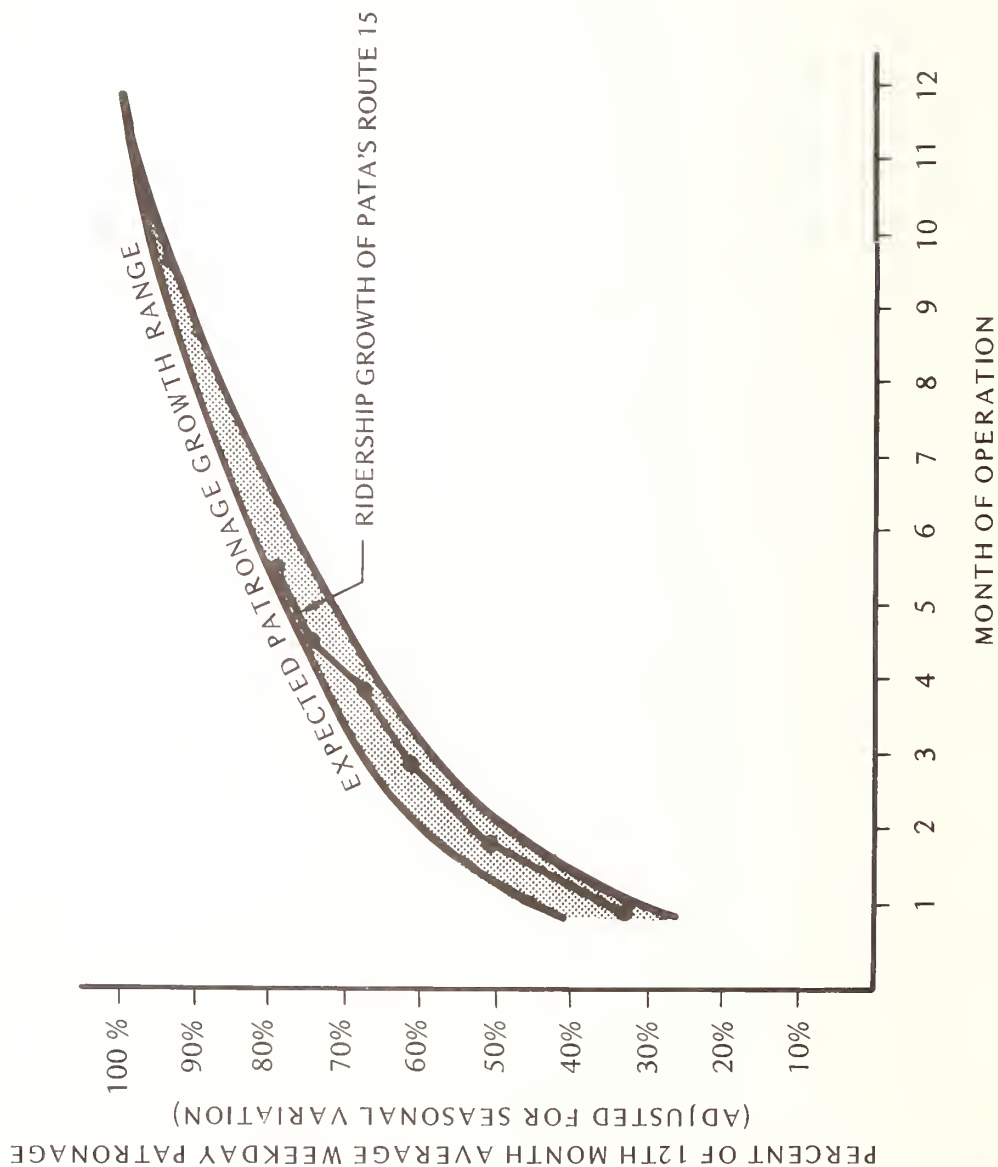
The staff then calculated the percentage that each monthly actual was to the ultimate monthly total, e.g., $4,600 \div 14,700 = 31\%$. These percentages were plotted on the general ridership expected growth curve presented in Figure IV-1 of Section IV. They discovered that Route 15 was exhibiting normal growth trends as shown in Exhibit 6 and a route change was not required.

- Route 14 - This route serves several communities in the outlying county area. Statistics for Route 14 are summarized below:

Round trip running time	- 70 minutes
Round trip miles	- 15 miles
Peak period headway	- 30 minutes
Off-peak headway	- 60 minutes

Because of the round trip running time of 70 minutes, three peak vehicles and two off-peak vehicles are required to meet schedules, which required an excessive amount of layover. To solve this problem, the manager decided to violate the policy headways for this route. Peak period headways of 35 minutes and off-peak headways of 70 minutes were selected as the new schedule for Route 14.

EXHIBIT 6
GENERAL RIDERSHIP GROWTH CURVE
FOR NEW BUS SERVICES



By making this change, peak vehicle needs were reduced from three to two, annual vehicle miles were reduced from 90,000 to 75,000, and annual vehicle hours were reduced from 7,000 to 5,800. Ridership and revenue impacts due to the schedule change were assumed to be minor.

Using the cost allocation formula, the new costs for Route 14 were reduced from \$174,550 (see Exhibit 5) to \$141,220. Using the current operating revenue of \$43,600, the operating ratio of Route 14 improved to 0.31.

Maximize Productivity of Labor Force - PATA had 15 mechanics assigned to maintain its 50-bus fleet, which is 3.33 buses per mechanic and slightly below the standard. However, PATA plans to expand its bus fleet by two vehicles next year. The manager decided that PATA would maintain its complement of 15 mechanics, even with two additional vehicles.

A review of driver productivity indicated that PATA's ratio of pay hours to platform hours was 1.20, which was at the standard, and no action was required.

Improve On-Time Performance - PATA's on-time performance was checked, and several routes were found to be below target levels. Street checks indicated that Route 2 had the worst on-time performance record as shown below.

<u>Period</u>	<u>Standard</u>	<u>Number of Daily Trips</u>	<u>Number on-time (0 to 5 minutes late)</u>
Peak	90% trips on time	24	17 (71%)
Off-Peak	95% trips on time	18	13 (72%)

Many trips violated the standard by being more than five minutes late. The route profile process described in Table IV-3 of Section IV was used to determine the cause. Exhibit 7 sets forth the results from this check.

The primary finding was that poor on-time performance of Route 2 resulted from improper scheduling: in some instances actual running times exceeded scheduled running times and recovery times were inadequate. New schedules for Route 2 were prepared to correct the scheduling deficiencies.

Corrective actions were also accomplished for the secondary causes. Bus stop signs were installed at every other block in the city and the city police were alerted to the problem of illegal parking at bus stop locations.

EXHIBIT 7
CHECKLIST FOR POTENTIAL ROUTE IMPROVEMENTS

Route: 2Prepared By: Street SupervisorDate: 2/15/81**1. Alignment**Yes NoIf "YES", DESCRIBE:

- a. Could the route be extended to serve major residential/activity concentrations?
- b. Could the route be curtailed without losing significant patronage?
- c. Could segments of the route be realigned to provide better service/increase speed?
- d. Does the route duplicate other routes in serving major markets?

X

X

X

X

2. Headways/Turnbacks

- a. Are "load standard" headways excessive or insufficient?
- b. Are "policy" headways at variance with service standards.
- c. Could certain trips be "turned back" mid-route without violating headway standards?
- d. Is there insufficient patronage early morning, late evening or weekends to justify service?
- e. Could schedules be better coordinated with predominate shift or school times?

X

X

X

X

X

CHECKLIST FOR POTENTIAL ROUTE IMPROVEMENTS (Continued)

	Yes	No	If "YES" DESCRIBE
3. <u>Schedule Adherence/Running Time</u>			
a. During short-headway periods, do vehicles "bunch up?"	X		During A.M. peak some trips arrive in downtown area 10 minutes apart rather than the 15 minute schedule.
b. Are there significant deviations between actual and scheduled running times by route segment by time period?	X		Late trips in downtown in some cases cannot be helped when loads are high.
c. Is there insufficient or excessive recovery time at each end of the route?	X		When bus becomes late, recovery time is inadequate and lateness continues on successive trips.
4. <u>Schedule Coordination</u>			
a. Should route be jointly scheduled with another route where service duplication exists?		X	
b. Where there is major transfer activity, should schedules be coordinated during policy headway periods?		X	
c. Could route be "hooked" with another route where there is major transfer activity?		X	
5. <u>Traffic Aids</u>			
a. Are recovery/turnaround points inadequate for vehicle storage?		X	
b. Are there serious congestion points along route?		X	
c. Does illegal parking/truck loading seriously impede vehicle movement?	X		Parked cars were observed at several bus stop locations in the downtown.

CHECKLIST FOR POTENTIAL ROUTE IMPROVEMENTS (Continued)

	<u>Yes</u>	<u>No</u>	<u>If "YES" DESCRIBE:</u>
d. Would a preferential turn, lane, or traffic signal significantly improve route speed?		X	_____

e. Are there pavement conditions which are highly detrimental to operations?		X	_____

6. <u>Transit Stops</u>			
a. Are there route segments where stops are too densely placed?	X		Stop locations along the route in the city are spaced every block.
b. Are there locations where additional stops may be justified?		X	_____

c. Are there top priority locations for transit shelters?		X	_____

d. Are passenger waiting areas in need of major security/appearance improvements?		X	_____

Maximize Revenue Passengers Per Vehicle Hour - Systemwide, PATA carried about 31 passengers per vehicle hour, which is slightly better than the systemwide productivity standard of 30. However, on an individual basis, Route 14 was found to carry an average of only 16 passengers per hour, which is below the acceptable level. Corrective actions taken resulting from the operating ratio analysis will reduce vehicle hours from 7,000 to 5,800. Assuming that 113,200 passengers will still be carried, the passengers per vehicle hour ratio will be improved to 20 (113,200 passengers divided by 5,800 vehicle hours). This is above the threshold level of passenger productivity requiring route corrective actions. Thus, no further changes to Route 14 are required.

Employee Evaluation of Training Program - PATA's manager reviewed the material contained in Section III of this manual concerning this category. In evaluating PATA's performance, the manager learned that the current evaluation process, while it does occur on an annual basis, is considered poor by the staff. Their main concern was that personal evaluations are based on subjective judgments rather than objective ones.

Following the suggestions presented in Section III, the manager established an employee evaluation process which was based upon defining objectives and measuring individual performance against them. Objectives for the top management employees at PATA were established at individual sessions with PATA's Manager. Here, the top management employees were directed to follow the same procedure with all employees under their control. An example of one of many objectives for each of the four top management positions follows:

- Marketing Director - Implement four new marketing programs.
- Maintenance Director - Improve road call rate from 6,500 to 7,000 miles.
- Operations Director - Reduce vehicle accidents from 53 to 48.
- Financial Director - Obtain federal operating assistance funds two weeks earlier than last year.

Improve System Awareness and Image - Up to now, PATA paid little attention to complaints made by passengers. Data indicated that during the past five years complaints have increased from an average of five per month to the current twenty per month. Following the procedure set forth in

Section III, the manager established a policy to deal with complaint handling and to implement corrective actions associated with valid complaints. The policy included:

- A willingness to receive valid complaints;
- Immediate acknowledgement of receipt of complaints, indicating that it is being investigated;
- Investigation of the merits of the complaint;
- If found to be valid, corrective actions implemented to improve situation; and
- Notice to passenger indicating actions taken as a result of the complaint.

PATA also set out on a program to increase public awareness of transit service. Generally, newspaper articles occur monthly resulting from the Board meeting and periodically as a result of follow-up articles on subjects discussed at the Board meeting. Two articles per month are common. A campaign was established to increase the number of newspaper articles per month by one. The campaign had as its foundation a program whereby PATA would issue press releases. They also attempted to foster open communication with the media.

Service Changes

The primary service change that PATA's manager had to deal with for next year was establishing the new route to service the city/county corridor described in Exhibit 8 which contains the new shopping mall. PATA's transportation department was directed by the manager to set up the new route following the procedure outlined in Section IV, pages IV-36 to IV-42. Steps accomplished are summarized below.

Planning - PATA's transportation department performed the following actions to develop the new route:

- Gather published information on the corridor, including:
 - population - 11,000 people
 - population density - 1,800 people/sq. mile
 - number of households - 4,800
 - auto ownership - 1.2 autos per household
 - age distribution - 0 to 20 years, 3,500;
20 to 65, 6,300; and 65 and above, 1,200

EXHIBIT 8

PATA'S
TRANSIT ROUTE ALIGNMENTS

LEGEND :

EXISTING SERVICE

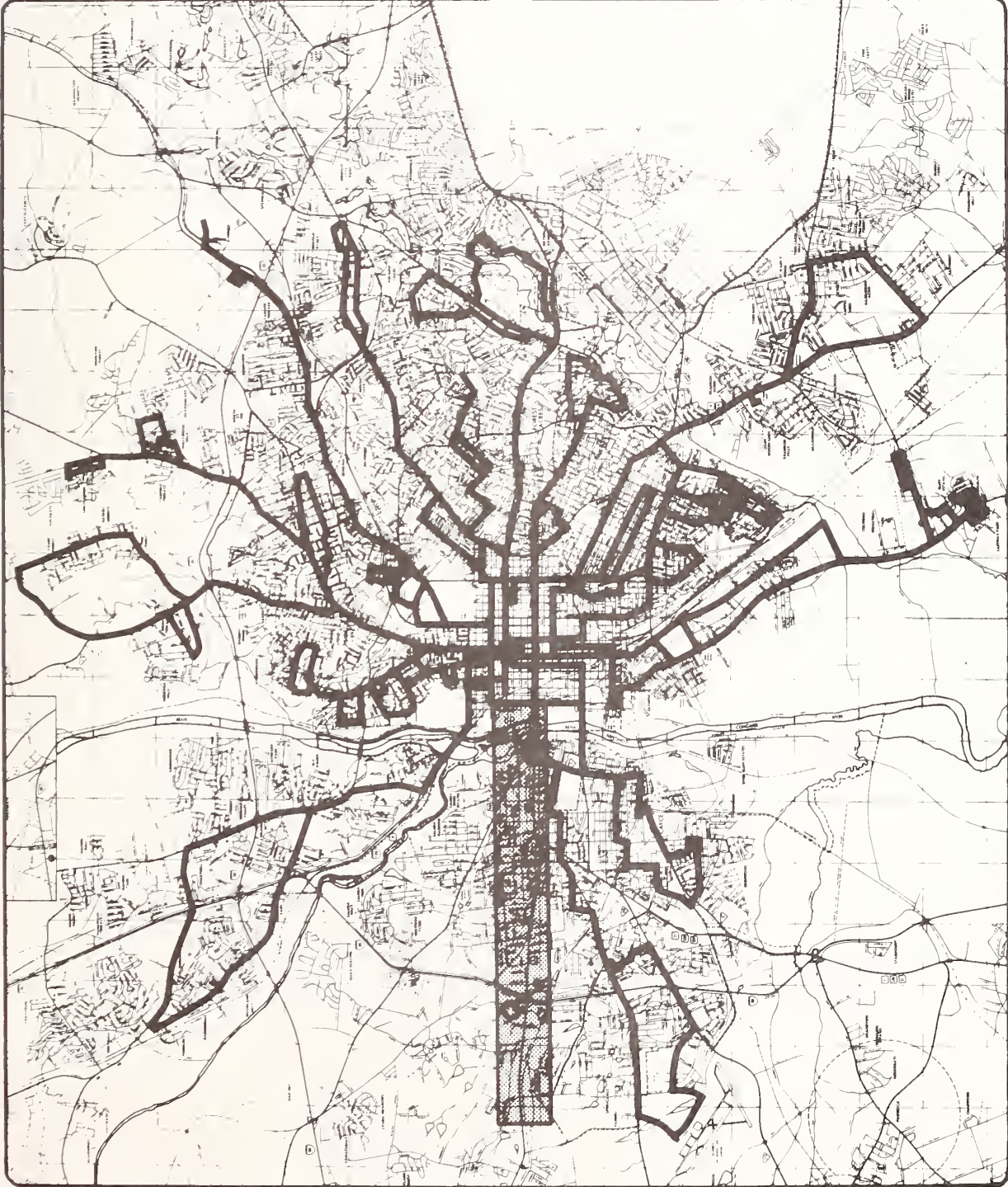
NEW MALL

UNSERVED CORRIDOR



0 1/2 1 2 3 4

scale in miles



- average household income - \$15,500
 - street and traffic data - land width, signalized intersections and speed limit
 - activity centers
- A review of the information revealed that the corridor exceeded the threshold level for potential new service based on two factors:
 - The corridor contained 11,000 people, which is greater than the threshold population of 10,000; and
 - A major activity center, the shopping mall, was located within the corridor.
- Based on published information, including a detailed street map of the corridor, a tentative route path was established. Field surveys were then conducted to determine:
 - round trip mileage
 - turn-around and layover locations
 - potential bus stop locations
 - running time estimates using a bus making simulated stops during both peak and off-peak periods
 - if street conditions and turning movements were acceptable for bus operations
 - potential passenger amenity needs
- Characteristics of the tentative route were then summarized
 - round trip mileage - 12 miles
 - round trip running time - peak and off-peak - 50 minutes
 - operating speed - 14.4 miles per hour
- To comply with PATA's adopted policy for service headways, the new route weekday service frequency was tentatively set at 30 minutes in peak and 60 minutes in off-peak periods. Saturday service was set at 60 minutes with no service operated on Sundays. Weekday span of service was 6:00 a.m. to 11:00 p.m. and 9:00 a.m. to 11:00 p.m. on Saturdays. While most of PATA's routes end service at 8:00 p.m., it was felt that since the mall is open to 10:00 p.m., the new route would operate beyond its closing time.

- The final schedules were prepared with a 10 minute layover per trip at the mall. Weekday round trips totalled 23 requiring two buses in peak periods. On Saturday, one bus could operate the planned 16 round trips.

Evaluation Process - With the new route well defined, the projected ridership, revenue, and operating costs were determined:

- Ridership - PATA's Route 10 covers a similar area compared to the proposed new route. Its population density is only slightly greater than that of the new route - - 2,000 persons per square mile compared to 1,800 persons per square mile. Income and auto ownership characteristics are within ten percent of each other and therefore no adjustments due to socioeconomic differences were necessary.

Ridership on Route 10 is 2.5 passengers per mile. Adjusting for the density variation, PATA projected the ridership of the new route to be 2.2 passengers per mile ($1,800 \div 2,000 \times 2.5$). Since the new route will entail about 82,000 miles per year, the projected annual ridership after it reaches its full potential will be 2.2 passengers per mile times 82,000 miles or 180,400 riders.

- Revenue - The new route's potential revenue is determined based on using the systemwide average fare times the ridership projection as follows:

<u>Average Fare</u>	<u>Ridership</u>	<u>Revenue</u>
\$0.38	x 180,400	= \$68,552

- Operating Costs - The costs allocation formula was used to compute the cost of the new route. Input data included the following statistics.

Vehicle Miles	=	82,000
Vehicle Hours	=	5,700
Peak Vehicles	=	2

It was determined that the new route would cost PATA \$143,605. An operating ratio of $\$68,552 \div \$143,605 = 0.48$ was projected for the route which was at system average.

Implementation - Since the operating ratio performance of the new route was acceptable, PATA proceeded to implement the new route following the guidelines set forth in Section IV. The ridership growth curve set forth in Exhibit 6 will be applied to the new route to monitor its performance.

Fare Changes

The PATA manager projected that expenses for next fiscal year will be \$2,350,000, an 11.9 percent increase over the \$2,100,000 budgeted in the current year. With current revenues projected at \$1,000,000, next year's revenues must be \$1,125,000 to maintain a 0.48 operating ratio.

Fare Structure Background - During the last five years, the PATA fare structure remained unchanged. It consists of a flat 45-cent base fare for all routes with senior citizens riding for free in off-peak periods. Students using PATA for transportation to and from school can purchase discount tickets for 30 cents per ride. Passengers are also offered the opportunity to transfer to another PATA route at no charge. A summary of current ridership and revenue at PATA is set forth below:

<u>Ridership Type</u>	<u>Fare</u>	<u>Passengers</u>	<u>Revenue</u>
Full fare -			
Peak	45¢	1,000,000	\$ 450,000
Full fare -			
Off-peak	45¢	1,000,000	450,000
Seniors -			
Off-peak	Free	118,500	40,000*
Students	30¢	200,000	60,000
Transfers	Free	281,500	0
		<u>2,600,000</u>	<u>\$1,000,000</u>

PATA has experienced increases in ridership in each of the past five years. However, while 10 to 15 percent increases occurred in the first three years of this period, the average increase during the past two years has slowed to below five percent. This trend of decreasing ridership gains caused the manager to assume no growth in ridership on existing routes for next year.

* Reimbursed by State.

Fare Change Approach - Following the procedure set forth in Section V, the manager met with the Board and asked them to identify the significance they placed on the six aspects of fare structure criteria identified in Table V-1. The unanimous position of the Board was that fiscal integrity was most important and that ridership loss in any one group should not be excessive. Other factors were identified as relatively minor.

The manager then proceeded to identify an array of discrete fare change actions for PATA following the method set forth in Table V-4. Exhibit 9 describes PATA's discrete action possibilities. For each discrete action the manager calculated the resulting ridership and revenue changes using the fare elasticity factors given on Page V-7 and which are listed below, and the ridership and revenue projection charts set forth on Figures V-1 and V-2, respectively.

Peak ridership	-	e = -0.10 to -0.20
Off-peak ridership	-	e = -0.30 to -0.40
Student ridership	-	e = -0.30 to -0.40

Exhibits 10, 11, and 12 show the impact of discrete fare actions for increasing the peak period adult fare, the off-peak adult fare, and the student fares, respectively. Introducing a transfer charge of five cents was determined to have a minimal effect on ridership and revenue.

Next, the manager grouped the discrete fare change actions into fare structure alternatives. Three alternatives were selected, as set forth in Exhibit 13: A - minimal ridership impact; B - uniform increases; and C - selective increases. Even when additional revenue from the State's senior citizens reimbursement program is included, Alternative C fails to meet the revenue objective of the Board, i.e., total revenue of \$1,125,000 which means the fare increase must generate at least \$125,000 of additional revenue, and it was dropped from further consideration. The remaining alternatives meet the fiscal integrity objective of the Board. Therefore, the manager considered the second criteria of the Board, which was not to overly burden one particular ridership group. Since Alternative B has a major effect on reducing off-peak riders, it too was discarded. Alternative A was judged the best fare structure plan.

Finally, the manager cleared the new fare structure with the Board and proceeded to follow the fare change implementation steps set forth in Table V-9.

EXHIBIT 9

ARRAY OF DISCRETE FARE CHANGE ACTIONS FOR PATA

	Current PATA Fare Structure	Discrete Fare Change Actions		
		Minimum Revenue Impact	Intermediate Revenue Impact	Maximum Revenue Impact
Peak Adult Fare	45¢	+5¢	+10¢	+15¢
Off-Peak Adult Fare	45¢	+5¢	+10¢	+15¢
Transfers	Free	Free	5¢	5¢
Student Fares	30¢	+5¢	+10¢	+15¢

EXHIBIT 10
IMPACT OF DISCRETE ACTIONS

Type of Action: Increase Peak Adult Fare

Elasticity Factor: -0.15

Annual Existing Ridership: 1,000,000

Annual Existing Revenue: \$ 450,000

Existing Fare: 45¢

Discrete Action	Fare Change		Projected Ridership Loss		Projected Revenue Gain	
	Absolute	Percent *	Absolute	Percent	Absolute	Percent
Minimum	+5¢	10.5%	-15,000	1.5%	+\$38,250	8.5%
Intermediate	+10¢	20%	-30,000	3%	+\$72,000	16%
Maximum	+15¢	28.6%	-45,000	4.5%	+\$103,500	23%

General Ridership Class Effected: Workers

* *New fare minus old fare divided by the midpoint between new and old.*

EXHIBIT 11
IMPACT OF DISCRETE ACTIONS

Type of Action: Increase Off-Peak Adult Fare

Elasticity Factor: -0.35

Annual Existing Ridership: 1,000,000

Annual Existing Revenue: \$450,000

Existing Fare: 45¢

Discrete Action	Fare Change		Projected Ridership Loss		Projected Revenue Gain	
	Absolute	Percent *	Absolute	Percent	Absolute	Percent
Minimum	+5¢	10.5%	-40,000	4%	+\$27,000	6%
Intermediate	+10¢	20%	-70,000	7%	+\$47,250	10.5%
Maximum	+15¢	28.6%	-100,000	10%	+\$67,500	15%

General Ridership Class Effected: Non-Workers

* *New fare minus old fare divided by the midpoint between new and old.*

EXHIBIT 12
IMPACT OF DISCRETE ACTIONS

Type of Action: Increase Student Fare

Elasticity Factor: -0.35

Annual Existing Ridership: 200,000

Annual Existing Revenue: \$ 60,000

Existing Fare: 30¢

<u>Discrete Action</u>	<u>Fare Change</u>		<u>Projected Ridership Loss</u>		<u>Projected Revenue Gain</u>	
	<u>Absolute</u>	<u>Percent *</u>	<u>Absolute</u>	<u>Percent</u>	<u>Absolute</u>	<u>Percent</u>
Minimum	+5¢	15%	-10,000	5%	+\$4,800	8%
Intermediate	+10¢	28.5%	-20,000	10%	+\$9,000	15%
Maximum	+15¢	40%	-30,000	15%	+\$12,600	21%

General Ridership Class Effected: Students

** New fare minus old fare divided by the midpoint between new and old.*

EXHIBIT 13

PATA FARE CHANGE ALTERNATIVES

	Alternative A Minimal Ridership Impact			Alternative B Uniform Increases			Alternative C Selective Increases		
	<u>Fare</u>	<u>Ridership Change</u>	<u>Revenue Change*</u>	<u>Fare</u>	<u>Ridership Change</u>	<u>Revenue Change*</u>	<u>Fare</u>	<u>Ridership Change</u>	<u>Revenue Change*</u>
Peak Period Adult	+15¢	-45,000	+\$103,500	+10¢	-30,000	+\$ 72,000	+10¢	-30,000	+\$ 72,000
Off-Peak Adult	+5¢	-40,000	+\$ 27,000	+10¢	-70,000	+\$ 47,250	+5¢	-40,000	+\$ 27,000
Student Fares	+5¢	-10,000	+\$ 4,800	+10¢	-20,000	+\$ 9,000	+15¢	-30,000	+\$ 12,600
TOTAL IMPACT		-95,000	+\$135,300		-120,000	+\$128,250		-100,000	+\$111,600

* Excludes additional revenue from State for senior citizens reimbursement of about \$5,000.

SECTION I:
SYSTEM OBJECTIVES

CONTENTS

SECTION I - SYSTEM OBJECTIVES

	<u>Page</u>
Definitions	I- 1
Survey Results	I- 3
Transit Objectives Categories	I- 6
Listing of Objectives	I- 7
Adopting System Objectives	I- 7
Example Scenario of Objective Selection	I- 9
Appendix I-A: Transit System Objectives Survey Results	
Appendix I-B: Mass Transit Goals and Objectives Selected Pennsylvania Systems	
Appendix I-C: Comparison of Pennsylvania and Nationwide System Objectives	
Bibliography: Transit Service Standards Objectives, Evaluation Criteria	

LIST OF TABLES

<u>Table No.</u>		<u>Following Page</u>
I-1	System Objectives by Category - System Efficiency	I- 7
I-2	System Objectives by Category - System Effectiveness	I- 7

SECTION I - SYSTEM OBJECTIVES

LIST OF TABLES (Continued)

<u>Table No.</u>		<u>Following Page</u>
I-3	System Objectives By Category - System Utilization	I- 7
I- 4	System Objectives by Category - Fare Policy	I- 7
I- 5	System Objectives by Category - Management	I- 7
I- 6	System Objectives by Category - Marketing	I- 7

SECTION I

SYSTEM OBJECTIVES

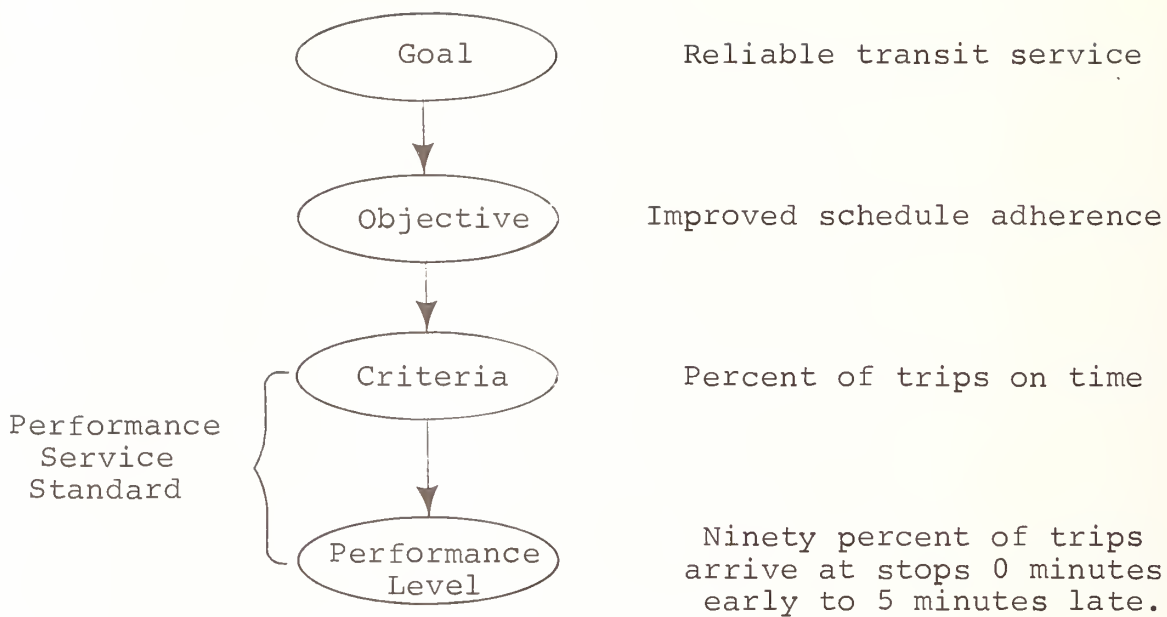
The formulation of goals and a set of specific objectives is critical to the successful development of any organization, whether it is public or private. In broad terms, goals define the basic direction of the organization and objectives are mileposts by which progress toward these goals is measured. Without these, whatever policies are devised are often ineffective due to the lack of purpose or direction which goals and objectives could provide. Vague, overly general goals and objectives fail to provide a basis for sound, effective decision making. On the other hand, overly specific and rigid goals and objectives can be unrealistic and unresponsive to changing conditions.

Frequently the goals and objectives developed by public transit agencies fall into the vague and general category. A common example is "to improve public transportation," or a variation - - commendable but too vague to be meaningful to the public or useful to management in judging the effectiveness of their efforts. It is also apparent that in order to be useful, objectives should be followed up by some means to measure the effectiveness of the system in meeting the objectives. The measurements, or criteria, must be directly related to their objectives. Frequently in the past, performance measurements were shown in transit literature as standards, and quoted as "good" performance, with no consideration of the variability of objectives among different systems.

Definitions

It is useful to define goals and objectives and then relate them to criteria and performance levels. The following flow chart illustrates the relationship and ranking of these concepts.

Example



A goal describes the highest level of development and achievement that an individual or organization hopes to reach. As such, goals should present a clear challenge to transit managers to develop creative, imaginative, and effective approaches to solving the problems of providing high quality, efficient transit service. By so doing, transit managers can set a high standard of performance for themselves and their systems. Goals provide a clear sense of direction to management in terms of basic system priorities. In addition, goals provide a basis of comparison for what a transit system is at present and what it should be in the future. Thus, goals are long range in nature.

Where goals describe an ideal state of development, objectives represent a more attainable and measurable set of conditions. Objectives measure progress in attaining a goal over a shorter range of time. Goals are not useful without definite specific objectives which are more concrete and provide for possible measurement and evaluation.

Not only do objectives aid transit managers in running their system, they also help political leaders in evaluating the development of the transit system, and in determining the allocation of resources necessary for the transit system to achieve its goals. Stating objectives can help the political leader in clarifying the role of the transit system, and in establishing priorities for its efforts.

Criteria and performance levels follow from objectives. Criteria are measurable characteristics which are directly related to the objectives, and provide the means of quantifying them. Specific performance levels can be set for the criteria, with existing system conditions measured, and progress monitored. This process will be discussed in subsequent chapters.

There is frequently a fine line between objectives and criteria. For the most part, objectives are policy statements that point to an intention, while criteria are measurable quantities.

Survey Results

To determine the degree to which transit managers currently develop and depend upon goals and objectives, a survey of Pennsylvania transit systems was conducted. Eleven systems were contacted representing a wide range of sizes and types. Detailed answers to survey questions can be found in Appendix I-A to this manual. The major results of the survey can be summarized in five points:

- Most systems do not have a formalized set of stated objectives that have been specifically adopted or utilized as guidelines for system operations. Some do have objectives mentioned in planning documents (TDP, TSM).
- Most objectives as stated in system transit development programs are shorter term (five years).
- Most systems do not specifically measure results of operations against system objectives.
- While outside agencies periodically review data generated by the transit system, it is usually in relation to finances, grants, and subsidies rather than to system objectives.
- The majority questioned believe that system objectives are or would be worthwhile and helpful if they were utilized properly and were not too general in nature.

An examination of the goals, objectives, and criteria stated or used by Pennsylvania operators shows a diversity of detail, scope, and format. The exact nature of presentation is not important, as the critical element is the process of

objective formulation, and then measurement. A summary of the goals and objectives of the Pennsylvania transit properties surveyed is contained in Appendix I-B. The following two formats are examples of how the objectives are stated in different properties. In both cases, a good use of specific objectives is shown.

Example 1

<u>Objective Area</u>	<u>Performance Level</u>
Ridership	5,500,000 passenger trips per year
Efficiency	Operating cost/passenger less than 55 cents (1978 constant dollars)
Service Quality	Excellent/good ratings by 90 percent of patrons

Example 2

Short-Term Priorities (Increase Efficiency)

<u>Goals</u>	<u>Objectives</u>
1. Reduce operating costs while maintaining present service.	A. Reduce scheduled service on inefficient routes and eliminate duplicated service. B. Reduce or eliminate service to areas with low patronage. C. Improve maintenance facilities to increase efficiency. D. Replace worn-out equipment.

Long-Range Priorities (Increase Revenue)

<u>Goals</u>	<u>Objectives</u>
1. Improve service to attract new riders.	A. Increase scheduled service on specific routes. B. Expand service to provide evening and/or Sunday service.

Long-Range Priorities (Increase Revenue)

(Continued)

Objectives

(Continued)

- C. Improve marketing and increase comfort and convenience.
- D. Extend existing routes or add new routes to areas not presently served by transit.

An analysis of selected transit systems throughout the United States was also made to determine whether the Pennsylvania systems were unique in their frequent lack of clear, formalized objectives. The results, detailed in Appendix I-C, show that nationally, most properties have the same difficulties as those in Pennsylvania. Although there were exceptions, the objective topics, formalization process, and vagueness were about the same both within the Commonwealth and nationwide. This illustrates the need for emphasis on a well-defined goals and objectives setting process throughout the transit industry.

The American Public Transit Association (APTA) has addressed the issue of objective setting recently, through a call for a National Performance Program.* They emphasize that objectives and subsequent performance measures should be used for internal management, and not to externally judge the system as a basis for grant funding. Also, they point out that a consensus on what constitutes "good service" is missing.

APTA has stressed that a performance management system must be tailored to each situation to be most useful. The setting of goals and objectives provides in part this management system, as the progress toward meeting the objectives gives a basis for estimating progress and success within the constraints of the particular property.

* "Revised Policy Statement, Transit Performance," submitted to the Board of Directors, American Public Transit Association, February 17, 1979.

Transit Objective Categories

To begin structuring the performance system, objective categories should be defined to be used when organizing the objectives. The groupings below use some aspects of the earlier APTA works, but contain a larger number of categories. The objective categories for this manual are:

- System efficiency,
- System effectiveness,
- System utilization,
- Fare policy,
- Management, and
- Marketing.

A discussion of how these transit objective categories are defined is useful.

<u>System Efficiency:</u>	the amount of resources used to produce some unit of output. Examples include comparisons such as the number of mechanics used to maintain the bus fleet, or the number of buses needed to provide a given level of service.
<u>System Effectiveness:</u>	concerns relative measures of the quality of service provided to riders. Examples are vehicle cleanliness and on-time performance.
<u>System Utilization:</u>	the degree to which the public consumes the transit services offered. Examples include rides per capita, and passengers per vehicle mile.
<u>Fare Policy:</u>	the pricing of the transit services provided. Examples are methods to increase system revenue, and fares to encourage identified groups to use transit.
<u>Management:</u>	includes administrative policies affecting efficiency, effectiveness, and utilization. Examples are budgeting controls, and coordination with outside agencies.

Marketing:

includes promotion and informational services provided to the community affecting efficiency, effectiveness, and utilization of the system. Examples are establishment of a usable marketing program, and public information aids available.

Many objectives can fall into two or more of these categories, and classification is somewhat subjective. The categories are differentiated primarily for convenience of understanding. It is possible for objectives to be conflicting, and in that case, priorities must be set. Minimum levels of acceptable performance must also be established for the less important ones.

Listing of Objectives

Tables I-1 through I-6 are listings of possible system objectives classified by the six categories discussed earlier. This list is purposely comprehensive, and represents a "shopping list" approach from which individual systems may select the objectives most appropriate to their system and goals. This allows the tailoring of performance measurement to the individual system, as recommended by APTA.

A great many variables will affect the performance levels of a system, including system size, type of community, and of course funding levels. These will be taken into account when setting performance levels for the objectives as outlined in the subsequent sections.

Adopting System Objectives

The objectives and their corresponding criteria and performance levels should be formalized through adoption by the transit agency governing board. The setting of these objectives accomplishes several purposes:

- The manager can make decisions throughout the year that are consistent with the objectives, with the knowledge that he is "headed in the right direction";
- A measure of system "success" is set at the beginning of the year, and both progress toward the indicated performance levels and ultimate attainment can be judged. As such, they form the basis for an internal evaluation process; and

TABLE I-1
SYSTEM OBJECTIVES BY CATEGORY

I. SYSTEM EFFICIENCY

<u>Topic Area</u>	<u>Objective</u>
Operating Ratio (Revenue ÷ Cost)	Stabilize system operating ratios. All routes at least at minimum level.
Adjust Service to Financial Resources Availability	Minimize cost increases.
Control of Overhead Expenses	Control administrative and managerial personnel requirements.
Duplication of Service	Reduce and eliminate where possible unnecessarily duplicative or overlapping service.
Efficient Energy Utilization	Efficiently use energy at fixed facilities. Improve mileage use of operating fuels and lubricants in vehicles.
Increased Labor Productivity	Maximize productivity of labor force: drivers, mechanics, others.
Improve Vehicle Utilization	Increase availability and productivity of revenue vehicles.
Equipment Replacement/Buses	Establish cost-effective bus replacement schedule.
Service Vehicles	Establish a cost-effective service vehicle replacement program.
Optional Equipment	Provide communications equipment.

TABLE I-2

SYSTEM OBJECTIVES BY CATEGORY

II. SYSTEM EFFECTIVENESS

<u>Topic Area</u>	<u>Objective</u>
Accident Control	Minimize vehicle, passenger and employee accidents.
Vehicle Appearance	Maintain good vehicle cleanliness and appearance.
Schedule Adherence	Improve on-time performance.
Employee Courtesy and Appearance	Employees at all levels courteous, responsive, and neat.
Coordination with other Public Transportation Modes	Assure coordination with other transit modes and operators in the service area to maximize passenger convenience.
Equipment Dependability	Minimize vehicle breakdown and missed trips.
Overloads	Stay within load standards.
Minimum Provision of Service	Set headways on ridership, with policy headways as minimums.
Night/Weekend/Holiday Service	Provide service on at least policy headways, and to areas with major needs.
Transfer Policy (Route Layout)	Minimize transfers.
Passenger Amenities (shelters, waiting areas, etc.)	Provide passenger amenities at major transfer and generator points.
Express Service	Effective implementation of express services.
Special Purpose Routes (shoppers, etc.)	Effective implementation of special purpose routes.
Service Area Coverage	Provide coverage of service area, within financing available.
New Service Provision	Provide new services to priority areas/groups based on analysis and established policies.
Social Service Oriented	Provide accessible transportation to special groups.

TABLE I-3

SYSTEM OBJECTIVES BY CATEGORY

III. SYSTEM UTILIZATION

<u>Topic Area</u>	<u>Objective</u>
System Usage	Minimize cost per rider.
System Usage	Minimize subsidy per rider.
System Usage	Maximize annual rides per capita.
System Usage	Maximize revenue passengers per vehicle mile or vehicle hour.
System Ridership	Increase ridership systemwide within existing level of service.

TABLE I-4

SYSTEM OBJECTIVES BY CATEGORY

IV. FARE POLICY

<u>Topic Area</u>	<u>Objective</u>
Fares	The fare policy should encourage ridership from selected groups such as: - choice riders - off-peak riders - senior citizens - handicapped citizens
Fares	Equitable fares throughout system by: - time of day - type of service - distance traveled
Revenue Generation	Generate sufficient revenues to maintain financial stability of system.
Revenue Generation	Make fare adjustments based on cost escalation.

SYSTEM OBJECTIVES BY CATEGORY

V. MANAGEMENT

<u>Topic Area</u>	<u>Objective</u>
Periodic Financial and Non-Financial Statements	Provide financial and operating statistics on a regular basis.
Budgetary Controls	Monitor and control department budgets.
Training and Upgrading of Employees	Establish and maintain employee evaluation and training programs.
Affirmative Action	Establish and maintain an effective affirmative action employment and training program.
Citizen Involvement in Planning Process	Solicit, establish and use effective citizen involvement in planning where appropriate.
Improve Communications with other Involved Agencies	Coordinated planning and/or goals in common areas and delineate responsibilities.
Capital and Operations Planning	Provide a realistic written plan covering a one and two-five year period with goals, objectives, priorities and implementation plans.
Service Coordination with Employer Oriented Services	Assure maximum coordination and assistance to employer oriented bus pools, van pools, and car pool programs within available resources and responsibilities.
Maintenance Facilities	Maintain existing maintenance facilities. Improve and modernize facilities and equipment as funds permit.
Fare Collection Equipment and Procedures	Move toward modern equipment and procedures to provide more secure revenue handling and accurate revenue and passenger data.
Citizen Comments	Be responsive to valid citizen comments.
Contingency Planning	Establish contingency plans for emergency situations: - weather - gasoline shortage - community emergencies

TABLE I-6
SYSTEM OBJECTIVES BY CATEGORY

VI. MARKETING

Marketing	Maintain appropriate level of marketing effort.
Marketing	Provide a written program showing marketing objectives and an implementation plan for current year, and short-range time period.
Public Information	Provide efficient public information by a variety of means, including printed and telephone information, and bus stop signs.
Public Awareness	Improve awareness and image of transit system through marketing.

- The trade-offs between objectives, particularly ones regarding funds and service provision, can be easily shown to the policy makers.

The key aspect of the adoption process is an awareness by the policy makers of the impact of their objectives on system operations. A clearly defined set of objectives and performance levels can make the interaction process clearer. Also, discussing the range of objectives together is much more effective than addressing them separately throughout the year as problems or issues arise.

How the adoption process is accomplished should be dictated by the personalities on the governing board, relationship to the staff, and the institutional structure of the area. It is valuable for the board to have an opportunity to become involved in the formulation process, without being overcome with details and alternatives. This involvement gives the policy makers a much better understanding of the interaction between objectives and makes their subsequent endorsement much more meaningful.

The objective and performance level formulation process can probably best be accomplished in several work sessions, rather than at one time. The process could include the following steps:

- In the first session, the range of objectives is presented as in Tables I-1 through I-6 of this manual. They are explained to the board, and the trade-offs and interaction generally outlined. Board thoughts and reactions on the priority of each major objective are noted.
- The manager then puts together a draft list of objectives based on the board session and shows appropriate criteria and recommended performance levels.
- A second work session is for the board to review the draft objectives and discuss performance levels. The process for reporting on the progress toward various performance levels is another important discussion topic.
- The objectives and performance are refined by the manager, and a finalized document prepared.

- The final objectives report is presented at a board meeting for formal adoption, along with the timetable/schedule for reports on progress.

Citizen involvement in this process depends on the local situation. If there is a working advisory committee, they might be useful in the initial formulation stages. However, this type of document is generally internally-operation oriented, and the governing board is already representing citizen views and balancing them against other aspects. Therefore, direct citizen input is not usually recommended. A public hearing on the document before final adoption, perhaps at a board meeting might again be valuable, based on the local situation.

The subject of board/citizen involvement in the transit management process is one that currently is receiving a great deal of attention. A number of references are shown in the bibliography concerning this topic. APTA also has a seminar course, "Policy Guidance for Public Transportation Decision Makers," primarily aimed at new board members. The seminar discusses transportation system operations, decision making, and the role of the policy makers, and can be very valuable in bringing members up to date on the issues and responsibilities they face.

Example Scenario of Objective Selection

An example is useful to point out key aspects of this process.

The General Manager of a 50 bus system in a medium-sized Pennsylvania city feels that the system needs a set of objectives to guide their efforts. The system is governed by a five-member board, with two citizens and three elected officials from the City Council, including the Mayor. Public funding has been increasing at about the same rate as inflation, and the attitude of the Board has been against new services. The Mayor also feels that clean buses are very important to the City's image. Since this is the first time that realistic goals and objectives have been used, the General Manager decides to keep the list short.

He decides that to relieve potential funding problems, he will establish his primary goal as getting better use of his existing resources. Another basic goal will be to improve the system image. His last goal is to find ways to bring service into several new areas of the City that have been requesting it.

Based on these goals, a sample set of system objectives would be:

Efficiency

- Increase the system operating ratio.
(It is currently at 0.47).
- Control hiring of new personnel.
- Increase productivity of mechanics.
- Increase productivity of revenue vehicles.

Effectiveness

- Reduce accidents. (The current accident rate is higher than the industry's average.)
- Improve and maintain vehicle cleanliness and appearance.
- Increase the number of passenger shelters.
- Limited new service in areas with strong justification. (A sub-objective will be to formulate the standards for putting in new service, and a rational analysis procedure.)

Utilization

- Increase ridership.

Fare Policy

- Maintain present fare structure. (No fare changes are expected this year.)

Managerial

- Provide financial and operating statements to allow close monitoring of progress.
- Training and upgrading of employees.
(Directly related to labor productivity.)
- Citizen involvement in planning process.
(More citizen involvement helps public image, provide valuable feedback and information.)

Marketing

- Write a marketing plan and establish marketing objectives. (No plan is now available.)

The General Manager would then go into Section II of this manual and establish criteria and anticipated performance levels. He could then present the entire package to the Board, indicating that the objectives and corresponding performance levels would be the primary system focus throughout the year. The Board would then use this list as a basis for discussion, refining them as needed. In this way, the measures of system success are set early in the year, and an ongoing evaluation process to monitor performance and keep the Board informed can be established.



APPENDIX I-A

TRANSIT SYSTEM OBJECTIVES
SURVEY RESULTS

TRANSIT SYSTEM OBJECTIVES

CONSOLIDATION OF TELEPHONE QUESTIONNAIRE ANSWERS *

The following are full names, for the system abbreviations used in the table.

<u>AGENCY</u>	<u>NAME</u>	<u>SERVICE AREA</u>
RRTA	Lancaster City and County Joint Transit Authority	Reading
AMTRAN	Altoona Metro Transit	Altoona
CAT	Cumberland, Dauphin, Harrisburg Transit Authority	Harrisburg
LCTA	Luzerne County Transportation Authority	Wilkes-Barre
PAT	Port Authority of Allegheny County	Pittsburgh
SEPTA	Southeastern Pennsylvania Transportation Authority	Philadelphia
WBT	Williamsport Bureau of Transportation	Williamsport
YATA	York Area Transit Authority	York
NCATA	New Castle Area Transit Authority	New Castle
POTTS	Pottstown Transit Company	Pottstown
CATA	Centre Area Transportation Authority	State College

*Lehigh and Northhampton Transportation Authority (LANTA) and Berks Area Reading Transportation Authority (BARTA) provided written responses and are excluded from the consolidated summary.



TRANSIT SYSTEM OBJECTIVES:

CONSOLIDATION OF TELEPHONE QUESTIONNAIRE ANSWERS

Questions

No.	Text	RRTA	AMTRAN	CAT	LCIA	PAT	SEPTA	WBT	YATA	NCATA	POTS	CATA
1	Does your transit system have a formalized set of objectives to guide system operations?	Yes, but only as part of Jan., 1976 TDP.	No, except as part of Feb., 1976 TDP.	Yes, but only as part of Sept., 1978 TSM.	Not formalized, only as part of Jan., 1979 TDP.	Yes, but only informal and generally standards based on past experience.	None approved by Board. Draft of strategic planning study being reviewed. Includes objectives.	Yes, copy promised, also part of 1978 TDP.	Yes, but only as part of 1977 TDP.	Not at present, recently completed study will include them.	No, only City Capital Improv. Plan and PennDOT subsidy program.	Yes, but only as part of Jan. 1979 TDP.
2	Are they long term or short term objectives?	Short-term.	Long- and short-term.	Long- and short-term.	Short-term.	Not specified.	Long- and short-term.	Short-term.	Short-term.	Probably short-term.	Not applicable.	Short-term.
3	Identify the most important areas of concern when formulating system objectives or representing the (list in order of importance who sets up priorities/ weighting factors - what are your own?)	No attempt made to follow those in TDP. No priorities or comments on importance.	Route network and schedules; preventive maintenance program; more marketing; increase rider-ship and revenue.	Energy utilization; better equipment use in peak periods and financial constraints.	High standards for all system functions; expand service; improve quality of service and area coverage.	Maintain or improve quality and quantity of service and improving productivity and efficiency.	Designates eight areas as important priorities; depend on specific situations.	Financial support; proper scheduling, improving or maintaining best level of service.	Construction of facilities and additional route extensions.	Vehicle utilization; extension and deletion of service and additional financial support.	Security of passengers; frequency and span of service; attraction of auto users and obtaining new buses, meeting needs, reliable, quality service and citizen participation.	Most effective service at lowest net dollar outlay; vice; attraction of amount and type of service to best.
4	How are these objectives determined or finalized?	None developed.	Group action management, County and consultant.	Consultant, Tri-County Planners, System Executive and Planner.	Executive Director, staff and consultant. Board approval.	Primarily by Director of Rates and Service plus the Schedule Department.	Primarily by Manager of Strategic Planning.	Group Action Executive Director, City Finance Director and consultant.	By Executive Director and staff, then to board for approval.	By Executive Director, his staff and consultant.	Not applicable.	Top management, employees, consultant and board.

TRANSIT SYSTEM OBJECTIVES:
CONSOLIDATION OF TELEPHONE QUESTIONNAIRE ANSWERS
(Continued)

No.	Questions Text	RRTA	AMTRAN	CAT	LCIA	PAT	SEPTA	WBT	YAIA	NCAIA	POTTS	CATA
5.	By whom are objectives reviewed, revised or updated and how frequently?	TDP approved by board. First update planned for Fall, 1979.	Management planners and board semi-annually.	By Executive Director and staff semi-annually.	Not done at present. An additional year added to TDP annually.	Director of Rates and Service and staff semi-annually.	Not done at present, but eventually by management and board annually.	By County Planners, Executive Director, City Finance Director and consultant annually.	York County and Metropolitan Planners; and area System Manager-vision next year.	Probably by County, City and area transit authority.	Not applicable.	Executive Director with recommendations to board for final action annually.
6.	What impact do stated objectives have as guidelines for daily management actions and decisions?	Minimal impact.	Strong impact.	Strong impact.	Some impact.	Strong impact.	Strong impact if adopted.	Different impacts based on individual objectives.	Strong impact.	Probably minimal impact.	Not applicable.	Strong impact.
7.	How often are system objectives referred to in day-to-day decision-making activities of management?	Seldom	Quite often.	Quite often.	Sometimes.	Sometimes.	Quite often hopefully if adopted.	Quite often.	Sometimes.	Probably on occasion at board meetings.	Not applicable.	Sometimes at present. Hopefully more often in future.
8.	How are they applied or utilized, and by whom in making managerial decisions (explain)?	Not used at present, but Executive Director and his staff would use and apply them.	Not in a formal way. Measured by use of operating statistics.	Discussed at staff meetings. Carried out by department heads and Executive Director.	Impact of major decisions on objectives analyzed prior to action.	By Director of Rates and Schedules and staff.	Planned for utilization by key management staff.	By Executive Director in light of other constraints and considerations.	By use of monthly statistical and financial reports and prior year comparisons.	Not at present, probably by Executive Director and staff with board approval.	None at present. City Manager's office would make final decisions.	Would be by Executive Director and staff with board approval in some areas.

TRANSIT SYSTEM OBJECTIVES:

CONSOLIDATION OF TELEPHONE QUESTIONNAIRE ANSWERS

(Continued)

Questions													
No.	Text	RR1A	AMTRAN	CAJ	LC1A	PAJ	SEPTA	WBT	YATA	NCATA	PORTS	CATA	
9.	How is it determined if objectives are being met and to what degree (explain)?	No measure used at present.	Not directly done, but corrective action taken if possible.	Monthly statistics and financial results are utilized.	Annually a report will be made on each objective.	Periodic financial and statistical reports and checker's reports, technique if adopted.	Will be by annual review and performance scaling technique if adopted.	Monthly statistical and financial reports utilized.	By study and use of monthly operating data.	Presently daily reports and monthly summaries used as tool for decision making.	Not applicable.	Refers now to monthly and quarterly statistical and financial data.	
10.	How often are operating results measured against system objectives?	Not measured at all at present.	Semi-annually.	Monthly	Monthly statistical and financial with annual review.	Semi-annually but actually an ongoing function.	Will depend on subject, critical nature, and reporting system.	Not measured now. Some reviewed monthly, most adjusted annually.	Annually.	Not measured at present.	Only measures at present are monthly statistical and financial reports and data to State.	Data recorded monthly and evaluated quarterly.	
11.	Do any organizations outside the system evaluate operating results against stated objectives?	County Planning Commission reviews data submitted but not in contrast to objectives.	County Planning Commission annually reviews entire TSM program.	No system evaluation made annually by PennDOT, primarily financial.	PennDOT, Counties and communities cooperate on projects not objectives specifically.	No, but PennDOT and Regional Planners make financial and performance analyses.	Not known specifically, but probably all funding agencies.	No, not directly. County Planners make comments on operating results.	York County Planning Commission will review data in mid 1979 for first time.	Lawrence County Planners and PennDOT review data submitted but not on objectives.	Only the County. County supplies local share of funding.	Area Regional Planning Commission and PennDOT get grant data.	
12.	How are the evaluations or comments utilized by management?	Comments discussed with Executive Director who advises board.	System management and planners work together informally.	Not applicable. System is its own peer.	Not applicable. (First Year)	Planning Commission reviewed and evaluated.	Not now utilized but probably reviewed by management.	By the Executive Director.	Not applicable. No evaluations made yet.	Not applicable. No evaluation made.	Comments of public and private groups are reviewed.	Comments are reviewed by Executive Director and discussed with agency or board.	

TRANSIT SYSTEM OBJECTIVES:

CONSOLIDATION OF TELEPHONE QUESTIONNAIRE ANSWERS

(Continued)

Questions													
No.	Text	RRTA	AMTRAN	CAT	LCTA	PAT	SEPTA	WBT	YATA	NCATA	POTTS	CATA	
13.	What is your opinion of the value of stated objectives?	Minimal.	They are a good thing and can be better utilized.	Depends on who sets up objectives. Actual operating experience needed.	They are a very good idea. Should include general and technical bases.	They are a necessity and can be a good management tool.	Believe they are worthwhile detailed with adequate performance measures.	Very helpful due to impact on annual transit plan.	A useful guide, more so with individual not general objectives.	They would be helpful to system in providing better service.	Not too important for bus system itself, perhaps to overall program.	They are very important and should be used realistically as guidelines.	
Comments:		Glad to cooperate in reviewing comments of other systems. Volunteer for demonstration.	Manual showing possible objectives would be beneficial.	Would like to see listing of potential objectives related to operations.	Would be glad to cooperate in a review of potential objectives.	Listing of potential objectives, primarily service oriented would be reviewed.	Objectives should be part of total management process.	Would like to know other area objectives and how they are used.	Present manuals and procedures adequate for system.	A listing of potential objectives would be helpful.	Would like to review potential objectives for possible use.	Would like to see what other systems use. Does not want funding tied to performance.	

APPENDIX I-B

MASS TRANSIT GOALS AND OBJECTIVES
SELECTED PENNSYLVANIA SYSTEMS

MASS TRANSIT GOALS AND OBJECTIVES
SELECTED PENNSYLVANIA SYSTEMS

I. System Efficiency

- Reduce scheduled service on inefficient routes (lower patronage).
- Eliminate duplicate service.
- Review schedules periodically to determine if allotted running times are excessive or inadequate.
- Increase energy efficiency of operations (fuel, heat, electricity).

II. System Effectiveness

- Promote schedule adherence by operators.
- Promote high standards of vehicle and shelter cleanliness and operator neatness.
- Establish fare collection and transfer system arrangements that minimize delays but produce adequate security.
- Replace worn out equipment (Capital Improvement Programs) - provide comfortable and convenient waiting areas.
- Provide park-and-ride lots if required.
- Provide express service if warranted.
- Provide service with vehicles of adequate size, design, and features based on need.
- Insist on prompt and courteous behavior to patrons and public by all employees.
- Set up a program of regular inspections and maintenance of all vehicles to reduce road calls.

- Develop routes and schedules to coordinate with other modes of travel where possible.
- Provide transportation service to disadvantaged (elderly, handicapped, young, etc.).
- Provide attractive alternative to the automobile.
- Provide access to major passenger generators and adjust if monitoring dictates.
- Institute programs to reduce the number of passenger and vehicle accidents.
- Offer a full range of public transportation service to the extent feasible by planning and financial commitments.
- Establish vehicle headways that minimize recurring overloads or bunching of vehicles.
- Provide direct routings or through routings of buses to improve origins and destinations on travel times and avoid transfers.

III. System Utilization

- Ridership up by approximately 7.1 percent per year.
- Continue to increase transit patronage at a rate of no less than 10 percent per annum.
- Maintain a route average of at least 25 passengers per vehicle per hour.

IV. Fare Policy

- Revise fare structure to make cost of transit more competitive with other modes of travel for both occasional and regular riders.

V. Managerial

- Promote efficient use, audit, and control of revenues and public funds.
- Prepare periodic statistical and financial statements and set up review procedures to evaluate results on a continuing basis.

- Institute continuing training programs for employees and provide promotion opportunities to best utilize experience.
- Monitor hiring procedures and performance of all employees to ensure that total is not excessive and that they are utilized effectively.
- Increase citizen participation in transit planning.
- Have a working relationship with federal, state, county, city, and private groups or agencies.
- Have short- and long-range planning programs with controlled implementation schedule.
- Set up stable and responsive organization with well-defined control, management and review responsibilities.
- Improve maintenance facilities.
- Coordinate service with van pools, subscription bus service, and car pools utilized by employers.
- Minimize deficits.
- Indicate revenue/cost recovery percentages regularly to help monitor financial performance.

VI. Marketing

- Maximize public information efforts to include all media and public agencies and improve transit image.
- Provide schedules and notices that are clear, easy to understand, and include route maps, and are readily accessible on buses and major generator or loading locations.
- Identify bus stops and provide signs that include route and/or schedule data.
- Improve marketing programs.

APPENDIX I-C

COMPARISON OF PENNSYLVANIA AND NATIONWIDE
SYSTEM OBJECTIVES

SURVEY OF
NATIONAL AND PENNSYLVANIA
OBJECTIVES
(JUNE 1979)

National

Improve the quality of the urban environment through the utilization of technologically advanced equipment and implementation of rational transportation/land use strategies.

Provide evening and Sunday service.

Shelters at major transfer points.

Provide transit service such that facilities and their operations do not have adverse effects on neighborhoods.

Provide transit service to major employment centers.

The transit system should have aesthetically pleasing vehicles and facilities.

Implement an ongoing citizen participation program to establish and monitor service needs.

Pennsylvania

Replace worn-out equipment (Capital Improvement Program). Provide comfortable and convenient waiting areas or shelters.

Review service routings to ensure adequate area coverage.

Institute programs to reduce number of passenger and vehicle accidents.

Promote high standards of vehicle and shelter cleanliness and operator neatness.

Insist on prompt and courteous behavior to patrons and public by all employees.

Establish vehicle headways that minimize recurring overloads or bunching of vehicles.

Provide park-and-ride lots, if required.

NOTE: A one to one comparison of objectives is not intended.

National

Insure that all residents, regardless of race, color or national origin, receive the benefits of improved scheduling, routing and quality of vehicles.

Provide maximum safety and convenience.

Improve weekend services, particularly to recreational facilities.

Pennsylvania

Promote schedule adherence by operators.

Provide express service, if warranted.

Provide transit service to transportation disadvantaged (elderly, handicapped, young, etc.).

Improve transit accessibility to social service and recreation facilities.

Provide direct routing or through routing of buses to improve origin/destination travel times and avoid transfers.

Provide services with vehicles of adequate size, design and features based on need.

Provide schedules and notices that are clear, easy to understand, include route maps, and are readily accessible on buses and major generators or loading locations.

Provide attractive alternative to the automobile.

Provide access to major passenger generators and adjust if monitoring dictates.

National

Provide subsidy to support transit other than through further taxation.

Develop a cost-sharing arrangement with suburban areas served by transit.

Fares should be comparable with that of the operating costs of an automobile.

Develop a financial structure which will provide service at the lowest possible consumer costs.

Ten percent reduction in per-passenger cost.

Aggressively seek out all possible government programs to aid transit.

Provide transit service with a minimum of public subsidy.

Pennsylvania

Revise fare structure to make cost of transit more competitive with other modes of travel for both occasional and regular riders.

Promote efficient use, audit and control of revenues and public funds.

Monitor hiring procedures and performance of all employees to ensure that total is not excessive and that they are utilized effectively.

Tailor services to reflect reasonable balance between amount and quality of service provided to anticipated financial resources.

Offer full range of public transportation services to the extent feasible by planning and financial commitments.

Prepare periodic statistical and financial statements and set up review procedures to evaluate results on a continuing basis.

Indicate revenue/cost recovery percentages regularly to help monitor financial performance.

Minimize deficits.

National

Coordinate an improved transit system with the special transportation activities of social service agencies and programs.

Implement a program of efficient fuel utilization.

Establish alternative courses of action to provide service in the event of fuel shortages or other economic dislocations.

Bus routes should be spaced so that all residences are within four blocks of a route.

Provide transit access to all residential areas where density is greater than four dwelling units per acre.

Enhance the attractiveness of transit use by minimizing the need for transfer, including opportunities for "one seat" trips.

Provide transit service in order to increase basic transportation capacity in corridors where major highways are now or will be (1990) operating at over-capacity levels.

Establish a continuing five-year capital improvement program.

Pennsylvania

Reduce scheduled service on inefficient routes (low patronage).

Eliminate duplicate service.

Improve marketing programs to try to attract automobile users.

Expand service to areas with high patronage or rider potential, possibly night or Sunday service.

Develop routes and schedules to coordinate with other modes of travel where possible.

Set up and follow preventive maintenance programs to reduce road calls.

Establish fare collection and transfer arrangements that minimize delays but provide adequate security.

Adjust frequency of service during peak and off-peak periods to reflect demand based on adequate passenger counts.

Improve maintenance facilities.

Maximize effective public information efforts to include all media and public agencies and improve transit image.

National

Service shall be so designed that at least 75 percent of all trips may be made without a transfer.

Maintain a reasonable level of vehicular movement through heavily traveled corridors by coordinating a program of traffic control and improved transit service.

Pennsylvania

Identify bus stops and provide signs that include route and/or schedule data.

Have short- and long-term planning programs with controlled implementation schedule.

Coordinate service with van pools, subscription bus service, car pools utilized by employers.

Institute continuing training programs for employees and provide promotion opportunities to best utilize experience.

Increase energy efficiency of operations (fuel usage, heat, electricity).

BIBLIOGRAPHY

TRANSIT SERVICE STANDARDS
OBJECTIVES, EVALUATION CRITERIA



BIBLIOGRAPHY: TRANSIT SERVICE STANDARDS
OBJECTIVES, EVALUATION CRITERIA

- Allen, William G., Jr., and Dicesare, Frank., "Transit Service Evaluation, an Introduction and Preliminary Identification of Variables Characterizing Level of Service." Prepared for presentation at the 55th Annual Meeting of the Transportation Research Board, Washington, D.C., January, 1976.
- Alter, Colin H., "Evaluation of Public Transit Services: the Level-of-Service Concept." Transportation Research Record, No. 606, 1976, Pages 37-40.
- Babcock, Henry A., "Desirable Standards for Transit Facilities and Services." Transportation and Metropolitan Planning, California Chapter of the American Institute of Planners, University Extension, University of California, 1956, Pages 44-58.
- Botzow, Hermann, "Level-of-Service Concept for Evaluating Public Transport." Transportation Research Record, No. 519, Public Transportation Planning Issues, 1974, Pages 73-84.
- Buckley, Richard L., and Ward, Peter E., "Service Standards and Operating Criteria in Nashville, Tennessee." Transit Journal, Summer, 1978, Pages 41-46.
- California Department of Transportation. UMTA Technical Study Grant CA-09-8001: Level of Service Criteria for Public Transit Service. Working papers presently available:
- Task B: Literature Search
 - Task C: Potential Level-of-Service Criteria
 - Task D: Recommended Level-of-Service Criteria
 - Task F: Transit Weighting Factor Survey
 - Task G: Mode Definition for Application to Level-of-Service Criteria
- Dean, Thomas B., "The Potential for Transit Standards." Traffic Quarterly, Volume 31, No. 1, January, 1977, Pages 119-137.

- Gilbert, Gorman, and Danjani, Jarir., Measuring the Performance of Transit Service. University of North Carolina, Chapel Hill, 1975.
- Heathington, Kenneth W., "Application of Levels of Service and Marketing in Public Transportation Planning." Urban Transportation Efficiency, Proceedings of the Specialty Conference on American Society of Civil Engineers, New York, New York, July 26-27, 1976, Pages 177-185.
- Heathington, Kenneth W., "Evaluation of Urban Public Transportation." ASCE Engineering Issues: Journal of Professional Activities, American Society of Civil Engineers, July, 1974, Pages 241-249.
- James, D. H., "Public Transportation Operating Standards." Special Report 144: Issues in Public Transportation, Transportation Research Board, July, 1972.
- Kansas City Area Transportation Authority, "Public Transportation Standards and Criteria: Kansas City Metropolitan Region." Kansas City, Missouri, 1976.
- Kasoff, Mark J., "The Quality of Service and Transit Use." Traffic Quarterly, Volume 24, January, 1980, Pages 107-119.
- Levinson, Herbert S., "Strategy Selection Criteria and Efficiency Measures." Urban Transportation Efficiency, Proceedings of the Specialty Conference on American Society of Civil Engineers, New York, New York, July 26-27, 1976, Pages 16-46.
- Massachusetts Bay Transportation Authority, "Service Policy for Surface Public Transportation, August, 1977.
- McCrossen, Dennis F., "Choosing Performance Indicators for Small Transit Systems." Transportation Engineering, March, 1978, Pages 26-30.
- Merewitz, Leonard, "On Measuring the Efficiency of Public Enterprises: Bus Operating Companies in the San Francisco Bay Area." Transportation, Volume 6, No. 1, March, 1977, Pages 45-55.
- Milwaukee Transport Services, Inc., "Milwaukee County Transit System: Recommended Transit Service Policies." April, 1977.

Mundy, Ray A., "Utilization of Standards in Urban Mass Transportation."
Paper presented at the National Planning Conference of the American
Society of Planning Officials, San Diego, California, April, 1977.

Munro, Steve, and Biemiller, Andrew, "Standards for Public Transit,
Part I: Criteria for Transit Service; and Part II: Allocation of
Operating Costs." Transit Canada Magazine, Part I - March/April, 1977,
Pages 5-8; Part II - May/June, 1977, Pages 5-8.

National Committee on Urban Transportation, Better Transportation for Your
City. Procedure Manual 4A: Measuring Transit Service. Procedure
Manual 8A: Recommended Standards, Warrants, and Objectives for Transit
Services and Facilities. Public Administration Service, Chicago, 1958.

New York State Department of Transportation, Transit Service Standards
for Small Urban Areas: Review and Planning Approach, by Resource
Planning Associates, Inc., and Applied Resource Integration, Ltd.,
March, 1976.

Pennsylvania Department of Transportation, "Operating Guidelines and
Standards for the Mass Transportation Assistance Program," January, 1973.

Seattle Metro Transit, Transit Department, "Report on Metro Transit
Service Evaluation Criteria, December, 1976.

Seattle Metro Transit, Transit Department, "Metro Transit Service Evalua-
tion Criteria, a Report on System and Route Performance," March, 1977.

Southern California Rapid Transit District, "Service Evaluation Program"

Southern California Rapid Transit District, "A Revised Service Evaluation
Program."

Toronto Transit Commission, "Standards for Evaluating Existing and Pro-
posed Routes," August, 1977.

Toronto Transit Commission, "Service Standards: Results of the Analysis
Undertaken for the Year 1978," April, 1978.

Vuchic, Vukan R., Tennyson, Edson L, and Underwood, William C.,
"Application of Guidelines for Improving Transit Service and Operating
Efficiency." Transportation Research Record, No. 519, 1974,
Pages 66-72.

Washington Metropolitan Area Transit Authority Office of Budget and
Management, "Analysis of Metrobus Performance Measures and Indicators
Quarterly Report," August, 1978.

Attanucci, John P., Becker, Jeff, Jaeger, Leora, "Bus Service Evaluation
Procedures: A Review". Prepared for U.S. DOT, April, 1979

SECTION II:
EVALUATION CRITERIA
AND
PERFORMANCE GUIDELINES

CONTENTS

SECTION II - CRITERIA AND PERFORMANCE LEVEL GUIDELINES

	<u>Page</u>
Criteria	II-1
General Practices	II-2
Performance Level Guidelines	II-2
Organization and Utilization	II-2
Index of Performance Level Guidelines	<i>following . .</i> II-4
Performance Level Guidelines	
System Efficiency	
System Effectiveness	
System Utilization	
Fare Policy	
Management	
System Marketing	

SECTION II

CRITERIA AND PERFORMANCE LEVEL GUIDELINES

The objectives in Section I are valuable to help focus on the priorities that are most important within each system. It is then necessary to find means of quantifying or measuring performance toward the objectives, and to determine whether performance is satisfactory or not.

Our approach toward achieving this evaluation consists of three steps: (1) identification of criteria which address each objective; (2) determination of general industry practices and/or operating statistics which relate to the criteria; and (3) development of performance level guidelines based upon results of Step 2. This approach is discussed in more detail below.

Criteria

Criteria are quantifiable characteristics that relate directly to an objective, and can be used as its measure. To be useful, a criterion must have two attributes:

- It must be a representative measure of the objective and be possible to be displayed as a discrete statistic; and
- The statistic or data must be easily collectible.

These requirements were considered when the criterion was selected for an objective, as several different aspects were essential. The criteria are judgmental, and many times others could be used. However, the ones shown are valid reflections of the objectives. Also, the PennDOT data requirements, Section 15 reports, and the system data survey indicate that most Pennsylvania properties are collecting data that could generally be used with the criteria shown.

General Practices

When determining a performance level, it is frequently useful to consider such factors as:

- Performance of other similar Pennsylvania properties;
- Performance and experience of other transit properties nationally;
- PennDOT and UMTA guidelines for performance; and
- Experience from other applicable industries.

Information from these sources were utilized in developing what we believe are the general practices and/or operating statistics that reflect achievable performance for medium-sized Pennsylvania transit systems.

Performance Level Guidelines

Based on the General Practices, a complete set of Performance Level Guidelines appropriate for medium-sized Pennsylvania properties were developed. In some instances, these guidelines are based on a consensus of generally accepted industry standards, such as the ratio of driver pay hours to work hours. Here, the recommended performance standard of 1.2 should be the "worst" case, and for only very unusual circumstances would a higher number be justified.

On the other hand, some performance levels are subjective and require managerial judgment to determine acceptable performance. An example is assistance with respect to fostering the use of van pools and car pools, which is a good practice and desirable, but must be judged in the context of each local situation.

Some of the criteria are applicable to specific routes and types of service and therefore, route level performance guidelines are also developed. However, evaluating route level performance is more demanding in terms of data gathering (which is the subject of the next section of this manual), but can be very beneficial in identifying situations that require further analysis and change that may not be apparent from a system level analysis only.

Organization and Utilization

The following portion of this section is organized as follows:

- (1) An index listing all objectives with an identification reference to the respective Performance Level Guideline sheet;
- (2) Individual Performance Level Guideline sheets which set forth:
 - Category and Identification Reference
 - Objective
 - Criteria
 - General Practices/Operating Statistics
 - Performance Level Guidelines
 - Cross Reference

The intended use by transit managers of this section of the manual is as follows:

- (1) He or she should obtain approval from the Board on a candidate group of objectives. This procedure is discussed more fully in Section I;
- (2) For those objective categories, he or she should refer to the respective performance level guidelines. An index scheme has been prepared to aid in this effort;
- (3) Using the Performance Level Guidelines, specific performance levels for his or her property should be prepared.
- (4) Finally, the specific performance levels should be reviewed with his or her Board with the intention of the Board adopting a set to be used in guiding the operation of the transit system in the upcoming year.

An example may be useful to show how this procedure could work. Assuming that an objective to "Increase Productivity of Mechanics" has been selected. Referring to Performance Level Guideline Number EFY-7, we find that 3.5 active buses per mechanic is a reasonable performance level. The transit manager should compute his or her respective performance. If actual performance is better than the guideline, he or she may decide that there is probably limited potential for improvement and maintaining the existing buses-per-mechanic ratio may be the selected performance level. However, if actual performance is worse than the

guideline, then either the guideline level or some interim level between actual and guideline may be selected. Appropriate actions to improve performance to the selected guideline level would then be a part of the plans for the coming year.

INDEX OF
PERFORMANCE LEVEL GUIDELINES

INDEX

PERFORMANCE LEVEL GUIDELINES

Symbols for Objective Categories

EFY = System Efficiency
EFT = System Effectiveness
UTL = System Utilization
FRE = Fare Policy
MGT = Management
MKT = Marketing

<u>Objective</u>	<u>Number</u>
<u>System Efficiency</u>	
Stabilize system operating ratios. All routes at least at minimum levels	EFY-1
Minimize cost increases	EFY-2
Control administrative and managerial personnel requirements	EFY-3
Reduce and eliminate where possible unnecessarily duplicative or overlapping service	EFY-4
Efficiently use energy at fixed facilities	EFY-5
Improve mileage use of operating fuels and lubricants in vehicles	EFY-6
Maximize productivity of labor force: drivers, mechanics, others	EFY-7
Increase availability and productivity of revenue vehicles	EFY-8
Establish cost-effective bus replacement schedule	EFY-9

<u>Objective</u>	<u>Number</u>
Establish a cost effective service vehicle replacement program	EFY-10
Provide communications equipment	EFY-11
<u>System Effectiveness</u>	
Minimize vehicle, passenger and employee accidents	EFT-1
Maintain good vehicle cleanliness and appearance	EFT-2
Improve on-time performance	EFT-3
Employees at all levels courteous, responsive, and neat	EFT-4
Assure coordination with other transit modes and operators in the service area to maximize passenger convenience	EFT-5
Minimize vehicle breakdowns and missed trips	EFT-6
Stay within load standards	EFT-7
Set headways on ridership, with policy headways as minimums	EFT-8
For night, weekend and holiday, service to be provided on at least policy headways, and to areas with major needs	EFT-9
Minimize transfers	EFT-10
Provide passenger amenities at major transfer and generator points	EFT-11
Effective implementation of express services	EFT-12
Effective implementation of special purpose routes (shoppers special, commuter club, etc.)	EFT-13
Provide coverage of service area, within financing available	EFT-14
Provide new services to priority areas/groups based on analysis and established policies	EFT-15

<u>Objective</u>	<u>Number</u>
Provide accessible transportation to special groups	EFT-16
<u>System Utilization</u>	
Minimize cost per rider	UTL-1
Minimize subsidy per passenger	UTL-2
Maximize annual rides per capita (transit habit)	UTL-3
Maximize revenue passengers per vehicle mile or vehicle hour	UTL-4
Increase ridership systemwide within existing level of service	UTL-5
<u>Fare Policy</u>	
A fare policy to encourage ridership from selected groups such as: choice riders, off-peak riders, senior citizens, and handicapped citizens	FRE-1
Equitable fares throughout system by: time of day, type of service, and distance traveled	FRE-2
Generate sufficient revenues to maintain financial stability of system	FRE-3
Make fare adjustments based on cost escalation	FRE-4
<u>Management</u>	
Provide financial and operating statistics on a regular basis	MGT-1
Monitor and control department budgets	MGT-2
Establish and maintain employee evaluation and effective training programs	MGT-3
Establish and maintain an effective affirmative action employment and training program	MGT-4
Solicit, establish and use effective citizen involvement in planning where appropriate	MGT-5

<u>Objective</u>	<u>Number</u>
Coordinate planning and/or common goals with other appropriate agencies. Delineate responsibilities	MGT-6
Provide a realistic written plan covering a one year period and a two to five year period with goals, objectives, priorities and implementation plans	MGT-7
Assure maximum coordination and assistance to employer oriented bus pools, van pools, and car pool programs within available resources and responsibilities	MGT-8
Maintain existing maintenance facilities. Improve and modernize facilities and equipment as funds permit	MGT-9
Move toward modern equipment and procedures to provide more secure revenue handling and accurate revenue and passenger data	MGT-10
Be responsive to valid citizen comments	MGT-11
Establish contingency plans for emergency situations: weather, gasoline shortage, community emergencies	MGT-12
<u>System Marketing</u>	
Maintain an appropriate level of marketing effort	MKT-1
Provide a written program showing marketing objectives and an implementation plan for current year, and short range time period	MKT-2
Provide effective public information by a variety of means, including printed and telephone information, and bus stop signs	MKT-3
Improve awareness and image of transit system through marketing	MKT-4

PERFORMANCE LEVEL GUIDELINES

PERFORMANCE LEVEL GUIDELINES
SYSTEM EFFICIENCY

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFICIENCY

Objective: Stabilize system operating ratios. All routes at least at minimum levels.

Criteria: Revenue versus cost figures, systemwide and by route.

General Practices/Operating Statistics:

- 1977-1978 Pennsylvania revenue/cost percent average for medium-sized properties was 52 percent, with range from 25 percent to 63 percent.
- The U.S. national average was about 50 percent for 1978. A nationwide survey showed minimum goals from 25 percent to 50 percent. In the past six years this ratio has decreased by about four percent per year.
- Nationally, this cost recovery ratio is seen as very key, as it is a direct indicator of the subsidy levels needed.
- Individual route ratios can be below the system minimums, but some route minimum levels are often established. General experience showed each route at least one half as productive as system average.

Performance Level Guidelines:

- Systemwide revenue/cost ratio minimum should be established between 40 to 50 percent.
- Variance depends on availability of subsidy funding, types of service provided, and fare levels.
- Individual routes should meet following standards:

Route Revenue/Cost Versus System Average

- | | |
|-----------------------|--|
| 80% of system average | - Satisfactory |
| 60% to 80% | - Evaluate route |
| 60% and below | - Eliminate unless special circumstances |

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFICIENCY

Objective: Minimize cost increases

Criteria : Percent of annual budget increase versus most recent industry wide increase.

General Practices/Operating Statistics:

As reported by APTA in the 1978 Transit Fact Book, the increases in transit operating expenses have been:

1973	13.2%
1974	27.7%
1975	14.4%
1976	8.5%
1977	7.1%

Performance Level Guidelines:

Keep percent of cost increase less than the most recent industry wide figure.

- Exceptions may be required when new regulatory requirements, such as special services for elderly and handicapped passengers are implemented.
- Also, this comparison should be made independently of service expansion statistics.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFICIENCY

Objective: Control administrative and managerial personnel requirements.

Criteria: Ratio of operating employees to administrative/management staff.

General Practices/Operating Statistics:

The Pennsylvania statewide average for 1978 was 6.1 operating employees per administrative/management employee.

Performance Level Guidelines:

- If the ratio of operating to administrative/management staff is at or above the Pennsylvania average, the performance is satisfactory, and should be maintained.
- If it is significantly lower than the Pennsylvania average, a re-evaluation of personnel practices may be called for. An interim performance level that improves the current ratio should be set, and changes made gradually toward a better ratio.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFICIENCY

Objective: Reduce and eliminate where possible unnecessarily duplicative or overlapping service.

Criteria : Number of routes (outside of core area) that traverse same or closely parallel streets.

General Practices/Operatings Statistics:

- Maximum normally acceptable walking distance is one-quarter mile. Therefore, normal route spacing is at least one-half mile to eliminate overlapping route service areas. However, in denser areas, or where routes converge, spacing must frequently be closer.
- Transit Corridors with high ridership sometimes have overlapping parallel routes, to provide the required service level.
- Studies have shown that, generally, a high frequency service on one route is more attractive to riders than a less frequent service on two parallel routes.

Performance Level Guidelines:

- Under normal conditions, transit routes outside the core area should be spaced at least one-half mile apart.
- Exceptions are heavily used corridors, or dense residential areas, where parallel routes closer than one-half mile can be used to increase the level of service, serve somewhat different ridership origins and serve different destinations. However, there must be a clear need for parallel service rather than increasing the frequency on the most major route.
- Special or unusual street networks or topographic conditions may require closely parallel service for some route segments.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFICIENCY

Objective: Efficiently use energy at fixed facilities.

Criteria:

- Number of KWh used per square foot of fixed facility.
- Amount of heating fuels used per square foot of fixed facility.

General Practices/Operating Statistics:

Transit properties nationwide are taking steps to make their facilities more energy-efficient. Actions have ranged from re-glazing windows and installing new doors, to using solar heat and "recycled" heat from other nearby sources. Peer comparisons are not appropriate for this measure.

Performance Level Guidelines:

- A plan for making appropriate facility and policy changes to conserve energy should be prepared and implemented.
- Both the number of KWh per square foot and the amount of heating fuel used per square foot should decrease each year.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFICIENCY

Objective: Improve mileage use of operating fuels and lubricants in vehicles.

Criteria:

- Miles/gallon of diesel fuel and/or gasoline
- Miles/quart of add oil.

General Practices/Operating Statistics:

A 1977 survey of large transit properties found the average was 3.8 vehicle-miles per gallon of diesel fuel. The average miles per quart of add oil was 225.

The 1977-1978 Pennsylvania average was 4.2 miles per gallon.

Performance Level Guidelines:

- Buses used in local service should be using 3-4 miles per gallon of diesel fuel.
- Buses used in express service should exceed 4 miles per gallon of fuel.
- Fuel usage can be influenced by such factors as traffic congestion, hilly terrain, loadings and vehicle size.
- Buses should operate 200-400 miles per quart of oil added (excluding oil changes).
- Oil usage is primarily determined by the mechanical condition of the vehicle.
- Agencies with a fleet of gasoline powered vehicles should compute their current fuel consumption rate and establish improvement objectives.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFICIENCY

Objective: Maximize productivity of labor force: Drivers, Mechanics, Others.

Criteria:

- Number of vehicles per mechanic
- Platform hours per driver pay hour
- Annual vehicle miles per employee
- Annual vehicle hours per employee

General Practices/Operating Statistics:

A 1977 survey of transit properties found that the number of vehicles per maintenance employee was 2.4 and the ratio of pay hours to platform hours was 1.14.

The 1977-1978 Pennsylvania statewide average for vehicle miles per employee was 14,700 with some properties achieving over 17,000.

The 1977-1978 Pennsylvania statewide average for vehicle hours per employee was 1,200 with some properties achieving over 1,300.

Performance Level Guidelines:

- Current ratios at or above 3.5 buses per mechanic and 2.4 buses per maintenance employee (including clerks, storeroom personnel etc.) should be maintained. Values below these figures should be targeted for evaluation and possible improvement.
- A current ratio of pay hours to platform hours above 1.2 should be targeted for evaluation and possible improvement. A ratio less than 1.2 should be maintained.
- A current ratio of vehicle-miles per employee below 15,000 should be targeted for evaluation and possible improvement. A ratio above 15,000 should be maintained.

- A current ratio below 1,000 vehicle-hours per employee should be targeted for evaluation and possible improvement. A ratio above this should be maintained.
- Scheduling and operating speeds can be major determinants of the vehicle-miles and hours ratios.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFICIENCY

Objective: Increase availability and productivity of revenue vehicles.

Criteria :

- Vehicle hours per peak period vehicle
- Revenue miles per revenue hour (scheduled speed)
- Spare ratio

General Practices/Operating Statistics:

The 1977-1978 Pennsylvania average number of annual vehicle hours per peak period vehicle was 3,000; the average spare ratio was 18 percent; and, the average speed was 12.7 mph.

A 1977 nationwide survey of transit properties found that the average spare ratio was 16 percent and the average speed was 12.7 mph.

Industry experience is to have at least 15 percent of the fleet as spares.

Performance Level Guidelines:

- The highest possible speed with due regard for safety, and comfort should be at least 12-15 mph for local service, 20-25 mph for arterial express and 25-40 mph for freeway express.
- Spare ratio should be 15-20 percent of the fleet.
- Factors which affect achieving operating speeds include traffic congestion during peak periods, excessive number of stops and other traffic delays.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFICIENCY

Objective: Establish cost-effective bus replacement schedule

Criteria : - Compliance with State and Federal guidelines
- Age of buses

General Practices/Operating Statistics:

Bus design life is approximately 15 years, including overhauls to major components. Experience indicates that life cycles for each major component are:

	Life Cycle in Miles	
	New	Rebuilt
Engine	300,000	250,000
Hydraulic Transmission	275,000	250,000
Differential	300,000	275,000

Generally, two rebuilding cycles occur in each component with reasonable assurance of successful performance. With more than two rebuilds the likelihood of inefficient performance and mechanical malfunctions increase. This standard equates to about 800,000 bus miles which, related to bus age, is about 16 years, assuming that buses are operated 50,000 miles per year. This can be shortened by poor roadway conditions, or use on suburban routes where mileage is accumulated faster than normal.

UMTA and PennDOT guidance is that buses should be replaced when 12 to 15 years old.

Delays in capital program funding and long vehicle procurement times necessitate a time-phased replacement program that is planned 3 to 4 years before the new vehicles are needed.

Average 1977-1978 bus age in applicable Pennsylvania properties is 7.2 years.

Performance Level Guidelines:

- Average fleet age should be between 6 and 8 years.
- A well-planned phased bus replacement program should be followed, with buses scheduled by number for replacement at certain times nearing the end of their life cycle.
- Replacement should focus on the oldest vehicles, with most mileage, with input from the maintenance supervisor.
- Procedures should be developed to assure that major repairs or overhauls are not performed on vehicles scheduled for imminent replacement.
- Records of age, mileage, and component overhauls, as shown above should be kept and form the basis for the replacement schedule.
- Replacements should be scheduled to achieve a relatively uniform mileage distribution over the fleet. This means that major component overhauls will be needed on a relatively uniform annual basis, and some newer vehicles are constantly available.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFICIENCY

Objective: Establish a cost effective Service Vehicle replacement program.

Criteria : - Annual maintenance costs of service vehicles
- Age and mileage of service vehicles.

General Practices/Operating Statistics:

Optimum replacement time differs by type of service vehicle.

No specific UMTA policy is available, although reasonable justification should be made.

Service vehicles are generally replaced based on age and mechanical conditions.

Performance Level Guidelines:

- Automobile average useful life should be based on mileage with compacts at 80,000 miles, and medium and full sized at 100,000 miles
- Light duty trucks have longer life spans, usually due to less annual mileage, and being equipped with heavy duty body and engine. Replacement should be based on a comparison of maintenance history, and replacement costs.
- Heavy duty trucks are not cost-effective to replace, and should be repaired and overhauled as necessary. Maximum service life is approximately 15 years, after which parts become difficult to obtain.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFICIENCY

Objective: Provide communications equipment

Criteria :

- Percent of service vehicles equipped
- Percent of buses equipped

General Practices/Operating Statistics:

The trend in the transit industry is to equip all service vehicles first and then buses, as funds permit, with communications equipment.

Performance Level Guidelines:

Same as above.



PERFORMANCE LEVEL GUIDELINES

SYSTEM EFFECTIVENESS

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFECTIVENESS

Objective: Minimize vehicle, passenger and employee accidents

Criteria:

- Number and type of passenger and employee accidents per 100,000 vehicle-miles
- Number and type of vehicle accidents per 100,000 vehicle-miles

General Practices/Operating Statistics:

The average number of vehicle accidents per 100,000 vehicle-miles in Pennsylvania in 1978 was 6.1.

A 1977 nationwide survey of larger transit properties found an average of 8.4 vehicle accidents per 100,000 vehicles.

Performance Level Guidelines:

The UMTA Section 15 report requires detailed accident data, so system trends can be examined frequently. Efforts to eliminate vehicle, passenger, and employee accidents should be continuing. In particular, any upward trends in the accident rate should be investigated, and corrective actions taken.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFECTIVENESS

Objective: Maintain good vehicle cleanliness and appearance.

Criteria :

- Missed cleaning cycles
- Frequency of body rehabilitation
- Prompt repair of vehicle exterior and interior damage
- Length of cleaning cycle
- Availability of trash baskets

General Practices/Operating Statistics:

Pennsylvania Department of Transportation Operating Guidelines specify exterior wash at least once a week for buses in daily service with interior cleaning every day.

It is general practice to:

- Have no missed cycles.
- Remove from service any bus that poses a safety problem
- Have other buses repaired at next scheduled preventive maintenance.
- Provide all vehicles with trash baskets.
- Perform body rehabilitation including all necessary repairs, painting, changing scratched windows, etc.

Performance Level Guidelines:

- Same as above with body work scheduled at major overhauls.
- Availability of bus washer increases frequency of washing.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFECTIVENESS

Objective: Improve on-time performance.

Criteria: Percent of trips 0 minutes early to 5 minutes late.

General Practices/Operating Statistics:

- Most Pennsylvania properties check on-time performance, but not on a systematic or recurring basis.
- National surveys have shown that on-time performance becomes more important as headways get longer.
- General practice for urban systems has been 85 percent on-time in peak periods, and 90-95 percent on-time in off-peak periods.

Performance Level Guidelines:

On-time performance can best be described with a table relating percent trips on-time on a route, to the headways. With close peak period headways, performance is less critical than with longer, off-peak ones that involve considerable waiting times for passengers.

<u>Time Period</u>	<u>Headways</u>		
	<u>< 10 Min.</u>	<u>10-30 Min.</u>	<u>Special</u>
Peak	80% (on time)	90%	95%
Off-Peak	--	95%	95%
Weekend	--	95%	95%

- Performance on routes should be checked when load counts are taken, and at least twice per year, or as required based on complaints.
- Recheck individual routes that perform below recommended on-time, to gather data for possible route adjustments.
- Develop systematic spot check procedures, using techniques such as radio checks with drivers by the dispatcher, or data-gathering "teams" that make spot checks in addition to systematically checking all system routes.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFECTIVENESS

Objective: Employees at all levels courteous, responsive, and neat.

Criteria :

- Number of customer complaints
- Results of spot checks reporting driver appearance (including uniform and behavior)

General Practices/Operating Statistics:

It is the general practice in the transit industry to monitor complaints against employees and to spot check driver appearance (including uniform and behavior).

One property's standard is to keep the number of valid complaints per driver to 3 or less each year.

Performance Level Guidelines:

- Supervisors monitor personnel performance through spot checks.
- Operators with more complaints than the system average should be reviewed.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFECTIVENESS

Objective: Assure coordination with other transit modes and operators in the service area to maximize passenger convenience.

Criteria:

- Regular meeting with other operators
- Examples of schedule, fare and information coordination
- Ridership and transfers on integrated versus separate services

General Practices/Operating Statistics:

It is the general practice in the transit industry to meet on a regular basis with other transit operators located in the same area.

Performance Level Guidelines:

- At least semi-annual meetings with other operators
- All operators are satisfied with the extensiveness and effectiveness of coordinated services
- Passenger concerns about coordinated services are addressed and changes made when appropriate.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFECTIVENESS

Objective: Minimize vehicle breakdowns and missed trips.

Criteria :

- Miles between road calls
- Percent of buses which don't leave the depot

General Practices/Operating Statistics:

Boston, Houston, and LANTA all set their minimum acceptable breakdown record as 10,000 miles/mechanical breakdown. However, the general industry standard is 4,000 to 6,000 miles between road calls.*

Houston's standard is to limit the percent of trips missed to less than $\frac{1}{2}$ percent. Boston's is 1/10 percent. Most properties attempt to have no missed trips.

Performance Level Guidelines:

The standards listed above are reasonable performance levels. If, however, last year's performance was significantly worse than these standards, maintenance procedures and/or the equipment needs to be modernized, and a reasonable interim performance level set.

* Road calls included a much broader area of vehicle breakdowns than the mechanical ones used as standards by Boston, Houston, and LANTA.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFECTIVENESS

Objective: Stay within load standards.

Criteria : - Vehicle load factors

General Practices/Operating Statistics:

- A national survey showed loading standards with many common elements among small and medium sized properties.
 - Peak and off-peak standards were different.
 - In off-peak periods, all passengers should have a seat (loading factor no more than 1.0).
 - In peak periods, arterial or line haul service load factors of less than 1.3 to 1.5 at the peak load points.
 - Rides for standees should not exceed 15 to 20 minutes.
 - In express service, the load factor should be no more than 1.0.
- PennDOT guidelines are that for any one-half hour off-peak period, the number of seats provided must exceed the total demand during that period at any one point.
- Some properties have established minimum loading standards for routes, such as:
 - In off-peak periods, trips can be eliminated if the average bus loads are 10 passengers or less.
 - In peak periods, service can be reduced if average loads fall below 30 passengers.

Performance Level Guidelines:

- Establish peak and off-peak loading standards, and adjust service to meet the standards.
- Maximum load factors should address both loads and time duration of standing loads. Generally measure load factors at the peak load point.
- Maximum (loads ÷ seated capacity)
 - Off-peak periods - 1.0
 - Peak period, line haul service - 1.4
 - Peak period, express (at least a 15 minute trip) - 1.0
 - Standing loads for no more than 15 minutes on any one trip.

(These apply to individual trips, not route averages).

- Minimum load averages should be established to guide service levels.
 - Off-peak trips average should have at least 10 passengers.
 - Peak trips average should have at least 25 passengers.
- Compromises may be necessary due to short-term inconveniences such as gasoline shortages.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFECTIVENESS

Objective: Set headways on ridership, with policy headways as minimums.

Criteria :

- Length of policy headway
- Length of other headways

General Practices/Operating Statistics:

- A survey of properties show general agreement on minimum policy headways for regular route service.
 - Peak periods, 30 minutes.
 - Off-peak periods, 60 minutes.
- PennDOT guidance has no route headways more than 60 minutes, preferably 30 minutes or less.
- Experience has shown that "clock" headways at major load points (with buses arriving at some rememberable time, such as on the hour, and at 15,20,30,40 and 45 minutes after) are useful to passengers.
- Headways closer than policies are based on loading levels, or density of the areas served.

Performance Level Guidelines:

- Policy headways for peak and off-peak regular service should be established:

- Peak periods, 30 minutes
 - Off-peak periods, 60 minutes
 - If ridership on routes fall below minimum established, using policy headways, consideration should be given to eliminating service.
 - Policy headways in dense areas may be closer due to latent demand.
- Increase service over policy headways based on established load standards to accommodate ridership.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFECTIVENESS

Objective: For night, weekend and holiday, service to be provided on at least policy headways, and to areas with major needs.

Criteria : Availability of service

General Practices/Operatings Statistics:

Night, weekend and holiday service is generally in direct proportion to the size of the urban area in which transit service is provided. In large urban areas, this type of service is provided. In small urban areas, late night and Sunday service is not provided.

Performance Level Guidelines:

- Night, weekend, and holiday service should be provided based upon an analysis of need including:
 - Transit dependancy of the area
 - Income levels
 - Generators served (shopping, medical, recreational)
 - Existing off-peak ridership.
 - Available funding.
 - Projected utilization.
- Service should be maintained on all routes which have evening or weekend ridership at least 50 percent of the system average weekday ridership (using passengers per vehicle mile or hour).

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFECTIVENESS

Objective: Minimize transfers.

Criteria : Transfers as a percent of system ridership.

General Practices/Operating Statistics:

- Pennsylvania average for medium systems is seven percent with a range from 4 to 16 percent.
- Transfer rates are usually higher in urban areas, with more diverse trip patterns.
- Studies have shown that transit users consider transfers to be very undesirable.

Performance Level Guidelines:

- Number of transfers should not exceed 10 percent of system total ridership.
- The percent of transfers can be larger if a "hub" type route structure is used.
- Major transfer facilities should have maximum convenience, to include schedule coordination with primary routes.
- There should be a route by route transfer analysis, and routes with a percent of transfers greater than the system average should be identified, and rescheduling to connect the routes in question should be investigated.
- A very low systemwide transfer rate may indicate that transfers are inconvenient or impossible, and potential transfer trips are not being made.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFECTIVENESS

Objective: Provide passenger amenities at major transfer and generator points.

Criteria:

- Percent of major transfer and generator points with shelters
- Number of new shelters installed
- Percent of stops equipped with benches

General Practices/Operating Statistics:

Except for stops where buildings provide convenient shelter, it is the PennDOT Operating Guideline to provide convenient shelter for all major transfer and generator points, and to provide benches at all stops with lengthy waiting times.

LANTA provides first priority to the installation of new shelters at stops with: 200 or more passengers boarding daily and routes with headways of 40 minutes or less; and, 150-200 passengers boarding daily with headways of over 40 minutes.

Other systems nationally have developed detailed criteria for evaluating locations.

Performance Level Guidelines:

A detailed locational selection list would include such characteristics as:

- The stop serves a major transit trip generator, e.g., an apartment complex, a school, a hospital, an industrial facility, a tourist attraction, a major commercial establishment, etc.
- The stop has been observed to be used by elderly persons.
- The stop is a major transfer point.

- The stop is at a park-and-ride lot or kiss-and-ride area (e.g., a bus turnout bay, an off-street temporary parking area, a route terminal, etc.).
- There are no surrogate shelters within 100 feet of the bus stop.
- The stop is served by an express bus route.
- The interval between buses at the stop is 15 minutes or more in the peak periods and boarding exceeds 150 per day.
- Sufficient space is available to install the shelter without causing boarding passenger/pedestrian congestion.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFECTIVENESS

Objective: Effective implementation of express services.

Criteria:

- Express services implemented
- Revenue/cost ratio of express service vs. system average
- Percent time savings of express vs. local
- Total transit ridership increases.

General Practices/Operating Statistics:

- National experience has shown express services to be attractive to current and potential transit users.
- Normal planning factors for express service include:
 - At least a three mile express segment
 - Collector segment of 10 minutes or less
 - Bus usage at least 40 passengers average, on a 50-passenger vehicle
 - Service of a major travel generator such as CBD or business area.

Performance Level Guidelines:

- Implementation of an express route should be considered when a route is identified with a three mile potential express segment, a reasonable collector area, and a potential usage of 80% of the vehicle capacity per trip.
- The revenue/cost ratio of an express route should not be below the system average after the route reaches its full potential, with a trial period of at least six months.
- Each express route should increase total system ridership (and not just divert passengers from local service).
- An express route should take 40 percent less travel time for the express portion than a corresponding local route.
- Express service ridership can be increased with park-ride lots, bus priority lanes, signal pre-emption devices, and other traffic engineering techniques.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFECTIVENESS

Objective: Effective implementation of special purpose routes, (shoppers special, commuter club, etc.)

Criteria :

- Special purpose routes operating
- Special service needs
- Revenue/Cost ratio.

General Practices/Operating Statistics:

- Special purpose transit routes to serve the needs of specific travel patterns, or generators, are often proposed to transit operators. (These do not include routes serving mostly elderly or handicapped persons.)
- These routes generally fall into two major categories: Off-peak non-work, and peak period work oriented.
- Many systems throughout the county have worked with employers, and specific residential areas, and established special commuter routes with a revenue level guaranteed by the user group. This has been referred to as subscription or club bus.

Performance Level Guidelines:

- Special purpose routes are established under specific policy guidelines concerning revenue/cost ratios, and service needs.
- Off-peak service such as shopper specials should be evaluated using the marginal costs of the service to the system.

- Marginal costs include those costs directly attributable to the service provision, such as diesel fuel.
 - The availability of drivers who are underutilized in the off-peak period is a major consideration for the service provision.
- Peak Period service, such as commuter buses, should be priced to have a Revenue/Cost ratio at least slightly above that of the system average. Revenue equal to or greater than fully allocated costs is desirable.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFECTIVENESS

Objective: Provide coverage of service area, within financing available.

Criteria:

- Percent of population within one-quarter mile of bus line
- Percent of major residential areas and activity centers served.

General Practices/Operating Statistics:

- The normal maximum acceptable walking distance to a bus line is one-quarter mile.
- Most systems nationally strive for 100 percent coverage of the urban core areas, with less service coverage in suburban areas. The socioeconomic characteristics of particular areas are also a determinant.

Performance Level Guidelines:

- 90 percent of the urbanized area population should reside within one-quarter mile of a bus line. More definitive standards can be developed for a particular community if desired.
- No major residential or activity centers should be further than one-quarter mile from a bus line. Each system must determine what the major residential and activity centers are in its own service area, based on appropriate local definitions.
- The percent population served will be lowered if funds for sufficient service are not available, population densities are low, or street patterns are unusual and prevent one-quarter mile service.
- UMTA procedures require a detailed analysis of services provided, and socioeconomic characteristics that can be useful in monitoring this criteria.
- Effective service area can be expanded with park-n-ride suburban collection areas.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFECTIVENESS

Objective: Provide new services to priority areas/groups based on analysis and established policies.

Criteria :

- Number of potential revenue passengers
- Revenue/Cost Ratio at end of trial period
- Number of requests for service

General Practices/Operating Statistics:

- Many transit systems nationwide have established policies for new service provision, which differ widely.
- Indicators of new service success have been:
 - Number of households served
 - Requests for service
 - Socio/economic characteristics of the community served.
- Experience has shown that route extensions build up ridership sooner than completely new services, but some start-up period is needed in both instances.

Performance Level Guidelines:

New route/extension policies should include providing service if:

- The new service will serve at least 500 households per mile.

- Has been requested by a large number of potential users.
- Has an estimated Revenue/Cost ratio (after six to nine months) equal to the system average.
- The new service area has such characteristics as lower auto ownership, or higher residential densities.

PERFORMANCE LEVEL GUIDELINES - SYSTEM EFFECTIVENESS

Objective: Provide accessible transportation to special groups.

Criteria :

- Number of riders from special groups (senior citizens, handicapped).
- Availability (location and frequency) of transportation for special groups.

General Practices/Operating Statistics:

- Federal transit guidelines require special fare programs, and encourage other efforts to meet needs of traditionally transit-disadvantaged groups.
- Pennsylvania transit operators provide free non-peak period transit rides to Senior Citizens and eligible handicapped persons.
- The average 1977-1978 transit habit (rides per year per Senior Citizen) for medium sized Pennsylvania transit operators was about 35.
- Studies have shown that for Senior Citizens, the large majority of transit trip purposes are for shopping, medical recreation or social.
- Special services often have lower revenue/cost ratios than other services.

Performance Level Guidelines:

- Expected generators for trips by special groups should be served by a reasonable level of transit service, at least hourly.
- Generators include:
 - Senior housing centers
 - Major shopping facilities
 - Major medical facilities
 - Senior nutrition and recreation centers
 - Vocational rehabilitation centers (with accessible vehicles).
- Efforts at identifying special needs, and coordinating with other services for special groups are essential.
- More sophisticated analyses of special accommodation services are available, and can be used, if desired.
- In the interim period, lift-equipped buses should be allocated to service handicapped persons.
- Applicability of demand responsive service should be investigated.

PERFORMANCE LEVEL GUIDELINES
SYSTEM UTILIZATION

PERFORMANCE LEVEL GUIDELINES - SYSTEM UTILIZATION

Objective: Minimize cost per rider.

Criteria : Operating cost/passenger.

General Practices/Operating Statistics:

- The average cost per passenger for medium Pennsylvania properties in fiscal year 1977-1978 was \$0.61 with several properties as low as \$0.44. Projecting a total cost increase of 20 percent to 1980, with no ridership increase, yields an average value of \$0.73 per passenger.
- Research has developed effective cost allocation formulas which assist in identifying the actual service provision costs on a route basis.

Performance Level Guidelines:

- System cost per revenue passenger should be approximately \$0.70 for 1980.
- The cost per passenger on a route basis, should be computed using appropriate cost allocation formulas.
- Effective marketing and route structuring that attracts more riders can lower per-passenger costs.

PERFORMANCE LEVEL GUIDELINES - SYSTEM UTILIZATION

Objective: Minimize subsidy per passenger

Criteria: Subsidy per passenger

General Practices/Operating Statistics:

The average for Pennsylvania properties in fiscal year 1977-1978 was 35¢ with some properties as low as 15¢.

Performance Level Guidelines:

Each system should determine its desired subsidy level, taking into account such factors as:

- PennDOT subsidy allocation criteria
- Local financial resources
- Trends of similar sized systems in Pennsylvania
- Special community needs.

Once the appropriate level is found, actions must be taken to control costs and revenues, to maintain the desired level.

PERFORMANCE LEVEL GUIDELINES - SYSTEM UTILIZATION

Objective: Maximize annual rides per capita (transit habit).

Criteria: Annual passengers/service area population.

General Practices/Operating Statistics:

The Pennsylvania 1977-1978 statewide average was 16.

Performance Level Guidelines:

Since service levels and communities vary greatly, each property should set its desired performance level based on:

- . Community needs
- . Funding availability
- . Vehicle resources
- . Geographic characteristics.
- . Demographic characteristics.
- . Socioeconomic characteristics.

Once the appropriate level is set, ridership should be monitored and actions taken to achieve or maintain the desired level.

PERFORMANCE LEVEL GUIDELINES - SYSTEM UTILIZATION

Objective: Maximize revenue passengers per vehicle mile or vehicle hour.

Criteria : Revenue passengers per vehicle mile or hour, system-wide and by route.

General Practices/Operating Statistics:

- The 1976-1977 Pennsylvania average for revenue passenger/vehicle mile was 2.3, the U.S. average was 2.8.
- The 1976-1977 Pennsylvania average for revenue passenger/vehicle hour was 28.2 which was typical of a sampling of other properties nationwide.

Performance Level Guidelines:

- System average passengers per vehicle mile at least 2.3.
- System average passengers per vehicle hour at least 28.
- Minimum levels of route performance are evaluated as follows:

Route performance relative to system average

- 80% of system average - Acceptable
 - 60% to 80% - Review for special circumstances
 - Less than 60% - Reduce service or make service changes
- Final decisions about a new service should not be made any sooner than six months after initiation since ridership is not stable prior to that time.

PERFORMANCE LEVEL GUIDELINES - SYSTEM UTILIZATION

Objective: Increase ridership systemwide within existing level of service.

Criteria : Percent increase in riders per vehicle mile of service.

General Practices/Operating Statistics:

- The average annual increase in Pennsylvania for Revenue Passengers per vehicle mile in the last 4 years has been 6.4 percent. The range however is 2.3 percent to 11.4 percent.
- Ridership increases must be based on a given service level, or use a per vehicle mile or other standard to account for differences in service provision that affect ridership.

Performance Level Guidelines:

- Increase per mile or per hour ridership by five percent annually.
- Influences such as marketing, parking policies, transit traffic priority, and gasoline availability should improve increases in ridership.

PERFORMANCE LEVEL GUIDELINES

FARE POLICY

PERFORMANCE LEVEL GUIDELINE - FARE POLICY

Objective: The fare policy should encourage ridership from selected groups such as:

- choice riders
- off-peak riders
- senior citizens
- handicapped citizens

Criteria : Annual ridership from each specific group

General Practices/Operating Statistics:

It is the general practice in the transit industry to provide different fares to certain groups of riders, such as school children and the elderly.

In Pennsylvania, in 1977-1978, the average riding habit for senior citizens was 35.

Performance Level Guidelines:

Increase ridership from each group each year. The ability to attract these groups through fare policy, if not already done, should be investigated for implementation potential. Use of service by senior citizens should be computed and compared to average. Peaking characteristics should be looked at from fare policy perspectives to see if fare incentives in off-peak periods can result in more uniform ridership throughout the day.

PERFORMANCE LEVEL GUIDELINES - FARE POLICY

Objective: Equitable fares throughout system by:

- time of day
- type of service
- distance traveled

Criteria :

- User charges per mile
- Fare structure

General Practices/Operating Statistics:

- Pennsylvania DOT guidelines indicate that premium fares should be charged for special services such as express.
- Pennsylvania DOT guidelines indicate that fares should vary by the distance travelled, outside the core area.
- Several properties nationally have lower fares for off-peak users than for peak period riders, to encourage ridership and recognize the lower cost of service provision.

Performance Level Guidelines:

- Zone charges should be used for trips which extend into the suburban areas, although charge per mile may be less.
- Express service should have a surcharge.
- Peak-off peak differential fares should be considered.

PERFORMANCE LEVEL GUIDELINES - FARE POLICY

Objective: Generate sufficient revenues to maintain financial stability of system.

Criteria : Annual revenue = operating costs less available subsidies.

General Practices/Operating Statistics:

- Fares are generally set to generate sufficient revenues to make up any difference between service costs and available subsidies. Otherwise, service must be reduced.
- In Pennsylvania, in 1977-1978, revenues are generated through

Fares and fare subsidies (School and Senior Citizens)	95.3%
Advertising	0.3%
Charter service	1.9%
Miscellaneous	2.5%

Performance Level Guidelines:

- Fare increases should be considered if for the forthcoming year, there is not sufficient projected revenue to make-up the differential between estimated operating costs and available subsidies.
- All areas of revenue generation should be fully explored, including fare subsidies, advertising and charter.

PERFORMANCE LEVEL GUIDELINES - FARE POLICY

Objective: Make fare adjustments based on cost escalation.

Criteria : (Percent change in fare) vs. (percent change in cost).

General Practices/Operating Statistics:

- Nationally rising costs have forced fare increases, generally, although in some systems fares have been kept low to stimulate ridership and service other social goals.
- Rising gasoline prices and other external factors are disrupting some of the previous elasticity ratios concerning fares and ridership.

Performance Level Guidelines:

- Fare increases should take place every two to three years to keep pace with operating cost increases. A trigger mechanism for a fare increase could be a certain percent of cost increases, perhaps 25 percent over some prior period.
- The percent of fare increase should depend on the amount of new revenue desired. However, the cash fare should be rounded up to the nearest nickel.
- A fare structure that is diversified will permit partial fare increases.
- A high or improved level of service, and/or auto disincentives, should result in fare increases without ridership loss.

PERFORMANCE LEVEL GUIDELINES
MANAGEMENT

PERFORMANCE LEVEL GUIDELINE - MANAGEMENT

Objective: Provide financial and operating statistics on a regular basis

Criteria : Regular availability of reports

General Practices/Operating Statistics:

It is the general practice in the transit industry to provide financial and operating statistics on a regular basis.

Performance Level Guideline:

Reports should be submitted on time and there should be no dissatisfaction expressed by board members, advisory groups and/or funding agencies. Any dissatisfaction should be reviewed and corrected.

PERFORMANCE LEVEL GUIDELINE - MANAGEMENT

Objective: Monitor and control department budgets.

Criteria :

- Comparison of department budget figures and actual expenditures
- Increases in department budgets compared to system average

General Practices/Operating Statistics:

Budget and actual expenditures are usually compared annually with some properties performing comparisons more often (monthly).

Performance Level Guideline:

- Except for unforeseen events, none of the actual expenditures should exceed corresponding budgeted amounts.
- Any department whose percent of budget increase exceeds the system average increase should be reviewed.
- At a minimum, quarterly budget and expenditure comparisons should be prepared with appropriate actions taken to eliminate end of year overruns.

PERFORMANCE LEVEL GUIDELINE - MANAGEMENT

Objective: Establish and maintain employee evaluation and effective training programs.

Criteria :

- Formal evaluation system of employee performance used
- Percent of employees satisfactorily completing course and training
- Number of in-house promotions
- Change in employee's performance after training.

General Practices/Operating Statistics:

It is the general practice in the transit industry to formally evaluate management employees on an annual basis.

Experience in other industries has shown employee evaluation to be valuable both to the employee and to management.

In Pennsylvania, a survey showed that many properties neglect evaluations for non-salaried or non-management employees.

Performance Level Guideline:

- All employees should be formally evaluated on an annual basis.
- All employees who enter training programs should satisfactorily complete them.
- All trained employees should maintain or improve their performance.
- Management should look in-house first for all promotions.

PERFORMANCE LEVEL GUIDELINES - MANAGEMENT

Objective: Establish and maintain an effective affirmative action employment and training program

Criteria:

- Minority employees as a percent of total employees
- Number of minority persons promoted
- Availability and effective use of special training programs for minority employees

General Practices/Operating Statistics:

National policy is to encourage the hiring and promotion of minorities and women in all industries.

APTA has endorsed this policy, and encourages transit properties to develop programs toward this objective.

U.S. DOT regulations, and other laws require compliance with minority employment and advancement guidelines.

Performance Level Guidelines:

- Comply with requirements of laws and regulations.
- Minority employment should reflect community make-up.
- Management should encourage minority training and promotion progress.

PERFORMANCE LEVEL GUIDELINES - MANAGEMENT

Objective: Solicit, establish and use effective citizen involvement in planning where appropriate

Criteria:

- Number of public hearings
- Meetings with advisory groups
- Number of citizens participating

General Practices/Operating Statistics:

- It is the general practice in the transit industry to involve citizens in discussions of changes or additions in service and fares that directly affect them.
- U.S. DOT regulations require citizen involvement of various kinds for certain types of service changes and plans.

Performance Level Guidelines:

- Comply with appropriate U.S. DOT regulations
- Generally, public meetings should be held for all major route service and fare structure additions, deletions and changes.
- Regular meetings should be held with advisory groups.
- Management should take positive steps to obtain public participation.
- Any concerns about the level of public participation by civic leaders should be addressed and satisfactorily resolved.

PERFORMANCE LEVEL GUIDELINES - MANAGEMENT

Objective: Coordinate planning and/or common goals with other appropriate agencies. Delineate responsibilities.

Criteria:

- Regularly scheduled meetings/communications
- Representation at planning meetings

General Practices/Operating Statistics:

UMTA and FHWA certifications and guidelines require an on-going short and longer range transit planning program, that must also be coordinated with other appropriate agencies.

Performance Level Guidelines:

- Comply with appropriate U.S. DOT regulations
- All concerned parties should be satisfied with the frequency and content of meetings
- The transit agency should be represented at all appropriate regional planning meetings.

PERFORMANCE LEVEL GUIDELINES - MANAGEMENT

Objective: Provide a realistic written plan covering a one year period and a two to five year period with goals, objectives, priorities and implementation plans.

Criteria:

- Availability of written plan, reviewed and updated periodically
- Implementation of program projects

General Practices/Operating Statistics:

UMTA and FHWA certifications and guidelines required an on-going short and longer range transit planning program, that must also be coordinated with other appropriate agencies.

Performance Level Guidelines:

- Comply with appropriate U.S. DOT regulations
- Management and the Board should be satisfied with the plan and implementation progress made.

PERFORMANCE LEVEL GUIDELINES - MANAGEMENT

Objective: Assure maximum coordination and assistance to employer oriented bus pools, van pools, and car pool programs within available resources and responsibilities.

Criteria :

- Contacts with employers
- Assistance provided

General Practices/Operating Statistics:

Ride sharing in many forms is becoming an integral part of the transportation system in many urban areas. Transit operators can offer valuable advise to employer and employee groups trying to find alternatives to the private auto.

Performance Level Guidelines:

Same as above.

PERFORMANCE LEVEL GUIDELINES - MANAGEMENT

Objective: Maintain existing maintenance facilities. Improve and modernize facilities and equipment as funds permit

Criteria :

- Condition of existing facilities
- Capital program budget and funding committments for maintenance facilities

General Practices/Operatings Statistics:

It is the general practice in the transit industry to maintain maintenance facilities and equipment that permit sound operation of vehicles and efficient use of labor.

Performance Level Guidelines:

If the facilities or equipment are deemed inadequate, a sufficient portion of the capital program should be allocated to their improvement or replacement.

PERFORMANCE LEVEL GUIDELINES - MANAGEMENT

Objective: Move toward modern equipment and procedures to provide more secure revenue handling and accurate revenue and passenger data.

Criteria :

- Regular audit reports
- Consistency between revenue and passenger counts
- Installation of registering fareboxes
- Use of secure revenue collection equipment

General Practices/Operating Statistics:

It is the general practice in the transit industry to check the consistency between revenue and passenger counts and to introduce more modern fare collection and handling equipment and procedures whenever possible.

Performance Level Guidelines:

- Immediate investigation and satisfactory resolution should be made for any indications of inconsistencies between revenue and passenger counts.
- Registering fareboxes should be introduced as funds permit.
- Revenue handling procedures should be established to prohibit revenues losses.

PERFORMANCE LEVEL GUIDELINES - MANAGEMENT

Objective: Be responsive to valid citizen comments.

Criteria :

- Existence of formal complaint procedure
- Resolution of complaints

General Practices/Operating Statistics:

It is the general practice in the transit industry to provide a formal procedure to handle the public's comments and complaints.

Performance Level Guidelines:

Any concerns by citizen groups about the complaint procedure should be addressed and satisfactorily resolved.

PERFORMANCE LEVEL GUIDELINES - MANAGEMENT

Objective: Establish contingency plans for emergency situations:

- . Weather
- . Gasoline shortage
- . Community emergencies

Criteria:

- Availability of written contingency plans
- Coordination of plan with the appropriate agencies.

General Practices/Operating Statistics:

It is the general practice in the transit industry to maintain contingency plans for extreme weather and emergency situations. Some systems are maintaining "mothball" vehicles, to be used in emergency situations.

Performance Guidelines:

- Cooperating agencies find the contingency plans acceptable.
- Management's best judgment and past performance indicate the adequacy of the plans.

PERFORMANCE LEVEL GUIDELINES

SYSTEM MARKETING

PERFORMANCE LEVEL GUIDELINES - MARKETING

Objective: Maintain an appropriate level of marketing effort

Criteria: Percent of budget allocated to marketing program

General Practices/Operating Statistics:

Based on other industries nationally, transit tends to underallocate resources to marketing. Firms in competitive industries spend two to ten percent of their budget on developing new services and selling them to the public.

Performance Level Guidelines:

The portion of the operating budget allocated to marketing should at least be two percent, and much more when the riding habit is low, or major service increases are planned.

PERFORMANCE LEVEL GUIDELINES - MARKETING

Objective: Provide a written program showing marketing objectives and an implementation plan for current year, and short range time period.

Criteria : Written program available

General Practices/Operating Statistics:

It is the general practice in the transit industry to follow a marketing program based on a written set of objectices.

Performance Level Guidelines:

Same as above.

PERFORMANCE LEVEL GUIDELINES - MARKETING

Objective: Provide effective public information by a variety of means, including printed and telephone information, and bus stop signs.

Criteria :

- Percent of bus stop not identified with signs
- Number of information outlets
- Periodic inspection of schedule and map format (updating)
- Phone information waiting time
- Percent of missed information calls

General Practices/Operating Statistics:

Transit industry experience is that public information, in many forms, can have a major effect on ridership.

Performance Level Guidelines:

- All major bus stops, especially at major generators, should be signed.
- Bus schedule information should be available at major generators and the information should be fully stocked.
- Schedule and map information and formats should be reviewed at least annually.
- Average phone information waiting time should be less than 1 minute.
- Not more than 5 percent of all information calls should be missed.

PERFORMANCE LEVEL GUIDELINES - MARKETING

Objective: Improve awareness and image of transit system through marketing

Criteria :

- Survey results
- Press coverage
- Commendations and complaints
- Public hearing comments
- Advisory committee comments

General Practices/Operating Statistics:

It is the general practice in the transit industry to regularly monitor the public's perception of the transit system.

Performance Level Guidelines:

Both formal (annual survey, commendations and complaints received) and informal (public hearing comments, advisory committee comments, press coverage) feedback about the public's perception of the system should indicate a positive image, and problem areas should not be recurring.

SECTION III:
EVALUATION
METHODOLOGY

CONTENTS

SECTION III - EVALUATION METHODOLOGY

	<u>Page</u>
Data Requirements	III-1
General Corrective Action Program	III-2
Detailed Performance Evaluation	III-5
External Indicators of Change	III-6
Cost Allocation Methodology	III-8
Performance Evaluations	following page III-11
Appendix III-A: Data Input for Performance Evaluation	
Appendix III-B: Bibliography Bus Cost Estimating Techniques	

LIST OF TABLES

<u>Table No.</u>		<u>Following Page</u>
III-1	General Corrective Actions by Objective Data	III-4
III-2	Key Performance Evaluation Indicators	III-5
III-3	UMTA Section 15 Level C Allocation	III-9
III-4	UMTA Section 15 Level B Allocation	III-9
III-5	Example of UMTA Section 15 Level C Usage for Cost Allocation	III-10
III-6	Allocation Formula Application RRTA System with Estimated Route Data	III-11

SECTION III

EVALUATION METHODOLOGY

After the establishment of desired performance levels for the system objectives, the next step is to evaluate the actual system performance, and compare it with the desired levels. Frequently, analysis tools, such as a cost-allocation formula to establish route costs, are needed. A methodology for identifying potential changes in those situations where improvement is indicated is also important. This section will detail these evaluation process steps and includes discussion of data requirements, a general corrective action identification program, detailed performance evaluations for 13 key indicators, a cost-allocation formula based on UMTA Section 15 reports, and case study examples.

The emphasis in this section is on identification of situations where changes or corrective actions are needed and what kinds of actions would be effective. This section therefore completes the basic evaluation framework consisting of objectives, criteria, desired performance levels, monitoring of current service, and evaluation to identify needed changes. Sections IV and V will present details on how to accomplish the needed service and fare related changes, respectively, and will determine costs and benefits of each specific action.

Data Requirements

Data must be gathered to determine the current level of performance relative to the established performance level guidelines. However, data availability was a key consideration when criteria for each objective in Section II was established. Efforts were made to identify criteria that could utilize data currently being collected for other reporting uses. Therefore, a minimum amount of new data would have to be collected to evaluate current performance.

As indicated in Appendix III-A to this section of the manual, most data required for evaluating performance are available directly from reports used for other purposes. Of the 23 different types of required data, there are only three which may require additional data collection and three which

may require special compilation of currently collected data. Most data are readily available from three primary sources: (1) Reports to PennDOT; (2) Section 15 reports; and (3) UMTA grant applications.

Data that may require special collection efforts include passenger load checks, on-time performance checks and attitude surveys. Areas wherein data are collected but not generally compiled in the manner to accomplish performance evaluations include utility energy usage, minutes from coordination meetings and compliant files. If objectives have been selected which require use of these type data, then procedures for collection and compilation should be planned and implemented.

Appendix III-A also sets forth the recommended frequency for collecting or reviewing each data item. The basic philosophy is that the collection or review frequency should be based on the probability of changes occurring in the item. For example, the number of employees in different skills/job classifications will not change unless a personnel action takes place. In contrast, the number of buses in maintenance changes daily. There are also long-term change items, such as the attitude of the residents toward the service which might change slowly and, therefore, requires monitoring perhaps only every other year.

An internal performance evaluation system depends on the accuracy of its input data, and will only be as good as the validity of the data. The emphasis should be on strengthening the existing data collection efforts, as much of the information is currently required in some form by state or federal agencies. Assuring that these efforts result in an accurate representation of operations should be a high management priority.

General Corrective Action Program

With the identification of data requirements and establishment of procedures for meeting the needs, the basic framework for internal performance evaluation is in place. The selection of objectives, development of desired performance levels, and establishment of a data collection program are the essential prerequisites to the evaluation of performance. This section will discuss the use of this basic framework in determining if corrective actions are needed, and then identify the general nature of the potential corrective actions that would be appropriate.

Use of Performance Data - Developing the data identified previously in this section will allow a transit property to determine the level of its actual performance regarding each objective. Data will frequently require summation and refinement, often through calculations using other data. An example is the need to combine total vehicle miles with the accident statistics to determine the miles per accident.

These summations and subsequent calculations should be done on a periodic basis with data subject to wide variations accomplished more often, perhaps monthly, compared to those that are fairly steady. Monthly or quarterly management reports showing desired and actual operating statistics should be used to display key objectives for review, analysis and, if appropriate, initiation of corrective actions.

This comparison of actual operations with the desired performance level is the key to performance evaluation. It is important, therefore, that two prior actions be incorporated in the performance comparisons. First, performance levels should be realistic ones, taking into account local conditions and establishing reasonable projected levels of attainment. Second, operating data to determine current performance must be collected or determined in a manner that results in an accurate representation of operations. Only if both of these have been accomplished will the evaluation be usable for decision-making regarding needed improvements.

Determination of Corrective Actions - After desired and actual performance levels have been compared, objectives needing corrective action can be identified. Any significant deviation from the desired performance level should result in an analysis of the actual performance trends. If trends in the actual performance data show consistent movement in the direction of desired levels, no new improvement actions are needed, but there still should be continued close monitoring.

For objectives that have below-desired performance that are not improving, corrective actions should be considered. It is not possible to detail every possible action to address each objective. However, general improvement actions by objective category can be identified. These are set forth in Table III-1 and are grouped into eight general categories which may be defined as follows:

Data Collection and Reporting - Determination of the frequency and accuracy of data to be collected, the thoroughness of the data reports and proper distribution lists.

Marketing - Evaluation of the public information programs for completeness and accuracy. Determination of what positive actions are being taken to improve awareness and public image.

Management Control - Determination of the appropriateness of systems and procedures for employees to follow in carrying out particular tasks. Investigation of the availability and use of documents addressing plans for accomplishing particular action. Proper attention given to see that systems, procedures and plans are implemented and followed.

Personnel Practices - Establishment of formal or informal training programs, personnel policies, incentive programs, and affirmative actions with respect to hiring and promotions.

Maintenance Practices - Establishment of vehicle and maintenance employee practices.

Equipment and Facilities - Evaluation of condition, and improvement or replacement of equipment, vehicles and facilities.

Routes and Scheduling - Investigation of changes in the bus services offered.

Fare Policies - Investigation of changes in the fares charged.

The management of each transit property must decide the actual steps to be taken within a particular category based on the local situation. Frequently, more than one category can affect performance, and an analysis of the situation must be made to determine if any one seems more applicable. The categories are not mutually exclusive, and a series of actions from different categories could be taken simultaneously. For instance, to minimize vehicle accidents, coordinated actions could include operator defensive driver training, detailed maintenance procedures that require all safety-related features of the bus to be checked daily and a driver safety award program. It is up to the manager to decide what action(s) is best to improve the specific performance deficiency.

TABLE III-1

GENERAL CORRECTIVE ACTIONS BY OBJECTIVE

GENERAL IMPROVEMENT AREAS

Objectives	Data Collection and Reporting		Marketing	Management Control	Personnel Practices	Maintenance Practices	Equipment and Facilities	Routes and Scheduling	Fare Policies
Efficiency									
1 - Revenue/Cost (1)		*		*				*	*
2 - Cost Increases				*					
3 - Operating/Administrative Employees				*	*				
4 - Duplicative Service								*	
5 - Energy Usage-Facility				*		*	*		
6 - Fuel/Oil Consumption						*	*		
7 - Labor Productivity(1)				*	*	*	*		
8 - Vehicle Productivity(1)					*	*	*	*	
9 - Bus Replacements							*		
10 - Service Vehicle Replacements							*		
11 - Communications Equipment							*		
Effectiveness									
1 - Accidents				*	*	*			
2 - Vehicle Cleanliness(1)				*	*	*	*		
3 - On-Time Performance								*	
4 - Courtesy					*				
5 - Coordination Service				*					
6 - Road Calls						*			
7 - Loading Standards (1)								*	
8 - Policy Headways(1)								*	
9 - Night and Weekend								*	
10 - Transfers								*	
11 - Amenities		*					*		
12 - Express Service								*	
13 - Special Services								*	
14 - Area Coverage								*	
15 - New Services								*	
16 - E&H Services								*	

TABLE III-1
GENERAL CORRECTIVE ACTIONS BY OBJECTIVE
(Continued)

GENERAL IMPROVEMENT AREAS						
Objectives	Data Collection and Reporting	Marketing	Management Control	Personnel Practices	Maintenance Practices	Equipment and Facilities
Utilization						Routes and Scheduling
						Fare Policies
1 - Cost/Passenger		*	*			*
2 - Subsidy/Passenger		*	*			*
3 - Rides Per Capita		*				
4 - Passengers/Mile or Hour (1)		*				*
5 - Change in Passengers/Mile		*				*
Fare Policy						
1 - Incentives		*				*
2 - Equity(1)						*
3 - Financial Stability						*
4 - Fare Adjustments(1)						*
Management						
1 - Reporting (1)	*					
2 - Budgets	*		*			
3 - Training and Evaluation (1)				*		
4 - Affirmative Action				*		
5 - Citizens' Input	*		*			
6 - Coordination Planning	*		*			
7 - Transit Plan	*		*			
8 - Van and Car Pools			*			
9 - Capital Improvements			*		*	
10 - Revenue Handling	*		*			
11 - Citizen Complaints			*			
12 - Contingency Plans			*			

TABLE III-1
GENERAL CORRECTIVE ACTIONS BY OBJECTIVE
(Continued)

	GENERAL IMPROVEMENT AREAS					
	<u>Data Collection and Reporting</u>	<u>Marketing</u>	<u>Management Control</u>	<u>Personnel Practices</u>	<u>Maintenance Practices</u>	<u>Equipment and Facilities</u>
						<u>Routes and Scheduling</u>
						<u>Fare Policies</u>
<u>Objectives</u>						
<u>Marketing</u>						
1 - Budgeted Amount		*	*			
2 - Written Plan		*				
3 - Public Information (1)		*			*	
4 - Awareness and Image (1)		*	*			

(1) These objectives are selected key performance indicators.

Detailed Performance Evaluation

From the universe of 52 objectives and performance level guidelines defined in Sections I and II, respectively, 13 have been identified as key indicators of performance. Identification of key indicators listed in Table III-2 was accomplished primarily to reduce the size of the group so that a manageable sample of detailed evaluations could be accomplished. Selection of these 13 was based on several criteria which are listed below:

- Judgment as to their significance and priority;
- Identification of at least one from each objective category;
- Elimination of redundant or similar measures; and
- Determination of the comprehensiveness of the group.

Selection of these 13 objectives is not aimed at influencing transit managers or boards as to what they should consider important in selection of their own performance measures. That decision must be made at the local level.

Evaluation Approach - Three steps have been included in the approach toward evaluating performance of the 13 key measures. First, an approach is defined aimed at identification of the specific problem. Since most performance levels involve a ratio, both the numerator and denominator should be assessed, independently if possible.

Second, pertinent factors are listed which should be considered in determining what is the cause of the problem. In this problem evaluation stage, we have identified many, but certainly not all, problem causes. Each transit system should assess their own problem cause based on their own local conditions.

Finally, we have prepared a listing of potential solutions that should be considered in improving the non-compliant performance. Here again, while an attempt was made to prepare a comprehensive set of solutions, there are likely to be others that are more local in nature that could also be appropriate.

Evaluation Results - Performance evaluations for the 13 objective areas listed in Table III-2 are included as the final part of this section of the manual. If other objectives were selected for your particular transit property, then a similar performance evaluation process should be conducted.

TABLE III-2

KEY PERFORMANCE EVALUATION INDICATORS

<u>Objective Category</u>	<u>Objective</u>	<u>Code</u>
Efficiency	Stabilize System Operating Ratio	EFY-1
	Maximize Productivity of Labor Force	EFY-7
	Maximize Productivity of Revenue Vehicles	EFY-8
Effectiveness	Improve On-Time Performance	EFT-3
	Stay within Load Standards	EFT-7
	Set Policy Headways	EFT-8
Utilization	Maximize Revenue Passengers/Vehicle Hour	UTL-4
Fare	Equitable Fares throughout the System	FRE-2
	Fare Adjustments Based on Cost Escalation	FRE-4
Management	Accurate and Complete Accumulation and Reporting of Data	MGT-1
	Employee Evaluation and Effective Training Programs	MGT-3
Marketing	Provide Effective Public Information	MKT-3
	Improve System Awareness and Image	MKT-4

These performance evaluations deal with many transit property issues/problems that are beyond those that involve service and fare changes. However, results of many of the performance evaluations do imply or are the trigger mechanism leading to service or fare change corrective actions. It is therefore based on these performance evaluations, as well as the evaluations of external or non-technical indicators of change presented in the next section, that service and/or fare changes should occur.

External Indicators of Change

The technical analyses of various characteristics of transit services presented in the preceding sections are important for all proposed changes. However, there might be occasions where factors other than the results of the technical evaluation process may indicate the need for service or fare revisions. Although these external or non-technical factors are usually more subjective and often less obvious than the technical ones, they may be just as important in identifying beneficial service changes. The non-technical factors that can be considered include:

Land Use Changes - Whenever changes in land use or residential patterns are planned or expected in the immediate future (e.g., a home for the elderly is to replace single family house, or an apartment complex is under construction) adjustments in the transit service should be publicized before and implemented concurrently with the change to encourage and guarantee its successful use afterwards. These adjustments might include schedule modifications, extensions of existing routes, rerouting, adding a new route, opening or extending weekend service, or altering stop locations.

Social Needs - When residents in part of the service area have only limited alternatives to travel by transit, introduction of service should be considered even though other indicators may not warrant it. Groups such as the elderly, who must rely on transit for such necessary trips as shopping and doctor's visits; the unemployed, who need transit to be able to find jobs; children of working parents, who have no other means of mobility; and people with very low incomes who cannot afford any other means of transportation, all have legitimate needs that should be addressed when deciding on schedules, route locations and the hours of service. It may also be necessary to consider special fares for some or all of these groups.

Parking - Whenever parking prices rise or parking availability is limited, transit headways can be shortened, and routes extended or added as necessary, to encourage and accommodate new riders.

Congestion - If street congestion is increasing, plans should be made in conjunction with other appropriate transportation agencies to provide for more effective transit service and greater transit usage to help alleviate the congestion. Improvements in the quality of service, such as shorter headways and increased amenities, will generally attract more passengers to transit. Frequently, physical separation of transit service in congested areas can both increase transit usage and aid in reducing overall traffic delays.

Energy - When gasoline prices rise sharply or supply is limited, headways can be shortened, existing routes extended, new routes and park-n-ride facilities added, or off-peak service hours lengthened to accommodate new riders and further encourage diversion from automobiles.

Street or Traffic Patterns - As street or traffic patterns change in response to population shifts, new development construction, changes in land use, etc., existing routes should be evaluated to determine their ability to accommodate these changes.

Public Comments - Careful monitoring of representative citizens' groups and press coverage may indicate the need for service or fare changes that might otherwise have gone undetected. In some cases, however, a vocal group may make requests, although the real needs for transit changes are modest. In other instances, major transit service deficiencies may not draw a justified citizen reaction because of inadequate citizen organization. For these reasons it is essential to provide processes that encourage citizen comments and also check their validity. Readily available and well publicized procedures for citizen input such as complaint boxes, regular questionnaires soliciting comments or an ombudsman's office with follow-up surveys measuring user and community sentiment on the significant issues raised can satisfy both of these needs.

Other Agency Requests - Requests from city, county or regional planning agencies, or even politicians, may be obtained for adjustments in transit services that could also trigger service or fare changes.

Regulations - Since transit operations receive federal funds, they are also expected to comply with federal regulations. Federal regulations have been and will continue to be a major force influencing services and fares. The impact of the Section 504 regulation on vehicle purchases is already being felt.

Funding Resources - The final, and perhaps the most important, external factor that could dramatically influence service and fares is the availability of federal, state and local funding resources to support the system.

Cost Allocation Methodology

When analyzing system and route performance, an important aspect is to understand the actual costs of providing service. On a systemwide basis this is relatively easy, as detailed records of system expenditures are routinely kept. However, records on the costs to operate an individual route are not readily available. Therefore, a methodology must be developed to allocate an appropriate portion of the systemwide expenses to each route. Then route revenues, which is information that can be directly collected, can be compared with the operating expenses and the financial performance for each route identified. Route financial performance data are valuable both as relative indicators to judge routes against each other and as absolute dollar figures on the cost of providing service.

Transit operators and researchers have suggested different approaches for estimating individual route operating costs.* The simplest, oldest and most widely used technique is the average costing approach, where total system operating costs are divided by either miles or hours of service, resulting in an average unit cost per mile or per hour. This average unit cost is then applied to either the routes miles or hours of service to determine the operating cost for the route. This simplistic approach is unacceptable for obtaining realistic cost estimates since the resulting cost factors are insensitive to performance characteristics of the route - - particularly operating speed and vehicle utilization.

Other techniques, using two or more variables, have been developed to account for individual route performance characteristics. Research has shown that in general the larger the number of variables used, the more accurate the representation of individual route costs will be. However, it has also been found that for most practical applications, a three variable approach is sufficiently sensitive, yet usable.

Three Variable Formula - The basic premise of the three variable cost allocation formula is that each operating expense item such as drivers' wages, fuel and repair costs, can be allocated to a particular transit resource or variable

* Appendix III-B sets forth a bibliography of reports which present various cost allocation techniques.

(e.g., vehicle miles, vehicle hours and peak vehicles). By allocating each expenditure to one or more resources, a series of unit cost factors (i.e., the cost allocation formula) can be derived from systemwide data. The allocation of expense items to a particular resource is typically done on the basis of logical judgments; however, some regression analysis has been performed in other research to confirm these intuitive decisions. The computation of individual route costs is then made by multiplying the unit cost factors by the appropriate resources for that route. Further details on the derivation of the three factor methodology can be found in references listed in the bibliography.

To further illustrate and explain the rationale in allocating expense accounts to the resources or variables, an explanation of the allocation process for the three variable formula, which can be easily based on financial reports such as UMTA Section 15, is presented below.

Vehicle Miles - Many costs are related directly to the miles of operation of each route. Expenses such as fuel, tires and maintenance of revenue equipment are a direct function of the number of miles operated. Expenses for vehicle bodies, brakes, engines, chassis and transmissions are also a function of exposure in terms of miles of service.

Vehicle Hours - The wages of bus drivers represent by far the largest single element of cost, accounting for about half of the total system costs. Operators are paid on an hourly basis, and thus the allocation of this wage expense is properly made to hours of service. Supervision of transportation operations is also directly related to the number of hours of service provided.

Peak Vehicles - Many individual expense items do not vary as functions of either vehicle miles or vehicle hours. For example, the costs resulting from providing and maintaining storage facilities for vehicles is determined from the size of the facility which is a function of the number of vehicles required to operate the service, rather than the number of miles or hours of service provided.

As noted, the UMTA Section 15 report forms an ideal basis for cost-allocation formula development. The recommended classification of each Section 15 operating expense item into one of the three allocation variables, for both Level B and Level C report formats, is presented in Table III-3 and Table III-4, respectively. Allocation of expenses in this manner, together with systemwide operating characteristics, i.e., vehicle miles, vehicle hours and peak vehicles, determined for the same period as the expenses, permits the derivation

TABLE III-3

UMTA SECTION 15 LEVEL C ALLOCATION

<u>Function and Expense Object Classes</u>		<u>BASIS OF ALLOCATION (%)</u>		
		<u>Hours</u>	<u>Miles</u>	<u>Vehicles</u>
501	Labor			
	010 Vehicle Operations	100%		
	041 Vehicle Maintenance		100%	
	042 Non-Vehicle Maintenance			100%
	160 General Administration			100%
502	Fringe Benefits			
	010 Vehicle Operations	100%		
	041 Vehicle Maintenance		100%	
	042 Non-Vehicle Maintenance			100%
	160 General Administration			100%
503	Services: Total Services			
	160 General Administration			100%
504	Materials and Supplies Consumed: Total Materials and Supplies			
	010 Vehicle Operations		100%	
	041 Vehicle Maintenance		100%	
	042 Non-Vehicle Maintenance			100%
	160 General Administration			100%
505	Utilities: Total Utilities			
	160 General Administration			100%

TABLE III-3

UMTA SECTION 15 LEVEL C ALLOCATION

(Continued)

Function and Expense Object Classes	BASIS OF ALLOCATION (%)		
	Hours	Miles	Vehicles
506 Casualty and Liability Costs: Total Casualty and Liability Costs			
03 Premiums for PL and PD Insurance			
160 General Administration		100%	
09 Other Corporate Losses			
160 General Administration			100%
507 Taxes: Total Taxes			
041 Vehicle Maintenance		100%	
508 Purchased Transportation Services			
160 General Administration			
509 Miscellaneous Expenses: Total Miscellaneous Expenses			
160 General Administration			100%
511 Interest Expense			100%
512 Leases and Rentals			100%

TABLE III-4

UMTA SECTION 15 LEVEL B ALLOCATION

<u>Function and Expense Object Classes</u>	<u>BASIS OF ALLOCATION (%)</u>		
	<u>Hours</u>	<u>Miles</u>	<u>Vehicles</u>
Function 010 - Administration of Transportation Operations			100%
Function 020 - Scheduling of Transportation Operations	100%		
Function 030 - Revenue Vehicle Operations			
501.01 Operators' Salaries and Wages	100%		
501.02 Other Salaries and Wages	100%		
502.15 Fringe Benefits Distribution	100%		
504.01 Fuel and Lubricants		100%	
504.02 Tires and Tubes		100%	
507.04 Vehicle Licensing and Registration Fees			100%
507.05 Fuel and Lubricant Taxes		100%	
510.01 Function Reclassifications			100%
510.02 Expense Reclassifications			100%
Function 041 - Maintenance Administration - Vehicles	100%		
Function 050 - Servicing Revenue Vehicles			100%
Function 060 - Inspection and Maintenance of Revenue Vehicles	100%		
Function 062 - Accident Repairs of Revenue Vehicles	100%		
Function 070 - Vandalism Repairs of Revenue Vehicles			100%
Function 080 - Servicing and Fuel for Service Vehicles			100%

TABLE III-4

UMTA SECTION 15 LEVEL B ALLOCATIONS
(Continued)

Function and Expense Object Classes	BASIS OF ALLOCATION (%)		
	Hours	Miles	Vehicles
Function 090 - Inspection and Maintenance of Service Vehicles			100%
Function 092 - Maintenance Administration - Facilities			100%
Function 100 - Maintenance of Vehicle Movement Control Systems			100%
Function 110 - Maintenance of Fare Collection and Counting Equipment			100%
Function 120 - Maintenance of Other Buildings, Grounds and Equipment			100%
Function 130 - Vandalism Repairs of Other Buildings, Grounds and Equipment			100%
Function 140 - Operation and Maintenance of Electric Power Facilities			100%
Function 145 - Preliminary Transit System Development			100%
Function 150 - Ticketing and Fare Collection			100%
Function 160 - General Administration			100%

TABLE III-4

UMTA SECTION 15 LEVEL B ALLOCATION
(Continued)

<u>Function and Expense Object Classes</u>	<u>BASIS OF ALLOCATION (%)</u>		
	<u>Hours</u>	<u>Miles</u>	<u>Vehicles</u>
Function 179 - Marketing			100%
Function 180 - General Function			100%

of unit cost elements - - cost per mile, cost per hour, and cost per peak vehicle. The basic three variable cost formula is:

$$C = U_m \times M + U_h \times H + U_{pv} \times PV$$

where:

C = Total operating costs

U_m , U_h and U_{pv} = Unit cost factors for miles, hours and peak vehicles, respectively.

M, H and PV = Operating statistics for miles, hours and peak vehicles, respectively.

Formula Development - There are four steps which small- to medium-sized transit properties in Pennsylvania should follow to develop their own cost allocation formula.

- (1) Gather annual operating (vehicle miles, vehicle hours and peak vehicles) and Section 15 financial statistics for the previous year.
- (2) Allocate expenses per either Table III-3 or Table III-4, depending on which Section 15 level is being utilized.
- (3) Determine unit cost factors by using the total allocated expense for miles, hours and peak vehicles together with respective operating statistics.
- (4) Combine unit cost factors to arrive at cost allocation formula.

Example of Formula Application - An example may be useful to show how a cost allocation formula could be developed. The Section 15 report and operating statistics for the Red Rose Transit Authority (RRTA) for FY79, as set forth in Table III-5, will be used. RRTA reported to UMTA in FY79 in a Level C format, so that the allocation in Table III-3 for Level C properties is appropriate. The expense totals for RRTA derived based on this allocation are summarized below:

Miles = \$	377,218	(26.5%)
Hours =	798,739	(56.2%)
Peak Vehicles =	245,746	(17.3%)

Total = \$1,421,703 (100.0%)

TABLE III-5

EXAMPLE OF UMTA SECTION 15 LEVEL C USAGE FOR COST ALLOCATION

Function and Expense Object Classes	BASIS OF ALLOCATION (%)			Total	ALLOCATION AMOUNT (\$)		
	Hours	Miles	Vehicles		Hours	Miles	Vehicles
501 Labor							
010 Vehicle Operations							
041 Vehicle Maintenance	100%	100%		\$894,148	\$673,556	\$129,264	\$10,125
042 Non-Vehicle Maintenance			100%				\$81,203
160 General Administration			100%				
502 Fringe Benefits				166,181			
010 Vehicle Operations							
041 Vehicle Maintenance	100%	100%			125,183	24,024	1,882
042 Non-Vehicle Maintenance			100%				15,092
160 General Administration			100%				
503 Services: Total Services				60,581			
160 General Administration			100%				60,581
504 Materials and Supplies Consumed:							
Total Materials and Supplies				164,722			
010 Vehicle Operations		100%				107,490	
041 Vehicle Maintenance		100%				42,792	
042 Non-Vehicle Maintenance			100%				4,091
160 General Administration			100%				10,349
505 Utilities: Total Utilities				4,291			
160 General Administration			100%				4,291

TABLE III-5
EXAMPLE OF UNTA SECTION 15 LEVEL C USAGE FOR COST ALLOCATION
(Continued)

Function and Expense Object Classes	BASIS OF ALLOCATION (%)			ALLOCATION AMOUNT (\$)		
	Hours	Miles	Vehicles	Total	Hours	Miles
506 Casualty and Liability Costs:						
Total Casualty and Liability Costs				\$ 74,825		
03 Premiums for PL and PO Insurance						
160 General Administration		100%				\$73,431
09 Other Corporate Losses						
160 General Administration			100%			1,394
507 Taxes: Total Taxes						
041 Vehicle Maintenance		100%		217		217
508 Purchased Transportation Services ⁽¹⁾						
160 General Administration						
509 Miscellaneous Expenses: Total Miscellaneous Expense						
160 General Administration			100%	5,279		5,279
511 Interest Expense			100%	8,881		8,881
512 Leases and Rentals			100%	42,578		42,578
TOTALS				\$1,142,703	\$798,739	\$377,218
						\$245,746

(1) Not included

The operating statistics for RRTA in FY79 were:

Total Vehicle Miles = 1,185,057
Total Vehicle Hours = 76,901
Total Peak Vehicles = 29

Unit cost factors are therefore:

$$U_m = \frac{\$ 377,218}{1,185,057} = \$0.318 \text{ per mile}$$

$$U_h = \frac{\$ 798,739}{76,901} = \$10.39 \text{ per hour}$$

$$U_{pv} = \frac{\$ 295,746}{29} = \$8,474 \text{ per peak vehicle}$$

The basic formula is then:

$$C = \$0.318 \times M + \$10.39 \times H + \$8,474 \times PV$$

The three operating characteristics of a specific route could then be put into this formula, and the operating cost calculated.

Route Application - An illustration of the application of this formula to two RRTA routes, as set forth in Table III-6, shows that during FY79, the fully allocated costs of operating the Lititz and 8th Ward/Parkside services were \$67,551 and \$177,406, respectively. RRTA could compare the revenue generated by these routes in FY79 and identify their financial performance.

TABLE III-6

ALLOCATION FORMULA APPLICATION
 RRTA SYSTEM WITH ESTIMATED ROUTE DATA

<u>Route</u>	<u>Peak Vehicles</u>	<u>Annual Vehicle Miles</u>	<u>Annual Vehicle Hours</u>
Lititz	2	50,000	3,340
8th Ward/ Parkside	3	112,000	11,200
Remainder	25	1,023,057	62,361
System Total	29	1,185,057	76,901

Lititz Route Costs

2 peak vehicles x \$8,474 per peak vehicle	=	\$16,948
50,000 miles x \$0.318 per mile	=	15,900
3,340 hours x \$10.39 per hour	=	34,703
Lititz Total		\$67,551

8th Ward/Parkside Route Costs

3 peak vehicles x \$8,474 per peak vehicle	=	\$ 25,422
112,000 miles x \$0.318 per mile	=	35,616
11,200 hours x \$10.39 per hour	=	116,368
8th Ward/Parkside Total		\$177,406

PERFORMANCE EVALUATIONS

PERFORMANCE EVALUATION

Objective: Stabilize system operating ratios. All routes at least at minimum levels (EFY-1)

Performance Level: Systemwide - 40 percent
Route - 80% of System Average - Okay
60% to 80% - Review
Below 60% - Adjust

I - Problem Identification

- A - Determine actual systemwide and route performance levels.
- B - If actual performance is below target levels, an analysis should be conducted to determine trends over the past several reporting periods. Routes or services with the poorest performance levels and those with steadily deteriorating performance should be identified for further analysis.
- C - Both the numerator and denominator must be analyzed to determine what the problem is. A poor operating ratio could result from low revenue figures and/or excessive costs. To assess which of these problems best explains the performance, similar type routes to the one under review should be compared to see if low revenue or excessive costs seem to be the major problem.

II - Problem Evaluation

- A - Assuming that the problem identification indicates that low revenue is the dominant problem, efforts should be focused on understanding why revenue is poor. Some factors which should be considered in the evaluation to determine possible causes are:
 - 1 - For systemwide improvements, the overall fare structure should be compared to that of other Pennsylvania systems to determine if fare increases are appropriate;

- 2 - For route improvements, passenger generating capability should be reviewed with respect to characteristics of the area/population served, including:
 - a. population density
 - b. auto ownership
 - c. average family income
 - d. age distribution of population;
 - 3 - For route improvements, service characteristics should be reviewed, including:
 - a. new versus established service
 - b. policy versus demand-based service
 - c. directness of service
 - d. major activity centers served
 - e. schedule coordination
 - f. travel time
 - g. public information/passenger amenities
- B - If the comparative analysis indicates excessive costs are the problem, then efforts should focus on why costs are higher than normal. Some factors affecting costs which should be evaluated are:
- 1 - For systemwide evaluations, the following general cost categories should be reviewed:
 - a. wage rates and fringe benefits
 - b. labor practices
 - c. outside contracts
 - d. maintenance practices;
 - 2 - For route improvements, the following should be investigated:
 - a. excessive amount of service both in span and headways
 - b. lower than average running time
 - c. excessive layover/recovery time
 - d. stop spacing too close
 - e. excessive amount of coverage.

III - Potential Solutions

- A - Types of solutions that can positively affect revenue generation include:
- 1 - Fare increases or fare promotion policies such as promoting transit passes or multi-ride tickets;

- 2 - Routing changes to provide more direct service, better service to major activity centers and coordination of service with other routes or employment start and end times; and
 - 3 - Marketing and promoting of existing services or improved services can encourage additional utilization, and thereby increase revenue.
- B - Solutions which can help reduce operating costs include:
- 1 - Scheduling changes involving the following:
 - a. increase headways
 - b. decrease span
 - c. cutbacks (short-turn) on area coverage;
 - 2 - Rerouting to improve running time and/or excessive layover (or recovery) time; and
 - 3 - Elimination of the entire route with some consideration given to servicing a portion of the eliminated route by an extension to another route.

PERFORMANCE EVALUATION

Objective: Maximize productivity of labor force (EFY-7)

Performance Level: 3.5 buses/mechanic
Payhours/platform hours of 1.2
Annual vehicle hours/employee of 1,500

I - Problem Identification

- A - Determine actual performance levels
- B - If actual performance is below target levels, an analysis should be conducted to determine trends over the past several years. Measures with poorest performance and those with steadily deteriorating performance should be identified for further analysis.
- C - Both the numerator and denominator must be analyzed to determine what the problem is.

II - Problem Evaluation

- A - A ratio of less than 3.5 buses/mechanic could be a vehicle or a labor problem.
 - 1 - Assuming the problem was vehicle caused, the evaluation process should entail the following assessments:
 - a. average age of fleet compared to state-wide 1978 average of 7.2 years
 - b. number of types of vehicle maintained
 - c. number of ADB's which are prone to design defects/deficiencies
 - d. mileage operated by the vehicles
 - 2 - If an excessive number of mechanics are identified as the problem, then the following evaluations should be made:
 - a. mechanics' duties outside vehicle maintenance
 - b. skill level and training

- c. facility and equipment deficiencies
 - d. extent of outside contract services
- B - A ratio of more than 1.2 payhours/platform hours usually points to an excessive number of payhours assuming that the level of service is fixed. Reduction in payhours should be evaluated based upon consideration of the following:
- 1 - Union contract provision;
 - 2 - New hires rather than payment of overtime penalties; and
 - 3 - Rescheduling and recutting of runs to eliminate unproductive time.
- C - A ratio of less than 1,500 annual vehicle hours/employee usually points to an excessive number of employees assuming that the level of service is fixed. However, since certain manpower requirements are more closely associated with mileage, this assumption should be checked by a review of annual vehicle miles/employee. Reduction in the number of employees should be evaluated based on the following:
- 1 - Experience and employee skill levels;
 - 2 - Functions performed in-house, rather than through outside contract services, e.g., claims adjustments, marketing and planning;
 - 3 - Use of overtime; and
 - 4 - Duplicate functions.

III - Potential Solutions

- A - Type of solutions that can improve the buses/mechanic ratio include:
- 1 - Reduce the average fleet age;
 - 2 - Standardize to one or two vehicle types;
 - 3 - Consider outside contract services;
 - 4 - Improve mechanic training programs; and
 - 5 - Refurbished or new facility and latest shop tools and equipment.

B - Excessive payhours compared to platform hours
can be improved in the following ways:

- 1 - Remove antiquated work rules from
labor contract;
- 2 - Consider new hires rather than
overtime pay;
- 3 - Accomplish new operation schedules to
eliminate unproductive time; and
- 4 - Contract work rule changes, i.e., part-time drivers.

C - Ratio of annual vehicle hours/employee can be
improved by:

- 1 - Upgrading the employee skill levels;
- 2 - Using outside contract services;
- 3 - Using overtime; and
- 4 - Eliminating redundant functions.

PERFORMANCE EVALUATION

Objective: Increase availability and productivity of revenue vehicles (EFY-8)

Performance Level: Vehicle hours/peak vehicle of 3,000
Scheduled Speed of 12 miles per hour

I - Problem Identification

- A - Determine actual performance levels.
- B - If actual performance level is below target levels, an analysis should be conducted to determine trends over the past several years. Routes with poorest performance and those with steadily deteriorating performance should be identified for further analysis.
- C - A low hours/peak vehicle ratio could result from either low vehicle hours or an excessive number of peak vehicles. This is easily determined by comparing the peak to base vehicle ratio. If it is greater than 1.5, then the system has a more than average peak vehicle usage.

II - Problem Evaluation

- A - Assuming that the problem identification indicated that low vehicle hours are the dominant problem, efforts should be focused on determining why vehicle hours are low. The primary factor which should be considered in this evaluation is the amount of non-peak period service including midday, evening and weekend.
- B - It is more likely that a low vehicle hours/peak vehicle ratio is caused by an excessive amount of peak period service. Some factors which should be considered in the evaluation to determine possible causes are:

- 1 - Loads experienced on peak period service; and
 - 2 - Services dominated by work trip users.
- C - Factors affecting operating speed which should be evaluated include:
- 1 - Stop spacing too close;
 - 2 - Congestion problems along route;
 - 3 - Illegal parking at stop locations;
 - 4 - Excessive number of traffic signals;
 - 5 - High load factors;
 - 6 - Excessive amount of turns; and
 - 7 - Scheduled speeds.

III - Potential Solution

- A - Types of solutions which could increase vehicle hours include:
- 1 - Increase demand for non-peak period service through marketing and fare incentive programs; and
 - 2 - Revise route structure in non-peak periods so that it more directly satisfies non-peak period activity centers.
- B - Peak period vehicle demands could be reduced in several ways including:
- 1 - Spreading out the peak service demand period through staggering of work hours;
 - 2 - Obtaining larger capacity vehicles such as articulated buses; and
 - 3 - Increasing the use of more direct and faster services such as express.
- C - Types of solutions which could increase operating speed include:
- 1 - Rerouting to reduce number of turns and avoid traffic congestion points;
 - 2 - Space stop locations farther apart and enforce no parking at stop locations;
 - 3 - Implement bus priority program that may include traffic signal pre-emption or exclusive bus lanes; and
 - 4 - Scheduling revisions.

PERFORMANCE EVALUATION

Objective: Improve on-time performance (EFT-3)

Performance Level: Peak period - 90%
Non-Peak - 95%

I - Problem Identification

- A - Determine actual peak and non-peak period performance.
- B - Routes that are below the target levels should be identified for further analysis.

II - Problem Evaluation

Poor on-time performance can result from many factors which include:

- 1 - Traffic congestion;
- 2 - High load factors;
- 3 - Poor street conditions/detours;
- 4 - Illegal parking at stop locations;
- 5 - Insufficient recovery time;
- 6 - Poor driver performance;
- 7 - Mechanical difficulties; and
- 8 - Improve scheduled running time.

III - Potential Solutions

Types of solutions which could improve on-time performance are:

- 1 - Rerouting to reduce exposure to high traffic congestion or poor street condition areas;
- 2 - Recut operating schedules to allow sufficient recovery time and provide for more realistic running times;

- 3 - Improve driver awareness of on-time service reliability;
- 4 - Improve reliability of vehicles;
- 5 - Utilize two-way radio communications equipment to improve service reliability; and
- 6 - Eliminate auto parking at bus stops.

PERFORMANCE EVALUATION

Objective: Stay within load standards (EFT-7)

Performance Level: Peak period load factor of 1.4
Non-peak - no standees

I - Problem Identification

- A - Determine actual peak and non-peak period performance.
- B - Trips that exceed the target load factors should be identified for further analysis.

II - Problem Evaluation

Excessive loads during peak and/or non-peak periods can occur as a result of many factors. Some factors which should be considered in the evaluation to determine possible causes are:

- 1 - Whether excessive loads occur on just one or two trips on a route;
- 2 - Number of major activity centers served by route;
- 3 - Primary destinations of the patrons, i.e., school or work;
- 4 - Point on trips where loads become excessive;
- 5 - On-time performance of trip which could imply that trip is picking up people who are early for subsequent service; and
- 6 - Load factors on trips both earlier and later than trip being evaluated.

III - Potential Solutions

Types of solutions which could help reduce excessive loads on certain peak and non-peak period trips include:

- 1 - Revise schedule to provide more frequent service;
- 2 - Split the route up into two routes, each to serve different trip purposes;
- 3 - Addition of tripper service to reduce loads;
- 4 - Institute closed door policy once load standard is met;
- 5 - Institute some express service on the route;
- 6 - Reroute lightly patronized routes to service area of the heavily patronized routes; and
- 7 - Utilization of larger capacity vehicles.

PERFORMANCE EVALUATION

Objective: Set headways on ridership (EFT-7), with policy headways as minimum (EFT-8).

Performance Level: Peak period - 30 minutes
Non-peak period - 60 minutes

I - Problem Identification

- A - Determine actual peak and non-peak performance.
- B - Routes that do not comply with the policy headway guidelines should be identified for further analysis.
- C - Non-compliance with policy headways are due to the special nature of particular routes or lack of resources to meet standards.

II - Problem Evaluation

- A - Assuming this comparative analysis indicates that the headways were set based upon the special nature of the route rather than for lack of resources, the evaluation should focus on determining if non-compliant headways are justified. Some factors which should be evaluated are:
 - 1 - Ridership by trip purpose
 - a. work
 - b. shopping
 - c. school
 - d. recreation
 - e. medical
 - 2 - Characteristics of service area compared to those of other routes
 - a. population, income and age
 - b. distance from collection to distribution area

3 - Route characteristics

- a. new versus established service
- b. alternative service availability
- c. resources necessary to meet policy headways

B - If the comparative route analysis indicates lack of resources as the problem, then efforts should be focused on resource commitment analyses. Some factors affecting the allocation of resources are:

1 - Characteristics of the fleet

- a. number of spare buses
- b. peak to base ratio;

2 - Fleet and service commitments to other routes

- a. route exceeding policy headways
- b. route ridership per mile or per hour of service
- c. revenue/cost relationships by route;

3 - Funding resource restrictions; and

4 - Manpower resource restrictions.

III - Potential Solutions

A - Types of routes that may be exempt from meeting policy headways include:

- 1 - Routes that are specially designed for one particular trip purpose;
- 2 - Routes where the residential or collection zone is a much greater distance from the distribution zone (perhaps 1.5 times farther) than other routes;
- 3 - A route has been recently established, and its ridership potential has not been reached; and
- 4 - Routes where alternative service is available.

B - Types of solutions that could improve resource availability are:

- 1 - Cutbacks, rerouting, or increased headways on other routes;

- 2 - Improvements to maintenance practices and, therefore, vehicle availability;
- 3 - Acquisition of new and/or used vehicles; and
- 4 - Use of part-time drivers.

PERFORMANCE EVALUATION

Objective: Maximize revenue passengers per
vehicle hour (UTL-4)

Performance Level: Systemwide - 20 passengers/vehicle hour
Route - 80% of System Average - Okay
60% to 80% - Review
Below 60% - Adjust
and/or Reduce
Service

I - Problem Identification

- A - Determine actual systemwide and route performance levels.
- B - If actual performance is below the target levels, an analysis should be made to determine trends over the past several reporting periods. Routes or services with the poorest performance levels and those with steadily deteriorating performance should be identified for further analysis.
- C - As is the case with any ratio indicator, both the numerator and denominator must be analyzed to determine what the problem is. Poor ridership attraction will result in relatively low passenger/vehicle hour statistics as will excessive vehicle hours. To assess which of these problems best explains the situation, similar type routes to the one under review should be compared to see if poor ridership or excessive vehicle hours seem to be the major problem with a particular route.

II - Problem Evaluation

- A - Assuming this comparative analysis indicates poor ridership rather than excessive vehicle hours is the dominant problem, efforts should be focused on understanding why ridership is poor. Some factors which should be evaluated to determine possible causes are:

- 1 - Characteristics of area/population served
 - a. population density
 - b. auto ownership
 - c. average family income
 - d. age distribution of population, etc.;
 - 2 - Service characteristics
 - a. new versus established service
 - b. policy versus demand-based service
 - c. directness of service
 - d. service to major generators
 - e. coordination with major work shifts
 - f. comparison with travel time by auto, etc.
- B - If the comparative route analysis indicated excessive vehicle hours is the problem, then efforts should focus on understanding why the denominator value is higher than normal. Some factors affecting the denominator which should be evaluated are:
- 1 - Excessive slack in the schedule;
 - 2 - Excessive layover time;
 - 3 - Lower than average running speed;
 - 4 - Stop spacing too close;
 - 5 - Hours of service excessive for the area served; and
 - 6 - Headways too frequent for the area served.

III - Potential Solutions

- A - Types of solutions that could positively affect revenue passengers are:
- 1 - Marketing and promotion of existing or improved service can encourage ridership as can better distribution of schedules, more waiting shelter and more bus stop signs;
 - 2 - Improved fare policy dealing both with convenience and equity. Also, redefining zone boundaries, reducing zone charges, fare incentives and promoting transit passes or multi-ride tickets; and
 - 3 - Routing revisions can generate more ridership by better serving major activity centers and/or residents.

B - Types of solutions that could reduce the number of vehicle hours are:

- 1 - Scheduling revisions to minimize "unproductive" schedule time including:
 - a. headway changes
 - b. hours of service changes
 - c. reduced layover/recovery time
 - d. improved running time;
- 2 - Routing revisions to reduce "unproductive" area coverage, including:
 - a. cutbacks
 - b. reroutings.

PERFORMANCE EVALUATION

Objective: Provide Equitable Fares throughout the System (FRE-2).

Performance Level: Zone charges for long distance suburban service and surcharge for express service.

I - Problem Identification

- A - To determine whether a zone fare system is appropriate, the fare rate per total route length (miles) should be computed for all routes. If the rate per route mile between the high and low rates differs by a factor of more than two to one, then a zone structure should be considered.
- B - Express services are a higher quality of transit operations and, as such, should be offered at a premium rate. If express service is provided and it offers a time advantage of 20 percent or more over the regular route time for the express portion, then a surcharge is appropriate.

II - Problem Evaluation

- A - Assuming that the rate charged per route mile differs widely throughout the system, factors that should be considered in assessing the appropriateness of a zone fare system on the low rate per mile routes are:
 - 1 - Service area characteristics
 - a. population density
 - b. family income levels
 - c. auto ownership
 - d. age distribution;
 - 2 - Quality of service provided
 - a. directness
 - b. headways
 - c. travel time
 - d. passenger amenities
 - e. new versus established route; and

3 - Ridership characteristics

- a. riders per mile or per hour of service compared to system average
- b. average trip length.

B - Assuming that express routes offer a 20 percent time advantage over regular route service, factors that should be considered in charging a premium are:

- 1 - Service area characteristics;
- 2 - Quality of service provided;
- 3 - Ridership characteristics;
- 4 - Loads factors on trips to the extent that standees occur; and
- 5 - On-time performance of express service.

III - Potential Solutions

- A - Develop a zone fare structure that depends on distance travelled, although the rate per mile for long distance routes should not necessarily be as high as the rate per mile on shorter distance ones. Trip time data should be considered in developing the rate and the zonal boundaries.
- B - A surcharge for express services offering a 20 percent trip time savings over regular route service should be adopted if other performance aspects of service are met.

PERFORMANCE EVALUATION

Objective: Fare Adjustments based on Cost Escalation (FRE-4)

Performance Level: Fare increases implemented when costs escalate more than 25 percent over a certain period.

I - Problem Identification

- A - The last time a systemwide fare increase was accomplished should be determined. If it were longer than three years, or if during the past three years costs have escalated by more than 25 percent, then a systemwide fare increase should be considered.

II - Problem Evaluation

- A - Factors to be considered in evaluating the need and/or desire for increasing systemwide fares are:
 - 1 - Current base fare rate compared to comparable sized Pennsylvania properties;
 - 2 - Revenue/cost ratio compared to performance guidelines;
 - 3 - Quality of the service provided including:
 - a. on-time performance
 - b. missed trips
 - c. average running time
 - d. directness of service
 - e. extent of passenger information and amenities;
 - 4 - Current transit system ridership trends and characteristics
 - a. low income
 - b. elderly
 - c. students;
 - 5 - Public image of the system; and
 - 6 - Attitude of local funding agencies with respect to increasing user charges.

III - Potential Solutions

- A - Institute selected or systemwide fare increases with the extent of increase dependent upon the amount of revenue desired. Public notification of the increase should point out reasons underlying the change. The public should be convinced to understand and accept the need for an increase.

PERFORMANCE EVALUATION

Objective: Accurate and Complete Accumulation and Reporting of Data (MGT-1)

Performance Level: Reports should be accurate, complete and submitted on time.

I - Problem Identification

- A - Generally, transit properties compile data from several sources such as vehicle miles from both operations and maintenance department records. A measure of data and recordkeeping accuracy would be the degree of data agreement between multiple sources. Due dates of reports and actual submission dates should be compared over the past year.

II - Problem Evaluation

- A - Factors to be considered in evaluating the accuracy and completeness of data collection are:
 - 1 - Number of sources used in data retrieval;
 - 2 - Frequency in which data is collected;
 - 3 - Skill level of personnel collecting data;
 - 4 - Use of standardized forms in data collection; and
 - 5 - Management direction and extent of written data collection procedures.
- B - Factors affecting the accuracy, completeness and on-time delivery of reports include:
 - 1 - Number of mandatory reports prepared annually;
 - 2 - Number of special situation reports prepared last year;
 - 3 - Responsibility for report preparation and review;

- 4 - Extent of management direction involving report preparation; and
- 5 - Time allocated by report for report preparation.

III - Potential Solutions

- A - There should be one primary source for all data. Data compiled from secondary sources should be compared to primary source data and reasons for any discrepancies noted and corrected.
- B - Data should be compiled on standardized forms. Reasonableness of all entries should be checked.
- C - Format and general content of all reports should be consistent with the purpose for which they are being prepared.
- D - All report requirements should be identified several months before the due dates. A time-phased plan should be prepared to identify all actions required to complete the report with milestones identified where key interim products are due. Adequate time should be permitted for review and final production.
- E - Reports should be distributed to appropriate agencies.
- F - Valid criticisms on prior reports should be reviewed and, if appropriate, corrected in subsequent reports.

PERFORMANCE EVALUATION

Objective: Employee Evaluation and Effective Training Programs (MGT-3)

Performance Level: Evaluate all employees annually with training programs offered.

I - Problem Identification

- A - To determine whether an improved or new evaluation program is required, management staff should be consulted with to obtain their views.
- B - To determine the effectiveness of the training programs staff are given the opportunity to attend, the request for attendance at programs offered last year should be reviewed. If requests are greater than the available opening, then the programs appear to be effective; if not, improvements are warranted.

II - Problem Evaluation

- A - Factors that should be considered in evaluating the employee evaluation process are:
 - 1 - Frequency in which employee evaluations are conducted;
 - 2 - Whether or not standardized forms are used in the process;
 - 3 - Existence of a written evaluation process policy; and
 - 4 - Relationship between performance and salary increases.
- B - Effectiveness of employee training programs should be evaluated by giving consideration to the following:

- 1 - Number of training programs periodically offered;
- 2 - Process whereby employees are offered opportunity to attend;
- 3 - Formal policy toward time off and reimbursement of expenses for those attending training programs;
- 4 - Number of employees in management or supervisory positions who once held lower level positions; and
- 5 - Employee turnover rate.

III - Potential Solutions

- A - A formal written employee evaluation program should be implemented both for hourly and salaried employees. It should be conducted at least annually with both a written and oral review. For management employees, performance could be evaluated based on the manager's obtainment of a predetermined set of objectives. For example:

<u>Position</u>	<u>Objective</u>
Marketing Director	Number of marketing programs implemented
Maintenance Director	Improvement in road call rate
Operations Director	Reduction in unproductive driver time
Financial Director	Improvement in budget controls

- B - Employee training programs should be offered with emphasis in both supervisory and functional skills. Management should identify the appropriate training programs and offer staff the opportunity to attend. Consideration should be given to both in-house and training programs offered by outside sources.

PERFORMANCE EVALUATION

Objective: Provide Effective Public Information (MKT-3)

- Performance Level:
- All major stops should have bus stop signs
 - Information racks should be checked and filled
 - Percentage of missed calls should be less than five
 - Maps and public timetables should be reviewed for currency at least annually

I - Problem Identification

To identify whether a public information program is effective, the actual performance should be determined in relation to the performance level guidelines listed above. The following factors should be determined:

- 1 - Percent of major stop locations that are without a bus stop sign.
- 2 - Frequency in which information racks are checked and filled.
- 3 - Percentage of missed telephone information calls and the average waiting time for the phone to be answered.
- 4 - Last time the system map and public timetables were revised.

II - Problem Evaluation

- A - The following factors should be reviewed to evaluate the current public information program:
- 1 - Amount of money budgeted for public information purposes;
 - 2 - Person or persons responsible for public information;

- 3 - Existence of written policies and procedures concerning:
 - a. information racks and their replenishment
 - b. handling of telephone calls
 - c. revising maps and public timetables
 - d. bus stop sign locations;
- 4 - Number and location of information centers and the percentage of copies not taken when racks are replenished;
- 5 - Experience and training of persons responsible for telephone information, the number of outside phone lines and the other duties, if any, of the information operator;
- 6 - Costs and number of copies printed of public timetables and system maps;
- 7 - Number of reprints made to replenish stock versus number of times printing is required resulting from change; and
- 8 - Attitudes and opinions of users.

III - Potential Solutions

Effective and accurate public information is essential not only in increasing ridership, but in maintaining current ridership. Therefore, efforts should be expended toward making public information easily available for those who want and need it.

PERFORMANCE EVALUATION

Objective: Improve System Awareness and Image (MKT-4)

Performance Level: - Qualitative rating of system by riders and non-riders
- Number of complaints
- Number of transit newspaper articles
- Number of public meetings/hearings

I - Problem Identification

To identify whether the public's awareness and image of the system require more attention, the system's performance with respect to the performance level guidelines listed above should be reviewed. The following factors should be determined.

- 1 - Trends in the attitudes of riders and non-riders concerning the job done by the transit system;
- 2 - Historical review of the number by type of valid monthly complaints;
- 3 - Number of transit-related newspaper articles by month and rating as to whether they were pro or con transit; and
- 4 - Opportunities the general public was given to express their views toward the system as determined by the number of public meeting/hearings held last year.

II - Problem Evaluation

A - The following factors should be reviewed to evaluate the image and public awareness of the system:

- 1 - Existence of policies and procedures for conducting rider and non-rider attitude surveys:
 - a. formal or informal
 - b. frequency
 - c. comparison of current results with prior ones;

- 2 - Existence of policies and procedures to handle valid complaints:
 - a. openly accepted
 - b. response time for reply
 - c. improvement actions, if necessary;
- 3 - Relationship of management staff and the media:
 - a. invitation to Board meetings
 - b. policy toward preparing and submitting press notices
 - c. open communications with media; and
- 4 - Use of public meeting/hearing process to both inform and truly solicit public comment and views:
 - a. attendance record
 - b. advertisement procedures
 - c. quality of presentation
 - d. availability of bus service to and from public sessions.

III - Potential Solutions

A high level of awareness of the system and the services offered are essential elements to any transit system. Furthermore, a positive image of the system in the mind of the public will help quiet major criticisms associated with service and fare changes. Therefore, efforts should be expended in taking positive actions toward improving the system's awareness and image.

APPENDIX III-A

DATA INPUT FOR PERFORMANCE EVALUATION

APPENDIX III-A

DATA INPUT FOR PERFORMANCE EVALUATION

Data Item	Objectives Using Item	[Source] or Current Reporting Use	Suggested Normal Frequency
System Expenses	EFY-1 EFT-12 EFY-2 EFT-13 EFY-5 EFT-15 EFY-6 UTL-1 EFY-7 UTL-2 EFY-10 FRE-4 MGT-2 MKT-1	Section 15	Monthly
System Revenues	EFY-1 FRE-3 UTL-2 FRE-4 MGT-10	PennDOT	Monthly
Route Revenues	EFT-12 EFT-13	PennDOT	Annually
System, Route Vehicle Miles	EFY-1 EFT-1 EFY-6 EFT-6 EFY-7 EFT-12 EFY-8 EFT-13 UTL-4 UTL-5	PennDOT	When Change

APPENDIX III-A

DATA INPUT FOR PERFORMANCE EVALUATION

(Continued)

Data Item	Objectives Using Item	[Source] or Current Reporting Use	Suggested Normal Frequency
System, Route Vehicle Hours	EFY-1 EFT-12 EFY-7 EFT-13 EFY-8 UTL-4 UTL-5	PennDOT	When Change
Vehicle Load Counts	EFT-7	[Load Checks]	Quarterly
System Ridership (Number & Type)	EFT-10 UTL-1 EFT-16 UTL-2 FRE-1 UTL-3 MGT-10 UTL-4 UTL-5	PennDOT	Quarterly
Route Ridership (Number & Type)	EFT-9 EFT-13 EFT-10 EFT-16 EFT-12 EFT-8	PennDOT	Annually
System & Route Transfers	EFT-10 EFT-11	PennDOT	Annually
Personnel Information	EFY-3 MGT-3 EFY-7 MGT-4	PennDOT	When Change

APPENDIX III-A

DATA INPUT FOR PERFORMANCE EVALUATION

(Continued)

Data Item	Objectives Using Item	[Source] or Current Reporting Use	Suggested Normal Frequency
Service Area Information, Map with Routes	EFY-4 EFT-13 EFT-8 EFT-14 EFT-9 EFT-15 EFT-10 EFT-16 EFT-11 UTL-3 EFT-12 FRE-2 MGT-8	UMTA Capital Grant Application [MPO – Planning Agency Records]	Annually, or When Change
Daily Operating Information ^(a)	EFY-6 EFT-2 EFY-8 EFT-4 EFT-6	Daily Operating Report	Daily
System Vehicle Fleet & Facility, Size and Characteristics	EFY-7 EFT-11 EFY-8 EFT-11 EFY-9 EFT-16 EFY-10 MGT-9 EFY-11 MGT-10 MKT-3	Section 15 (Buses) PennDOT	When Change

APPENDIX III-A

DATA INPUT FOR PERFORMANCE EVALUATION

(Continued)

Data Item	Objectives Using Item	[Source] or Current Reporting Use	Suggested Normal Frequency
Headway Sheets	EFY-1 EFT-8 EFY-8 EFT-9 EFT-3 EFT-12 EFT-7 EFT-13 EFT-16	Headway Sheets	When Change
Fare Levels	FRE-1 FRE-3 FRE-2 FRE-4	PennDOT	When Change
Budget Amounts	EFY-2 FRE-3 EFY-9 FRE-4 EFY-10 MGT-2 EFY-11 MGT-8 UTL-2 MGT-9 MKT-1	Projections to PennDOT [Budget]	Prepared Annually, Amended as Needed; Compared with Expenses Monthly
Utility Usage	EFY-5	[Monthly Utility Statements]	Monthly
Accidents (Number & Type)	EFT-1	Section 15	Quarterly
On-Time Checks	EFT-3	[On-time Checks]	When Do Load Checks

APPENDIX III-A

DATA INPUT FOR PERFORMANCE EVALUATION

(Continued)

Data Item	Objectives Using Item	[Source] or Current Reporting Use	Suggested Normal Frequency
Coordination Meetings Held, Attended	EFT-5 MGT-6 MGT-8	[Meeting Minutes]	Quarterly
Hearings, Other Public Meetings Held; Attendance, Comments	MGT-11 MKT-4	UMTA Grant Applications	Quarterly, and When Prepare Grants
Complaints Received	EFT-4 MGT-5 MKT-4	[Complaints File]	Monthly
Public Attitude Toward System	MGT-11 MKT-4	[Attitude Survey]	Two Years

(a) Includes fuel and oil used, vehicle availability and maintenance report, supervisory reports, breakdowns.

APPENDIX III-B

BIBLIOGRAPHY

BUS COST ESTIMATING TECHNIQUES

APPENDIX III-B

BIBLIOGRAPHY

BUS COST ESTIMATING TECHNIQUES

- Arthur Andersen and Company, "Bus Route Costing for Planning Purposes."
Transport and Road Research Laboratory Supplementary Report 108 uc.
- Cherwony, Walter, "A Cost Centers Approach to Transit Performance."
Transit Journal, Washington, D.C., American Public Transit Association.
- Cherwony, Walter and McCollom, Brian E., "Development of Multi-Modal Cost Allocation Models." Proceedings of Fourth Annual Intersociety Conference on Transportation, ASME, 1976.
- Cherwony, Walter and Mundle, Subhash R., "Development of Transit Cost Allocation Models." ASCE Journal, Fall, 1979.
- Cherwony, Walter and Mundle, Subhash R., "Peak-Base Cost Allocation Models." Research Record 663.
- Ferreri, Michael G., "Development of Transit Cost Allocation Formula." Highway Research Record 285.
- McClenaman, J. W., Nicholls, D, Elms, M., and Bly, Pitt, "Two Methods of Estimating the Crew Costs of Bus Service." Transport and Road Research Laboratory Supplementary Report 364, 1978.
- Oram, Richard L., "Peak-Period Supplements: the Contemporary Economics of Public Transit." January, 1979.
- Polin, Lewis, "Allocation of Peak Period Costs - Orange County Transportation District." Unpublished memorandum, June, 1979.
- Quillian, L, Hillegas, T., and Zimmerman, S., "A Bus Operating Cost Method for Planning Analysis." October, 1977.
- Reilly, J., "Transit Costs During Peak and Off-Peak Hours." Paper presented at the Annual Meeting of the Transportation Research Board, Washington, D.C., 1977.
- Simpson & Curtin, "Revenue and Cost Analysis - Technical Memorandum 41." Northern California Transit Demonstration Project, January, 1966.
- Simpson & Curtin, "Transit Cost Allocation Model Development - Transit Technical Memorandum Number 1, Miami Urban Area Transportation Study." Prepared for the Metropolitan Dade County, Florida, July, 1967.

Simpson & Curtin, "Transit Operations and Financial Analysis System (TOFAS)." City of Laval Transit Commission, Laval, Canada, 1977.

M. R. Travers, Morgan & Partners, "Bradford Bus Study - Final Report." January, 1976.

SECTION IV:
SERVICE CHANGES

CONTENTS

SECTION IV - SERVICE CHANGES

	<u>Page</u>
Service Change Actions	IV-1
Service Change Profiles	IV-2
Route Profile Process	IV-3
SERVICE CHANGE PROFILES	
ACCOMMODATION OF TRANSFERS	IV-5
I - Planning Steps	IV-5
II - Evaluation Steps	IV-7
III - Implementation	IV-9
RUNNING TIME	IV-11
I - Planning Steps	IV-11
II - Evaluation and Implementation Steps	IV-13
SPAN OF SERVICE	IV-15
I - Planning Steps	IV-15
II - Evaluation Steps	IV-16
III - Implementation	IV-17
COORDINATION WITH GENERATORS	IV-18
I - Planning Steps	IV-18
II - Evaluation Steps	IV-19
III - Implementation	IV-20

SECTION IV - SERVICE CHANGES

	<u>Page</u>
HEADWAYS	IV-21
I - Planning Steps	IV-21
II - Evaluation Steps	IV-23
III - Implementation	IV-24
ROUTE CUTBACKS	IV-25
I - Planning Steps	IV-25
II - Evaluation Steps	IV-26
III - Implementation	IV-28
ROUTE ELIMINATION	IV-29
I - Planning Steps	IV-29
II - Evaluation Steps	IV-30
III - Implementation	IV-30
REROUTING	IV-32
I - Planned Steps	IV-32
II - Evaluation Steps	IV-34
III - Implementation Steps	IV-34
PROVISION OF NEW REGULAR ROUTE SERVICES	IV-36
I - Planning Steps	IV-36
II - Evaluation Steps	IV-38
III - Implementation	IV-41
PROVISION OF EXPRESS BUS SERVICE	IV-43
I - Planning Steps	IV-43

SECTION IV - SERVICE CHANGES

	<u>Page</u>
II - Evaluation Step	IV-46
III - Implementation	IV-48
BUS PRIORITY TREATMENT	IV-50
I - Planning Steps	IV-50
II - Evaluation Steps	IV-51
III - Implementation	IV-52

LIST OF TABLES

<u>Table No.</u>		<u>Following Page</u>
IV-1	Service Change Types	IV-2
IV-2	Route Operating Data	IV-4
IV-3	Checklist for Potential Route Improvements	IV-4
IV-4	Service Changes to Improve Operating Time with Travel Savings Estimates and Associated Implementation Cost Elements	IV-14

LIST OF FIGURES

<u>Figure No.</u>		<u>Following Page</u>
IV-1	General Ridership Growth Curve for New Bus Services	IV-42

SECTION IV

SERVICE CHANGES

The preceding sections of this manual have set forth a step-by-step process whereby transit systems can, based on establishing a set of objectives, criteria and performance levels, evaluate their services to determine if changes in their services are required. This section is the next logical step. It defines types of service changes that are available and details what specific actions are required to plan, to evaluate and to implement each category of service change.

The emphasis in this section is on detailing actions to be followed in making service changes. Section V will present details on how to accomplish fare related changes and the resulting impact on revenue and ridership of specific fare change actions.

Service Change Actions

Generally, changes in services that are provided by small- to medium-sized transit systems in Pennsylvania can be grouped into one of the four following categories:

- Scheduling;
- Frequency;
- Routing; and
- New Services.

Each of these categories and the types of service changes classified within each are detailed further below.

Scheduling — The definition of scheduling changes encompasses those actions that require minor adjustments to the scheduled times of a route without significantly effecting the amount of service provided on that route. For example, service to a major employment center could be scheduled to arrive at that center at 8:00 A.M. when the work shift start time is also 8:00 A.M. Workers at this employment center have service available to them, but this service is not scheduled properly to enable them to effectively use the service. A scheduling change is therefore identified as an action to improve service to permit coordination with major activity centers.

The four service change actions classified under the scheduling category are:

- Accommodation of transfers;
- Improved running time;
- Span of service; and
- Coordination with generators.

Frequency — Load checks on a particular route could have indicated a significant number of standees. This fact should lead the transit system to evaluate the route to determine whether headway adjustments are necessary. Conversely, an evaluation of the cost/revenue ratio, passengers carried or revenue contribution for a particular route could indicate poor performance which should in time lead to consideration of service change alternatives. One alternative, among many, would be to increase the headway on that route.

Headway adjustments would fall within the frequency category of potential service change actions.

Routing — The above two categories dealt with service changes accomplished through adjustments of scheduled times or headways. Routing changes assume that scheduled times and headways are appropriate, but the path over which the route traverses requires change. In this case, a rerouting change should be investigated.

Other types of routing changes that may be appropriate are cutbacks or complete eliminations of a route. For these types of changes, which can have a major effect on the population in the area affected by the change, scheduling and frequency adjustments should be evaluated first. If all else fails, then the final consideration should be the service cutback or elimination strategy.

New Services — We have classified three types of service change actions into the category of new services:

- Route extensions or new regular routes;
- Establishing express/limited stop trips; and
- Bus priority treatments.

Service Change Profiles

For each of the 11 discrete service change actions discussed above and set forth in Table IV-1, we have prepared

TABLE IV-1

SERVICE CHANGE TYPES

Scheduling:

- Accommodation of Transfers
- Improved Running Time
- Span of Service
- Coordination with Generators

Frequency:

- Increase or Decrease to Headways

Routings:

- Reroutings
- Route Cutbacks
- Route Elimination

New Service:

- Route Extensions or New Regular Routes
 - Establishing Express/Limited Stop Trips
 - Bus Priority Treatments
-

a detailed profile containing those elements that are essential considerations for making each change. Each service change profile is structured with a standard format containing the five sections discussed below:

1. Definition — In this first part, the type of change is described.
2. Purpose — Here, a description is presented of the trigger mechanism that leads to the decision that the particular service change should be investigated. The trigger mechanism would result from either the detailed performance evaluation or the external indicators of change set forth in Section III of this manual.
3. Planning Steps — In this detailed section, all the data gathering, analysis and preliminary service change proposal work required is set forth.
4. Evaluation Steps — The detailed technical methods to determine what effect the proposed change would have on ridership, revenue and operating costs is delineated in this part.
5. Implementation — This final section of each profile contains those actions which must occur to implement the particular service changes. It also defines the mechanism for monitoring the impacts of the change.

Route Profile Process

Frequently, a bus route may be performing below average, and a brief look at its operating data will not identify any major reason. In this case, a detailed route profile may be necessary. This is a systematic analysis of a number of aspects of the route to determine specific areas for improvement. The profiles can be done only on poor performing routes, or as part of a systematic process for all routes in the system.

The profile generally has three parts:

- Tabulation of data;
- Checklist of improvements; and
- Analysis.

Each of these parts will be explained in the following subsections.

Tabulation of Data — Table IV-2 shows the general format and data frequently required. Much of the data should be readily available, with most information taken from headway sheets. This data assures a good understanding of resources that are going into route operations.

Checklist of Improvements — It is usually valuable to develop a route profile checklist to simplify the analysis of actual operations. A checklist can be utilized by planners, schedulers, management personnel, or operators. The person rides the route, then by means of yes/no answers and comments, completes the checklist and in so doing, frequently identifies potential improvements.

A sample checklist is set forth in Table IV-3 and includes the following major topics:

- Alignment;
- Headways/turnbacks;
- Schedule adherence/running times;
- Schedule coordination;
- Traffic aids; and
- Transit stops.

Specific questions are answered regarding each of these topics.

Analysis — The checklist should be filled out by at least two or three different people after riding a sample of trips at different times of the day. A consolidated list can then be made up, incorporating all observations. Generally, the consolidated list will show similar observations concerning potential improvements.

Those improvements that appear most useful should be subjected to the detailed evaluations discussed later in this section. Many times, more than one topic of service change could take place, as with short-turning some trips, and adjusting headways and running times on others.

Use of the profile process can help both to identify major service changes and to "fine-tune" route operations. The process can be formalized with prepared forms that make their completion quicker and easier, and allow the participation of a variety of skilled personnel.

TABLE IV-2
ROUTE OPERATING DATA

Route No.: _____

Name: _____

Date: _____

Round Trip Route Length Miles	Weekday Service Utilization		Maximum Load Points	
	Trips	Passengers	Direction	Location
Local — _____	_____	_____	<i>A. M. Peak</i>	
Short Run — _____	_____	_____	Inbound — _____	
Express — _____	_____	_____	Outbound — _____	
	_____	_____	<i>Midday</i>	
	_____	_____	Inbound — _____	
	_____	_____	Outbound — _____	
	_____	_____	<i>P. M. Peak</i>	
	_____	_____	Inbound — _____	
	_____	_____	Outbound — _____	
Total		_____	Inbound — _____	
			Outbound — _____	

		Summary of Service			
Fare Structure	Vehicle Requirements	Time Period	Scheduled Headway	Total Trips	Normal Cycle Time
Base Fare — _____	A. M. Peak — _____	A. M. Peak (6-9 a.m.)	_____	_____	_____
Additional Zones — _____	Midday Base — _____	Midday (9-4 p.m.)	_____	_____	_____
Maximum One- Way Fare — _____	P. M. Peak — _____	P. M. Peak (4-6 p.m.)	_____	_____	_____
	Evening — _____	Evening (6-10 p.m.)	_____	_____	_____
	Saturday — _____	Saturday	_____	_____	_____
Transfers — _____	Sunday — _____	Sunday	_____	_____	_____

Miles/Hours of Service			
	Weekday	Saturday	Sunday
Scheduled Miles	_____	_____	_____
Pay Hours	_____	_____	_____
Miles/Hour	_____	_____	_____

TABLE IV-3
CHECKLIST FOR POTENTIAL ROUTE IMPROVEMENTS

Route: _____

Prepared By: _____

Date: _____

1. Alignment

Yes No

If "YES", DESCRIBE:

- a. Could the route be extended to serve major residential/activity concentrations?
- b. Could the route be curtailed without losing significant patronage?
- c. Could segments of the route be realigned to provide better service/increase speed?
- d. Does the route duplicate other routes in serving major markets?

2. Headways/Turnbacks

- a. Are "load standard" headways excessive or insufficient?
- b. Are "policy" headways at variance with service standards.
- c. Could certain trips be "turned back" mid-route without violating headway standards?
- d. Is there insufficient patronage early morning, late evening or weekends to justify service?
- e. Could schedules be better coordinated with predominate shift or school times?

CHECKLIST FOR POTENTIAL ROUTE IMPROVEMENTS (Continued)

	<u>Yes</u>	<u>No</u>	<u>If "YES", DESCRIBE:</u>
3. <u>Schedule Adherence/Running Time</u>			
a.			During short-headway periods, do vehicles "bunch up?"
b.			Are there significant deviations between actual and scheduled running times by route segment by time period?
c.			Is there insufficient or excessive recovery time at each end of the route?
4. <u>Schedule Coordination</u>			
a.			Should route be jointly scheduled with another route where service duplication exists?
b.			Where there is major transfer activity, should schedules be coordinated during policy headway periods?
c.			Could route be "hooked" with another route where there is major transfer activity?
5. <u>Traffic Aids</u>			
a.			Are recovery/turnaround points inadequate for vehicle storage?
b.			Are there serious congestion points along route?
c.			Does illegal parking/truck loading seriously impede vehicle movement?

CHECKLIST FOR POTENTIAL ROUTE IMPROVEMENTS
(Continued)

		<u>Yes</u>	<u>No</u>	<u>If "YES" DESCRIBE:</u>
d.	Would a preferential turn, lane, or traffic signal significantly improve route speed?			
e.	Are there pavement conditions which are highly detrimental to operations?			
6.	<u>Transit Stops</u>			
a.	Are there route segments where stops are too densely placed?			
b.	Are there locations where additional stops may be justified?			
c.	Are there top priority locations for transit shelters?			
d.	Are passenger waiting areas in need of major security/appearance improvements?			

SERVICE CHANGE PROFILES

ACCOMMODATION OF TRANSFERS

Definition: This type of service change involves the joining of two routes, the coordination of schedules and the improvement of waiting facilities at transfer points.

Purpose: Service changes to reduce the inconvenience that transferring causes may be warranted as a result of the following two factors:

- Evaluation of system and route transfer activity (see Section II - Performance Level Guideline - Minimize Transfers - EFT-10) indicates excessive transfers between two routes; and
- Evaluation of a route's operating ratio (see Section III - Performance Evaluation - Stabilize System Operating Ratios - EFY-1) indicates low revenue is the dominant problem, and the route times are not coordinated with other routes.

I - Planning Steps

Reducing the inconvenience that transfers cause requires a thorough knowledge of current transfer patterns and a careful analysis of the effects of possible improvements. Specifically:

- A - If not already available as part of ongoing data collection procedures, the number of transfers that are currently being made at each transfer point should be ascertained. If feasible, a breakdown by trip is also helpful. This information enables the operator to locate the specific transfer locations and movements that are the most significant. Routes where transfer activity exceeds the performance level guidelines (10 percent is the suggested norm) should be identified.

Another step in this data collection procedure should involve identification of those poor performing routes where additional transfer opportunities with other routes could be accomplished with coordinated schedules.

B - The inconvenience due to transfers can be reduced by improving one or more of the following features:

- 1 - Schedule coordination of crossing routes;
- 2 - Transfer facilities; and
- 3 - Routing scheme.

Steps involved in each are fully described below.

Coordination of Schedules — Transferring is particularly onerous when the passenger has to wait a long time (15 minutes or more) to make the transfer. If headways are short (less than 15 minutes), there is no problem. If headways are long, it is important to coordinate the schedules. Here, a timed transfer system, where both vehicles are scheduled to arrive at the same time, wait for a few minutes and depart at the same time, is called for.

Any ongoing coordination of schedules assumes that the coordinated routes all operate with the same headway. If the headways are different and cannot readily be made the same, there is only a limited number of available options. If one particular run accounts for a large percentage of the transfers, then the schedule can be adjusted to accommodate that specific run. If significant numbers of transfers occur on many runs, however, the only possibility is to adjust the schedules of the intersecting routes so that as many runs as possible are coordinated. However, at a minimum, it should be possible for every other trip to be a transfer connection.

Improving Transfer Facilities — When transfer facilities are convenient (short walking, full weather protection, etc.), clean, comfortable, safe, informative (concerning routes and schedules) and have amenities available, the inconvenience due to transferring is substantially reduced and when integrated with shopping facilities, can even become a desirable part of the trip. Although some of these improvements are costly, there is a growing trend toward enlisting the support of the business community to help finance the improvements in exchange for advertising or sales space.

Rerouting — This is particularly desirable if there are many people making the same transfer movement. Joining the parts of different routes that passengers transfer between into one route eliminates the need for these transfers. However, this action is generally appropriate when at least 20% of the riders on a particular trip transfer to the same route. Here, care must be taken that the realignment of the routes does not produce a comparable problem for those who used to travel through on the original routes. Options such as branches or service limited to the specific time periods when transferring is the heaviest often provide a workable compromise.

If headways on the routes to be joined are not equal, the disparity between loads that this implies must be checked to see if the new routes can be operated efficiently. Similarly, if the two routes currently have different spans of service, a new span must be determined and checked for efficiency. In addition, the overall length and running times of the new routes should be compared with acceptable minima and maxima, and readjusted if necessary.

II - Evaluation Steps

The benefits of an improved transfer policy generally belong to the passengers. They obtain faster, safer and more comfortable travel. If this leads to an increase in ridership, then the operator can also benefit directly. The options listed in the previous section have varying costs and benefits.

A - A major cost involved in coordinating schedules would occur only if changes in schedules are required to permit a coordinated transfer. Benefits for coordinated schedules would involve less waiting time for existing riders, and possibly new riders would also be attracted. To evaluate whether a change is warranted, the following "rule of thumb" should be used:

- 1 - Calculate the revenue obtained from the transferring passengers. This should include their base fares and transfer charges.
- 2 - Next, calculate the incremental costs involved in making the schedule adjustment. It is suggested that only the difference between direct costs including drivers' wages, their fringes, and fuel, be used in this calculation.

- 3 - Finally, compare the revenue and costs. If revenue exceeds costs, then the schedule coordination program should be adopted. If it doesn't, it should be deferred and another approach tried.
- B - A new transfer waiting facility would generally involve only a capital cost to construct the facility and a small operating expense to maintain it. Such a facility should be constructed if 100 or more people would use the facility daily. Increased comfort for the waiting passenger should be the primary benefit from such an endeavor.
- C - In evaluating the feasibility of joining two routes together, the following steps should be accomplished:
- 1 - For small- to medium-sized properties in Pennsylvania, the route structure generally consists of a system of radial routes terminating in the downtown area. Joining of two routes to eliminate transfer movements would therefore involve merely joining the routes at the downtown location.
 - 2 - Constructing a through route from two former radial routes has two primary evaluation elements - - matching the frequency and the running time.
 - 3 - If the frequency and running time of the two former routes are similar, then a new schedule should be prepared which joins the two. If not, it is suggested that a completely new route be constructed for the proposed new through route. The new route should attempt to provide the same level of service as the level of service provided by the better route. Exceptions to this could be made based on load factor data.
 - 4 - A cost comparison should be made between the former two routes and the new through route based on the application of the cost allocation formula presented in Section III of this manual.
 - 5 - It is likely that revenue increases would occur resulting from the new combined route. However, to be conservative, the new route revenue should be assumed at the same level of revenue as the total for each individual route.

- 6 - If the cost of the new route is much greater (10 percent or more) than the combined cost for the former two routes, then the plan should be deferred unless it can be determined that the combination will result in substantial ridership gains (20 percent or more).

III - Implementation

Each of the three methods to reduce the inconvenience to passengers that transferring causes requires different implementation actions.

- A - Implementing a change to coordinate schedules of two or more routes involves the following:

- 1 - Headway sheets reflecting the changes should be prepared.
- 2 - New public timetables are required. These timetables should clearly note the trips where timed transfers occur.
- 3 - New procedures should be established which permit the timed transfer to occur even if service on a route is delayed. A property that has a bus two-way radio communications system should use that system for this purpose.

- B - A new transfer waiting facility requires a capital investment and a small construction project. Steps to be followed are the same ones as those required for any passenger waiting facility. In summary, they include:

- 1 - Investigating the location to determine its owner;
- 2 - Obtaining permission or required easements to build a shelter on the site;
- 3 - Obtaining the required federal state and local funds;
- 4 - Determining the size and type of facility required;
- 5 - Preparing bid specifications and selecting the lowest bidder;

- 6 - Entering in a contract with the selected firms;
 - 7 - Monitoring the awarded bidders construction progress; and
 - 8 - Readyng the shelter for use which may involve power hook-ups for lights and putting up public information displays.
- C - Prior to any changes in a route's layout that would be necessitated by the joining of parts of two different routes, the following three actions must be taken:
- 1 - The basic data concerning the new route should be forwarded to the schedule department, including previously determined aspects such as:
 - headways;
 - routing; and
 - span.

A headway sheet should be made up and vehicles required, as well as operating miles and hours, compared with the earlier estimates. If there are major discrepancies, then actions such as reducing proposed service levels or allocating additional costs should be taken.
 - 2 - Drivers must be taught the new route layout. Although they may already be familiar with both parts of the route, some practice runs and schedule familiarization prior to implementation is important.
 - 3 - Any change in service must be well publicized for it to succeed. In this case the public information is even more important because it will prevent widespread confusion between the paths of the old and new routes. The public information campaign should include:
 - printing and distribution of public timetables and route maps;
 - media advertising; and
 - notices posted at existing and future stops.

RUNNING TIME

Definition: Running time service changes relate to decreasing both the actual running time and the dwell time, which together here we call operating time.

Purpose: A decrease in operating time is always desirable for both passengers and the operator. For passengers it leads directly to a higher level of service. For the operator it may lead to a reduction in the vehicle hours and required fleet size, thus lowering the capital and operating cost for the agency. Even more significant in some cases is that since travel time is a strong factor in passenger attraction, its decrease may result in the generation of new passengers for transit.

Generally, the schedule speed performance evaluation presented in Section III (see - Increase Availability and Productivity of Revenue Vehicles - EFY-8) would lead to investigating service changes in this area.

I - Planning Steps

Operating time is composed of two parts, running time and dwell time. Its magnitude is influenced by many factors, only some of which are exclusively within the control of the transit agency. All factors need to be analyzed to be sure that the lowest operating time is achieved.

The complete analysis would include:

- A - A breakdown of the total operating time into the running time between stops and the dwell time at each stop is necessary. This can be done with a standard speed and delay study. The information gained from this study enables the operator to find the sections and/or characteristics of the route that cause excessive delay and would therefore be the first areas to try to improve.

- B - The next step would involve the enumeration of possible solutions to improve operating time. This would include:
- 1 - Faster fare collection techniques, such as pre-paid passes;
 - 2 - Changes in route layout that eliminate excessive turns or indirect routings;
 - 3 - Different vehicle stopping policies, such as express or skip-stop operation;
 - 4 - Increasing stop spacing or optimizing stop intersection location such as near side or far;
 - 5 - Using a dispatcher at particularly busy stops;
 - 6 - Improvements in intersection design and control such as channelization, provision of bus bays and special transit turning lanes;
 - 7 - Elimination of curb parking along transit routes;
 - 8 - Use of signal preference for transit vehicles;
 - 9 - Introduction of exclusive transit lanes; and
 - 10 - Changes in vehicle design and performance characteristics such as improved interior circulation, double channel doors and dynamic characteristics that match the type of route.
- C - To match the problems identified in Step A with the solutions in Step B would involve classifying the problems and improvements as being applicable to the entire route or to specific sections and by their applicability to running time or dwell time. The suggested improvements in Step B are classified as follows:

	<u>Entire Route</u>	<u>Specific Sections</u>
<u>RUNNING TIME</u>	● Different vehicle stopping policy ● Increasing stop spacing ● Elimination of curb parking ● Signal preference ● Exclusive transit lanes	● Changes in route layout ● Changes in intersection design or control ● Elimination of curb parking ● Signal preference ● Exclusive transit lanes
<u>DWELL TIME</u>	● Faster fare collection	● Use of a dispatcher ● Changes in intersection design or control

D - Many of the solutions listed in Step B require the approval or cooperation of other agencies, or in the case of improved vehicle design, of the vehicle manufacturer. The willingness and ability of these other parties to affect any desired changes must be taken into account. If none of the appropriate solutions are feasible, then the schedule should be adjusted to the actual operating time.

II - Evaluation and Implementation Steps

To decide whether introduction of a measure for speed increase is justified, the operator must make an analysis of all of its benefits and costs. In some cases, particularly with respect to changes the operator can introduce alone, the analysis is rather simple; in others, particularly those involving the introduction of transit lanes, signal actuation or reconstruction of streets, which are under the jurisdiction of other agencies and affect not only transit users, but also auto drivers and other parties, it is necessary to make a very comprehensive analysis.

The financial benefits that accrue from decreasing operating time are twofold. First, is the possibility of reducing the number of hours of service and vehicle needs. Costs would therefore be reduced. Second, the reduced travel time (and generally concurrent increase in reliability) may attract more passengers and thus provide more revenue. Each of the improvements should be carefully analyzed to see what its potential time savings will be. In addition to the benefits of reduced travel time and improved reliability for passengers

and perhaps reduced operating costs and more revenue passengers for the operator, all of these changes involve some cost to implement. These cost elements and travel time saving estimates which range from two percent to 25 percent are set forth in Table IV-4.

TABLE IV-4

SERVICE CHANGES TO IMPROVE OPERATING TIME
WITH TRAVEL SAVINGS ESTIMATES
AND ASSOCIATED IMPLEMENTATION COST ELEMENTS

<u>Improvement Area</u>	<u>Estimated Travel Savings Time</u>	<u>Implementation Cost Elements</u>
Pre-paid passes	2% to 5%	. Preparation and distribution of information material . Opening of sales facilities . Operation/personnel for sales . Printing cost
Elimination of indirect routing	5% to 10%	. Preparation and distribution of information material . Reduction of area coverage
Express or skip stop spacing	15% to 25%	. Preparation and distribution of information material . Added waiting time for non-preferred stops
Increased stop spacing	5%	. Preparation and distribution of information material . Dismantling of signs . Extra walking time for some passengers
Intersection Redesign	2% to 5%	. Cost of design . Cost of construction
Elimination and enforcement of curb parking at end near transit stops	2% to 5%	. Cost of signs . Enforcement costs

TABLE IV-4

SERVICE CHANGES TO IMPROVE OPERATING TIME
WITH TRAVEL SAVINGS ESTIMATES
AND ASSOCIATED IMPLEMENTATION COST ELEMENTS

(Continued)

<u>Improvement Area</u>	<u>Estimated Travel Savings Time</u>	<u>Implementation Cost Elements</u>
Transit preferential treatment	5% to 10%	. Design and hardware . Maintenance . Enforcement of exclusive lanes
Improvements in vehicle design	2% to 5%	. Added cost from manufacturer
Dispatcher	2% to 5%	. Added salary

SPAN OF SERVICE

Definition: Service changes that involve the time the service starts and ends during the day are included in span of service.

Purpose: Adjustments in the starting or ending time of services should be considered for numerous factors. Those that warrant an investigation to increase span include:

- Evaluation of a route with a poor operating ratio (see Section III - Performance Evaluation - Stabilize System Operating Ratio - EFY-1) which, by an increase in span, improved revenues are possible; and
- External factors such as a new shopping center along a route could warrant an increase in span.

Consideration for decreasing the span of service may be appropriate for the following reason:

- Evaluation of a poor performing route from either an operating ratio (EFY-1) or a revenue passenger per vehicle hour (see Section III - Performance Evaluation - Maximize Revenue Passenger per Vehicle Hour - UTL-4) analysis could indicate that a decrease in span is justified.

I - Planning Steps

The efficiency of service on a problem route may be improved either by reduction or extension of its span of service. Each solution has its own series of planning steps.

- A - If indicators such as a low operating ratio show that there might be substantial savings from decreasing the span of service, more specific information needs to be collected to make a final judgment.

- 1 - Passenger counts for each of the runs that might be eliminated should be made. This enables the operator to determine which runs, if any, are likely candidates to be eliminated. If possible, breakdowns by passenger type (senior citizens, school children, etc.) should be made.
 - 2 - Special circumstances should also be explored. Even if only a relatively small number of people use an early morning run, for example, but they have no other means of transportation to work, that particular run might have to be continued.
- B - Increases in the span of service are usually necessitated by changes in the served activity centers. These changes can be ascertained by monitoring the number and nature of passenger requests for service extensions, careful observation of major activity center operations and plans, and by establishing formal communications channels between operators/owners of activity centers and the transit agency.

Once again, special circumstances, such as the extension of the work hours of a factory with many transit dependent workers, may necessitate extension of the span regardless of the number of passengers served.

II - Evaluation Steps

A - Decrease of Span:

- 1 - Using the information from the passenger counts, the potential lost revenue can be calculated. The magnitude of the inconvenience to passengers should also be considered.
- 2 - The new cost of operating the route is to be calculated. Since the cost allocation methodology presented in Section III, as applied to the old and new service, is not aimed at determining incremental costs involving slight service reductions, it would exaggerate the savings of this reduction. Therefore, the operator should determine the direct costs that would be saved including drivers' wages and fuel. Since this will underestimate the savings, a "rule of thumb" for the expected savings is that it would be halfway between these two estimates.

- 3 - The projected operating ratio can then be calculated for the reduced service and compared with the old one to determine the magnitude of the change.
- 4 - The improvement in operating ratio can then be weighed against the number of people inconvenienced, the nature of this inconvenience, and any other special factors to arrive at a final decision.

B - Increase in Span:

- 1 - To evaluate any proposed increase in the span of service requires knowledge of the increased costs and the additional revenue from the newly served passengers. The increased cost can be calculated as it was done for decreased span, i.e., the actual cost will be halfway between the direct additional expenses at the lower boundary and the value given by the cost allocation methodology at the upper boundary.
- 2 - Estimating additional patronage is somewhat more complex than estimating the additional costs. A carefully mounted study of the demand for this extension of service hours would require significant time and expense and probably be beyond the means of a small- or medium-sized transit agency. A "rule of thumb" that will generally provide satisfactory results is to project the same utilization for the extended service as the ridership generation of proceeding trips. If the extension of service is being made to accommodate work related trips, estimates from the affected employers or the existing peak period demand might prove to be a better estimate.

III - Implementation

Before changing the span of service:

- Driver and vehicle schedules need to be recomputed to maintain efficient use of labor and equipment; and
- The public needs to be informed via notices along the route and at the major activity centers as well as through a wider distribution system, such as a notice in the local newspaper.

COORDINATION WITH GENERATORS

Definition: This section focuses on schedules of bus routes that serve major traffic generators to insure that the service is coordinated, as much as possible, with the activities at the traffic generators.

Purpose: The need for coordination of the schedules of bus routes with the served traffic generators will become apparent from either a technical evaluation or an external factor:

- Evaluation of the routes' financial performance (EFY-1) or passenger utilization per vehicle hour (UTL-4) are the usual technical factors that point to change in this area; and
- External factors will generally be in the form of letters or calls from the public who are inconvenienced by the current service and point out the deficiencies.

I - Planning Steps

Regardless of the type of traffic generator or the existing level of coordination, there are a number of planning steps that need to be followed to ensure the best possible coordination.

- A - Obtain the schedules of the traffic generators. This will generally include opening and closing times for shopping centers, shift changes at factories, beginning and dismissal times at schools, scheduled church services, etc.
- B - Classify each potential coordination time as "before" or "after." A "before" classification signifies that optimal coordination is achieved when the bus is scheduled to arrive slightly before the event at the traffic generator. The beginning of work at a business or school, or the start of church services are good examples of "before" activities. Similarly, "after" times, such as the end of a work day, involve those activities for which the optimal coordination requires the bus to depart slightly after the event.

- C - Construct alternative schedules. If there is only one traffic generator served by the route and no other important constraints exist, changing the schedule is simple. If more than one important traffic generator is served by the route, it will generally not be possible to construct a schedule that provides for perfect coordination at each traffic generator. In this case, it is usually preferable to schedule the bus to arrive extra early at some of the "before" stops and extra late at some of the "after" stops, rather than make some exact connections, but completely miss others. The degree to which this is followed should vary in the different alternative schedules.

II - Evaluation Steps

Rescheduling a particular route to coordinate with traffic generators can usually be done without any additional operating expense. Since better coordination should increase ridership and thus revenue, the task of evaluation is not to decide if coordination should be implemented, but rather to judge the tradeoffs in ridership and convenience among the different alternative schedules. If there is only one traffic generator served by the route that requires coordination, there will generally be only one reasonable schedule. In this case, it should be adopted. If there is more than one traffic generator, however, each alternative schedule will tend to favor some generators at the expense of others. In this case, there is a number of factors to consider before selecting a schedule.

- A - The total increase in ridership — By their very nature, some traffic generators, such as schools, are more likely to be used by transit riders than others. The better the schedule coordination at these traffic generators, the greater the total ridership increase.

Special constraints — Despite a relatively small number of potential new riders that may follow a coordinated schedule at a particular traffic generator, a schedule that provides better coordination with that generator than some others which project greater ridership gains may have to be considered for political or social reasons.

The schedule ultimately selected will generally be the one that produces the greatest increase in ridership while also satisfying the special constraints.

III - Implementation

Before any change in schedule is implemented, the following two steps should be accomplished:

- A - Schedules of drivers, support personnel and facilities, and vehicles need to be recomputed to maintain efficient use of labor and equipment.
- B - The public needs to be informed and the new coordinated service publicized. This would include notices at all stops and particularly at the traffic generators, special internal circulation at the traffic generators such as a story in the employee newsletter, and wider area publicity such as newspaper and radio advertisements. The latter ones can stress that the newly coordinated service is an example of an improved area transit service.

HEADWAYS

Definition: This service change category involves either an increase or a decrease in the frequency of service of a route.

Purpose: Headway changes may be warranted as a result of numerous factors including:

- Evaluation of poor performing routes from a revenue/cost ratio (EFY-1) or passenger generating capability (UTL-4) should cause an investigation to determine whether a headway increase is possible; and
- Excessive loads identified through an evaluation of load factors (see Section III - Performance Evaluation - Stay Within Load Standards - EFT-7) should be assessed to determine whether a decrease in headway is possible.

I - Planning Steps

Initial data gathering steps required to increase or decrease service frequency are similar and include:

- Comparison of existing headways with peak and off-peak policy headways; and
- Determination of ridership levels by trip throughout the day.

A - Planning steps associated with a decrease in service frequency involve:

- 1 - Determination of whether the poor ridership occurs for every trip or is isolated on just a few.
- 2 - If just a few trips are poor performers, then the services around these trips could be adjusted by a frequency change. For example, service in the off-peak is provided every hour. The noon trip is lightly patronized.

The service provided by the 11:00 A.M. trip could be moved to 11:15 A.M., and the 1:00 P.M. trip moved to 12:45 P.M. Service on the noon trip would be eliminated.

- 3 - If poor performance is exhibited on almost every trip, service on the route should be reduced to policy headways. If policy headways or worse are provided, then a reduction of service levels by 15 minutes in the peak and 30 minutes in the off-peak should be tried. However, if this change still results in the need for two buses to provide peak service, it may be appropriate to reduce the service frequency to a level where only one bus will be needed. Service frequency reductions are generally done for economic reasons. Therefore, service frequencies should be determined with complete knowledge of resources saved by the change.

B - An increase in service frequency would entail the following analyses:

- 1 - Determination of whether the excessive loads occur on every trip or just a few.
- 2 - If just a few trips exhibit excessive loads, then tripper service should be added to handle the loads.
- 3 - If excessive loads occur on most trips, service on the route should be increased. Suggested frequency changes are listed below for both peak and off-peak periods:

<u>Peak</u>		<u>Off-Peak</u>	
<u>From</u>	<u>To</u>	<u>From</u>	<u>To</u>
30 min.	20 min.	60 min.	45 min.
20 min.	15 min.	45 min.	30 min.
15 min.	10 min.		

However, before making an increase in service change, the extent of the change as it impacts vehicle and driver commitments should be thoroughly determined. A service change should be made, at least initially, by adding no more than one vehicle.

II - Evaluation Steps

- A - The evaluation of a route where the frequency of service is being reduced generally entails determining whether the change is effective in improving the route's performance to the point where other more drastic actions, such as route cutbacks, are unnecessary.
 - 1 - The first step would be determining what percent of the service was cut in terms of both vehicle miles and vehicle hours.
 - 2 - Costs of providing service on the reduced service route should be determined by applying the cost allocation method described in Section III to the remaining hours, miles and vehicles. Since the resources eliminated are normally used to increase service on another route, the costs determined in this fashion would be an accurate representation of the reduced route costs.
 - 3 - Ridership loss resulting from a frequency of service reduction should generally be minimal, especially if only certain trips are eliminated. A conservative estimate of ridership loss would be halfway between the percent of service cut and retaining full ridership. For example, if 20 percent of the service was cut, then the ridership loss could be assumed at no greater than ten percent.
 - 4 - Finally, the cost for the reduced frequency route should be compared to the revenue attributed to the ridership level and a determination made as to whether the route is in line with performance guidelines. If not, more drastic measures would be called for.
- B - Frequency of service increases should be evaluated from a cost, ridership and revenue standpoint.
 - 1 - Costs should be determined for the increased frequency route using the cost allocation method described in Section III. However, for minor service changes, this method would tend to overestimate costs. Therefore, costs should also be determined for the direct costs for the new service including drivers' wages, fuel, etc., which would identify the low cost point. A "rule of thumb" cost estimate would be halfway between these two costs.

- 2 - Ridership should increase resulting from the improved quality of service offered. Just how much is difficult to project in general. However, a "rule of thumb" estimate would be half of the level of service increase measured in terms of vehicle miles or vehicle hours. For example, if service was increased by 20 percent, then a ridership increase of half that percent or ten percent could be expected.
- 3 - Finally, the cost and revenue for the increased frequency route should be determined and compared to the performance of the unchanged route to see if a change is warranted.

III - Implementation

Frequency change implementation steps are not involved and generally include preparing new vehicle and manpower schedules reflecting the change and providing the public with the new schedules at least one month prior to implementation.

ROUTE CUTBACKS

Definition: This type of service change involves shortening the length of a route or shortening certain trips on a particular route.

Purpose: Generally, a route cutback would be warranted based on conclusions reached in evaluating a route based upon one or both of the following two factors:

- If an evaluation of the route's operating ratio (see Section III - Performance Evaluation - Stabilize System Operating Ratios - EFY-1) indicates that excessive costs and therefore too much service is the problem, then if increasing the headways or decreasing the span are insufficient solutions, route cutbacks should be considered.
- If an evaluation of the passenger generating performance (see Section III - Performance Evaluation - Maximize Revenue Passengers per Vehicle Hour - UTL-4) indicates that scheduling changes are insufficient solutions for reducing vehicle hours, route cutbacks should then be considered.

I - Planning Steps

A cutback on the service coverage of a route should only be considered after other less drastic service changes are attempted first, such as increasing the headways, or decreasing the span of service. If these service changes do not go far enough toward solving the route's problem, then a route cutback should be considered. Cutting the coverage on a route requires an in-depth understanding of the current operations and performance of the route. This detailed information can be supplemented through the route profile process. Planning steps include:

- A - Identification of passenger usage along the various segments of the route. This passenger data should include detailed counts and statistics on a trip-by-trip basis for several weekdays and for weekend service, if appropriate. Data should include:

- 1 - Number of passengers boarding and alighting by stop location by trip;
 - 2 - Composition of ridership, i.e., elderly, school children, etc.; and
 - 3 - Trip purpose for ridership, i.e., work, shopping, medical, recreation, etc.
- B - Statistics for the cutback portion of the route should be identified to include:
- 1 - Passenger loss by type and trip purpose;
 - 2 - Amount of hours and miles of service eliminated; and
 - 3 - Major activity centers no longer served as a result of the cutback.
- C - Data should be obtained for the route portion left unchanged including:
- 1 - Running time estimates;
 - 2 - Round trip mileage estimates; and
 - 3 - New turn-around and/or layover location.
- D - Services for the cutback route should be defined including:
- 1 - Headways should be better than or at least equal to those of the prior route; and
 - 2 - Span of service should be similar to the old route except for cases where the span was defined for an activity center which was eliminated from the service area as a result of the cutback. In these cases, the span could be reduced.

II - Evaluation Steps

Two major considerations are necessary before implementation of a route cutback should occur.

- A - First, extent of ridership impact should be assessed:

- 1 - Percent of ridership loss should be compared to the percent of service cut, measured in terms of both miles and hours. The ridership loss percent must be less than the service loss percent.
 - 2 - A qualitative assessment should be made of the types of riders impacted and their trip purposes. If the impacted riders are captive riders, i.e., senior citizens, school children and low income families, then consideration should be given to cutbacks on some but not all of the service.
- B - Second, the performance of the new cutback route should be determined:
- 1 - Assumptions should be made that the ridership and therefore the revenue from the remaining portion of the cutback route will be the same as before. This assumption should be valid, if there are no major changes in headways or span.
 - 2 - Operating costs should be calculated for the remaining route based upon the hours, miles and vehicles requirements using the cost allocation technique presented in Section III.
 - 3 - Finally, a cost/revenue ratio should be developed. It should be compared with the performance level guideline for individual routes (EFY-1). If it is still below the 60 percent of system average with the headway increases and span reductions which were attempted previously, then the entire route should be a candidate for elimination. A ratio of 60 percent or more should be considered as performance acceptable for implementation.

Other assessments that should be done in evaluating a route cutback include:

- A - Are there major activity centers which will be affected by the change, e.g., a hospital, which while not generating large numbers of riders, are essential to the few who rely on them?
- B - Will the cutback have an adverse political or public opinion effect on the system?
- C - Is the area affected by the cutback growing and is it just a matter of time before improvements will occur?

III - Implementation

If the evaluation process points toward the route cutback change, the following implementation steps should occur.

- A - Vehicle and manpower schedules for the remaining route should be prepared.
- B - Drivers should be informed of the change and taught the new location for their turn-back/layover points.
- C - A focused public information program should occur for the area of the affected service. This should include notification to those riders affected by the cutback at least one month prior to the change. Such notification should include reasons why the change will occur. If appropriate, alternative mobility sources should be pointed out.
- D - Amenities along the eliminated route should be removed including bus stop signs and passenger waiting shelters.
- E - Management personnel should be prepared to answer letters and phone calls questioning the change.
- F - Land use and socioeconomic characteristics of the affected area should be monitored periodically, perhaps annually, to see if there are changes which warrant reinstitution of the entire route.

ROUTE ELIMINATION

Definition: This type of service change involves the complete elimination of a particular route.

Purpose: A route elimination is generally warranted for a very poor performing route after scheduling changes (increase headway or decrease span) and route cutbacks are implemented, but where they do not provide an adequate solution. Generally, the same two evaluation factors as for route cutbacks, i.e., poor route operating ratio and passenger generating capability, should point to route elimination as a potential service change alternative.

I - Planning Steps

An elimination of an entire route should be the final service change option when dealing with a poor performing route. In anticipation of adverse public reaction to route elimination, planning steps should therefore focus on justification for reaching the decision. It should include the following factors:

A - Attempts made to improve the route's performance from a passenger/revenue generating aspect. For example:

1 - Promotion/public information;

2 - Service quality characteristics

- running time
- reliability
- equipment used
- span
- frequency
- major activity centers serviced; and

3 - Fare structure and fare incentive programs.

B - Actions accomplished to reduce the costs of the services provided. For example:

- 1 - Frequency changes;
 - 2 - Span reductions;
 - 3 - Reroutings; and
 - 4 - Route cutbacks.
- C - The analysis should also present the statistics of the route compared to other routes as well as the system average. This should show that the route is an economic and resource drain. Statistical comparisons may include:
- 1 - Revenue/cost ratio;
 - 2 - Passengers carried per vehicle hour and per vehicle mile; and
 - 3 - Deficit per passenger carried.
- D - Finally, the analysis may include a plan for reallocation of resources from the eliminated route to new services. If reallocation of resources is planned, then it should show the expected benefits of the new services compared to those of the eliminated route. The same points discussed above, i.e., revenue/cost, passengers per hour or mile and deficit per passenger, could be used in this comparison.

II - Evaluation Steps

If the transit property completes the above four planning steps and the conclusion reached is unchanged, then additional evaluations are unnecessary and actions to accomplish elimination of the route should begin.

If the analysis conducted in the planning steps points to service change alternatives not yet accomplished, the route elimination alternative should be held back until the other corrective actions are attempted. It may be appropriate at this time to inform the riders and residents along the route that corrective actions being implemented are the last actions to improve the route's performance and, if unsuccessful, route elimination will follow.

III - Implementation

If the evaluation process points toward the elimination of the route, the following implementation steps should occur.

- A - A focused public information program, including a public meeting, should be held in the area of the affected route. This meeting should be held at least one month prior to the change and should discuss reasons why the elimination will occur. If appropriate, alternative mobility sources should be pointed out.
- B - Amenities along the eliminated route should be removed including bus stop signs and passenger waiting shelters.
- C - Management personnel should inform the leaders in the area or community affected by the change prior to public notification so that they would not be surprised when it is announced publicly, and so that they could answer the questions of their constituents.
- D - Management personnel should be prepared to answer letters and phone calls questioning the elimination.
- E - Land use and socioeconomic characteristics of the affected area should be monitored periodically, perhaps annually, to see if there are changes which warrant reinstitution of the route.

REROUTING

Definition: Minor route or alignment changes to an existing bus route generally within the same level of service resources (miles, hours and vehicles).

Purpose: Reroutings can be investigated due to a number of factors including:

- Underutilization of service on some route segments, with corresponding effects on the operating ratio and route revenues (EFY-1);
- Poor revenue vehicle productivity (operating speed) due to route operating conditions (EFY-8);
- Poor route on-time performance due to excessive number of stops, high traffic congestions, and other conditions (EFT-3);
- Vehicle overloads on nearby routes with some excess capacity on the route in question (EFT-7);
- Need to service nearby generators or residential areas (UTL-4); and
- External factors such as requests for service to an unserved area.

I - Planned Steps

Critical to the process of planning the rerouting of an existing route is an in-depth understanding of the current operations of the route. This can be accomplished through the route profile discussed earlier in this manual. Of particular importance is:

- A - An identification of passenger usage along various segments of the route. Such data as:
 - 1 - Boarding and alighting patterns;
 - 2 - Loads at major intersections, as well as the maximum load points;

- 3 - Off-peak ridership patterns; and
 - 4 - Ridership by special groups such as the elderly, or school children.
- B - An evaluation of the detailed operating characteristics of the route including:
- 1 - Traffic bottlenecks;
 - 2 - Difficult turns or roadway geometric problems; and
 - 3 - Stops closely spaced together.
- C - Opportunities for servicing additional nearby generators or ridership groups such as:
- 1 - New shopping areas;
 - 2 - Remodelled or new major commercial buildings;
 - 3 - New housing developments;
 - 4 - Schools; and
 - 5 - Senior citizen activity centers.

It will not be possible to reroute to address all problems or take advantage of every potential opportunity. However, the detailed knowledge of the route and its surroundings will help to point out the possible reroutings that offer the most potential.

- D - A new route alignment can then be designed. Street checks must be done to insure that there are no roadway or other conditions that would preclude bus use. The alignment change should deviate as little as possible from currently heavily utilized portions of the route, unless necessary due to unacceptable operating conditions.
- E - The new alignment should be structured so as to both alleviate the problem conditions, and also increase ridership through service to new generators, and increased operating speeds. Consideration of transit priority to assist in traffic problems could also be included.

- E - Estimates should then be made of the running time and route mileage for the new alignment (or alignments if several alternatives are considered). Assume headways are the same as existing service unless it is obvious that increases (or decreases) should be made.

Using the cost-allocation formula, determine the costs of the entire route for the new alignment. This should be compared with the cost of the old alignment.

- F - Finally, some estimate of new riders who would be gained, and any current riders who will no longer be able to use the route, should be made. Generally, with minor realignments these passenger changes will not be large. However, service to new generators could generate more trips and even necessitate increased service levels during some time periods.

II - Evaluation Steps

After the planning steps and estimates of cost, passenger, and time changes have been made, the information must be analyzed to determine if the rerouting offers sufficient benefit. The general procedure would be:

- A - Determine operating costs, ridership, and travel time changes as a result of rerouting.
 - 1 - If operating costs decrease, new riders are expected and the travel time for existing riders is reduced, the rerouting change should certainly be implemented.
 - 2 - Conversely, if costs increase, very few new riders are expected and the travel time on the route for existing riders is greater, then the change should be deferred.
 - 3 - For situations where one or two of the three parameters is improved, e.g., costs and travel times for existing riders are increased but many new riders are projected, then the extent of each change should be carefully considered before making the decision.

III - Implementation Steps

After evaluating the costs and benefits of various alignments, the one best suited to the conditions should be chosen. Prior to its implementation, three steps must be taken:

- Prepare vehicle schedules;
- Provide driver information and training;
and
- Provide public information.

These are very similar to new service implementation strategy and are discussed there in detail. However, several important differences should be brought out:

- Drivers are familiar with the old route, and must be briefed both on the new routing and the reasons for the change. Reminders to all drivers on the route should be used frequently in the first two weeks; and
- Good public information is essential to reach current route riders well in advance of any changes. The reasons for the change should be outlined in very general terms, and the positive aspects such as fewer transfers or a faster trip should be emphasized. Bus stops bypassed by a change must be posted, again well in advance. Also, sufficient copies of new timetables must be available and should be handed out to current riders just before the change. These efforts are essential to maintaining good system image.

PROVISION OF NEW REGULAR ROUTE SERVICES

Definition: Provision of bus services to areas not previously served, either through establishment of a new route or an extension of an existing route.

Purpose: New services may be warranted as a result of numerous factors including:

- Land use changes such as new residential or commercial development;
- Social needs of special groups such as the elderly, poor or students;
- Public planning groups or even political requests;
- High cost and/or limited supply of energy; and
- Reallocation of resources from under-utilized services.

I - Planning Steps

Within any Pennsylvania service area, there is a wide variety of development patterns present - - ranging from high density development in the urban areas to very low density patterns in the outlying areas. Even if there are land use changes, public requests, etc., that point toward new services, it is necessary to define a set of new service guidelines designed to help identify whether new services are truly warranted.

- A - New potential service areas are generally identified through external factors such as land use changes, public requests, etc. The first step in the planning process is to gather information on the potential service area to include:

- 1 - Population and population density;
- 2 - Socioeconomic characteristics such as:
 - auto ownership
 - income
 - age;
- 3 - Street and traffic data; and
- 4 - Major activity center sizes and locations
 - shopping centers
 - major employers
 - hospital facilities
 - education facilities.

Much of this information is readily available from either city or county planning agencies.

- B - Characteristics of the potential service area should be compared with guidelines which are minimum threshold levels that an area should meet before new service is provided. Guidelines identified below do not imply that areas in compliance with a minimum guideline should automatically receive service, or that those below will not; they are advisory only.

Factors

Guidelines

Residential:

Population	10,000 people
Population Density	500 dwelling units/mile

Major Activity Centers:

Employment	500 employees/quarter mile
Shopping	250,000 square feet of retail floor space
Hospitals	100 beds/site
Higher Education	1,000 students/site

- C - For potential service areas that meet one or more of the minimum guidelines, a tentative route path should be identified, followed by a detailed field survey to identify the necessary elements of the route including:

- 1 - Street and traffic conditions;
 - 2 - Potential bus stop locations;
 - 3 - Running time estimates (this should be done using a bus making simulated stops and starts);
 - 4 - Turn-around and/or layover locations;
 - 5 - Round trip mileage; and
 - 6 - Potential passenger amenity needs.
- D - For the potential new route whose path may have been adjusted as a result of the field work, tentative headways should be chosen. The starting point should be in accordance with policy headways, i.e., 30 minutes in peak and 60 minutes in non-peak periods.
- E - Finally, the duration of time each bus is "made available," commonly called span of service, should be defined. Most regular route service should begin around 6:00 A.M. and continue until after the evening peak period, around 6:00 P.M.

Routes which serve shopping activities, hospitals, recreational facilities, and other types of generators which are characterized by day-long activity, typically have a span of service sufficient not only to permit shoppers to utilize the service, but also to allow employees to make their trips via public transit. This will require operations that start prior to 8:00 A.M. and continue after 10:00 P.M.

II - Evaluation Steps

With the new route well defined, the projected ridership, revenue and operating costs should be determined.

- A - Projected ridership is necessary to both determine if sufficient vehicle capacity is planned, and to estimate revenues. There are a variety of ways to estimate ridership potential, with some quite complicated. For small to medium sized systems, a simple and fairly accurate method would be to use ridership statistics from a comparable existing route. The procedure would entail steps as follows:
- 1 - The land use characteristics, including density, average income level, and auto ownership per household for the new area should be compiled. These characteristics have been shown to be primary determinants of transit usage.

- 2 - The same characteristics should be compiled for an existing route that operates through comparable areas, and under similar conditions (local, downtown oriented, etc.). Detailed ridership data for this route should also be obtained, including boardings/alightings along various segments.

- 3 - Develop the ratio of:

$$\frac{\text{population density}^{(1)} \text{ (persons per mile) new area}}{\text{population density}^{(1)} \text{ (persons per mile) existing route}}$$

to determine the factor to apply to the existing route ridership. The factor should be adjusted slightly. If there are major differences in average income levels or auto ownership (lower income groups, and fewer autos per household generally result in more transit trips per person), it should be noted. To estimate the income level and auto ownership effect, the following sample formula could be applied:

$$\begin{array}{rcl} 10\% \text{ difference} & & 1\% \text{ change in} \\ \text{in income or} & = & \text{ridership} \\ \text{auto ownership} & & \end{array}$$

For example, if the area of the existing route has 10 percent of its households without automobiles and the new area has 15 percent, then the new area has 50 percent more households without autos and, therefore, ridership would be projected at five percent more than expected by the density ratio only.

- 4 - The new route ridership would be equal to the ratio of the population density times the existing routes ridership⁽²⁾ adjusted for auto ownership and income level characteristics. In equation form, the ridership projection formula would be:

(1) Population density would be computed over the mileage spanning the unduplicated route length and with a width of between one-half and one mile.

(2) If service levels for the new route are different from the existing route, ridership per mile should be used.

$$\frac{\text{New Ridership}}{\text{Mile}} = \frac{\text{Existing Ridership}}{\text{Mile}} \times$$

$$\frac{\text{New Area Density}}{\text{Existing Area Density}} \times \text{Adjustments}$$

Since it takes time to develop a new route, these new route ridership figures would not be anticipated until about one year after the service was instituted. About 75% of this projected ridership would be expected during the first full year of operation.

- C - The potential revenue after the first year from the new route could then be calculated by:

$$(\text{average fare}) \times (\text{estimated ridership}) = \text{revenue}$$

During the first year, about 75% of this revenue would be obtained. The fare used could be the system average, or the fare from the area to the CBD or largest destination. The most realistic figure of fares per trip should be used, and such factors as lower fares for school children and senior citizens should be included if sufficient information is available for estimates.

- D - Costs of the new route could be determined by applying the cost allocation methodology presented in Section III. However, since the cost allocation methodology is not aimed at determining incremental costs involving slight service expansions, it would present a high cost estimate. Therefore, the operator should also determine the direct costs for the new service including drivers' wages and fuel, which should identify the low cost point. As a "rule of thumb." expected actual costs would fall halfway between the two cost estimates.
- E - Finally, a projected cost/revenue ratio should be developed. It should be compared to the performance level guideline for individual routes (EFY-1). If it is below 60 percent of the system average of cost/revenue, it should not be implemented. If the ratio falls in the 60 percent to 80 percent of system average range, it should be implemented, but only on a trial basis. Above 80 percent, steps toward implementation should begin.

III - Implementation

Prior to new service implementation, four actions must be taken which are:

- Prepare vehicle and manpower schedules;
- Provide driver training;
- Provide public information; and
- Project ridership growth.

A - The basic data concerning the new route should be forwarded to the schedule department, including previously determined aspects such as:

- headways;
- routing; and
- span.

A headway sheet should be made up and vehicles required, as well as operating miles and hours, compared with the earlier estimates. If there are major discrepancies, then actions such as reducing proposed service levels or allocating additional costs should be taken. The objective should be a realistic final evaluation of the probable costs, ridership, and revenues from the new service, so that comparisons and evaluations can be made after its implementation. Finally, vehicle and manpower requirements should be defined and the new service needs integrated into the overall system.

B - Drivers must be taught the new route prior to its implementation. Essential elements in the driver training program include: route path, major turn points, stop locations and fare structure.

C - Of course, a major aspect of the provision of new service is the dissemination of information regarding the service to the people within the new service area. A new service public information campaign including the following essential elements must be accomplished:

- Printing and distribution of public timetables;
- Media advertising;
- Notifications of new service at affected major activity centers; and
- Service promotions such as free passes.

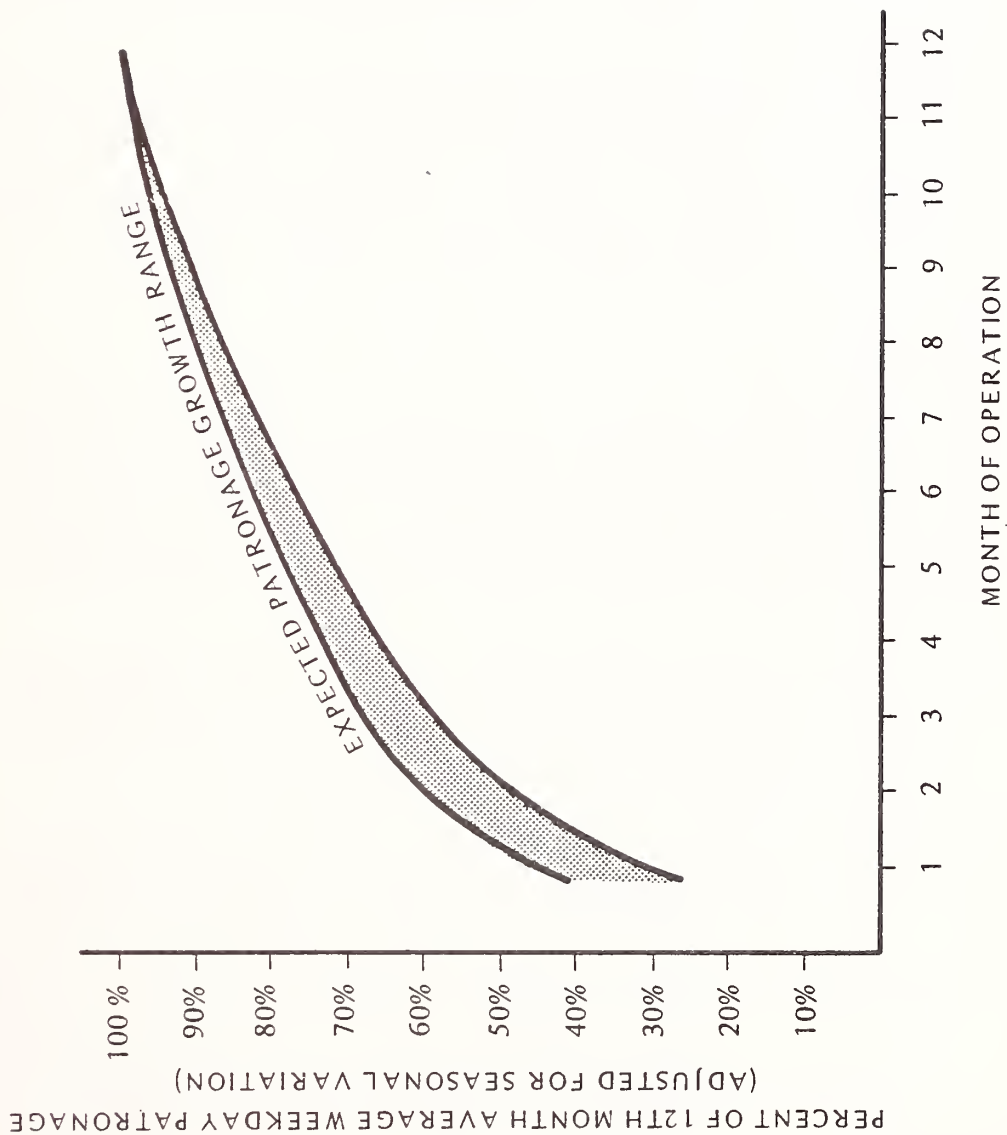
D - Ridership on the new route should increase gradually over time and eventually reach the projected level about one year after initiation. As part of the implementation process, expected ridership growth rates during the initial years should be determined. Figure IV-1 sets forth the guide for developing the range for acceptable growth rates. Several key threshold levels listed below should be achieved during the first year:

<u>During Month</u>	<u>Percent of Potential Ridership</u>
Two	50%
Six	75%
Nine	90%

If these levels are not obtained, the operator should consider improving promotional activities, reducing the service level, or even discontinuing the service.

E - PennDOT should be informed of the new service.

FIGURE IV-1
GENERAL RIDERSHIP GROWTH CURVE
FOR NEW BUS SERVICES



PROVISION OF EXPRESS BUS SERVICE

Definition: Provision of bus services that have a non-stop (or limited stop) portion, either through establishment of a new route or through changes to certain trips of an existing route.

Purpose: Express bus services are generally implemented either due to external factors which influence the transit system to provide new services to an outlying system area, or through a technical evaluation. Technical evaluation would mainly relate to identification of a need for making certain trips express ones.

I - Planning Steps

Transit services offered by most Pennsylvania small- to medium-sized systems are generally focused on a hub city. Most properties also provide service to outlying areas. The following guidelines should be followed to determine whether some services to outlying areas should be converted to express and/or whether new express routes are warranted.

A - To determine whether some trips should be converted to express services, the following data should be obtained and analysis conducted for those routes which serve an area at least ten miles from the hub city.

1 - Express bus services for small- to medium-sized Pennsylvania systems are generally appropriate only for satisfying peak period work trips. Therefore, ridership data for each peak period trip with boarding and alighting locations should be accumulated. This collection of ridership data should initially be focused on corridors with the greatest potential for express services. These corridors have the following characteristics:

- Concentrations of population ten miles or more away from the hub city with low density in between;
 - Travel desires from the outlying area, especially for work trip purposes, are focused on the hub city, i.e., at least 50 percent of the working population from the outlying area is employed in the hub city.
- 2 - Quality of services offered on the candidate express routes should be defined to include:
- Comparison of the existing route path miles with the most direct routing miles;
 - Comparison of the travel time of the current route with the travel time over the most direct routing or an alternate routing over a limited access highway; and
 - Peak period headways.
- 3 - Ridership data by trip should be plotted on the route map to ascertain the candidate mid-span portion of the route where the least amount of riders board or alight. This mid-span express zone should be at least three miles in length and should offer a minimum time savings of 20 percent over that of the regular route.
- 4 - For candidate express routes, detailed data should be collected pertaining to new running times and the route mileages. Schedules should be constructed combining the single trip or several trip express runs with the regular route runs. If the time savings obtained with the express services are large enough, the operator may consider adding another peak period trip to the route.
- B - Factors to be considered in developing a new express route are:
- 1 - Candidate corridors should be identified which have the following characteristics:

- Has concentrations of population ten miles or more away from the hub city with low density in between. Number of people in the collection zone, which can be over a large area (20 square miles) if park-and-ride service is offered, should be at least 10,000; and
 - Work trips from the outlying area are predominantly oriented toward the hub city.
- 2 - For the candidate corridors, a preliminary route path should be identified which should be followed by a detailed field survey to determine the necessary route elements, including:
- Street and traffic conditions;
 - Precise location of the mid-span express portions;
 - Running time estimates (this should be done using a bus making simulated loading and unloading stops and starts);
 - Turn-around and/or layover locations;
 - Route mileage;
 - Potential bus stop sign and passenger amenity needs and locations; and
 - Determination of park-and-ride locations either using existing parking lot space or new locations.
- 3 - The corridor assessment should also include a review and analysis of potential collection zone options in the outlying area. These include:
- Local service is appropriate where the population is concentrated over a small area;
 - A park-and-ride collection system has a greater influence zone and is most appropriate when the population in the outlying area is spread over a large area. Generally, this area or park-and-ride influence zone could include a 20 square mile area. Its contour generally includes an area radiating about five miles from the park-and-ride lot

in the directions away from the hub city, and one mile from the lot in the direction of the hub city; and

- Combined local service with a park-and-ride lot is appropriate where a small part of the outlying area has a dense population distribution. Here, local service would operate in the densely populated area, and park-and-ride would attract the remainder.
- 4 - Since express service is generally for work trips, a schedule should be developed initially which uses only one bus. This may therefore involve only two or three trips for each peak period. However, midday service should also be provided which, at a minimum, should involve a late morning and a mid-afternoon round trip. In total, the schedule would involve six to eight round trips (four to six during the peak period).
- 5 - Workers are concerned with being at work on time. Therefore, data should be obtained which identifies the major work shift times in the hub city. Schedules for the express service should be geared to deliver the workers 10 to 15 minutes before the start time and pick them up five to ten minutes after closing time.

II - Evaluation Step

With the express trips for the regular route or the new express routes well defined, the projected ridership, revenue and costs of the service change should be determined.

- A - Making one or more trips on a regular route express trips will have little, if any, impact on overall costs of the route. Even if another peak period trip were added with the saving of time resulting from the express zone, the incremental costs would be minimal and should only involve the cost factor related to miles, as presented in the cost allocation methodology described in Section III. This cost increment should be determined.

Ridership on the express trips would undoubtedly increase because of the higher quality of service offered. However, assuming no ridership increase, the express service should provide added revenue since express trips should be offered at a fare slightly above the regular route charge (10 percent

to 20 percent higher). This surcharge revenue should be determined and compared with the incremental mileage cost, if any, to decide whether this service change should be offered.

B - Projected cost, patronage and revenue for new express services would involve more detailed analyses than conducted above:

1 - Costs of the new express route could be determined by applying the cost allocation methodology presented in Section III. However, since the cost allocation methodology is not aimed at determining incremental costs involving slight service expansions, it would present a high cost estimate. Therefore, the operator should also determine the direct costs for the new service including drivers' wages and fuel, which should identify the low cost point. A "rule of thumb" for expected actual costs would be halfway between the two cost estimates.

2 - If express bus service is presently offered, a simple and fairly accurate method to determine projected ridership for new services would be to use data from the existing route. The mode split for transit use would be determined and applied to the number of hub city bound trips from the influence zone of the new service. For example, the influence zone of an existing express service area may include 10,000 people with 1,500 daily hub city bound trips of which 225 or 15 percent presently use transit. Therefore, 15 percent would be applied to the daily number of hub city bound trips from the new area to determine projected ridership.

If express bus services are new to the area, then the mode split for transit usage on regular routes from outlying areas throughout the entire system should be determined. A mode split percent should be selected and applied to hub city bound trips for the new express route service area.

3 - The potential revenue from the new route could then be calculated by:

$$(\text{average fare}) \times (\text{estimated ridership}) = \text{revenue}$$

The fare used could be the charge for similar length routes with an added 10 percent to 20 percent surcharge.

- 4 - Finally, the cost/revenue relationship of the express route should be determined and compared to route performance standards to determine whether or not implementation is called for.

III - Implementation

Implementation steps involving changes of certain trips to express ones and/or establishing an entirely new express route would follow very closely those defined for the Provision of New Regular Route Services. Even the expected ridership growth defined in that section would be applicable. Difference would occur, though, if a park-and-ride lot were to be implemented. As a first step, a low capital cost park-and-ride lot solution should be sought. This would entail investigating the potential for use of existing parking resources such as those found at shopping centers, churches, drive-in movies, and freeway interchanges. If this fails, a new park-and-ride lot program should be investigated. Key implementation aspects of such a program include:

- A - Selection of a site that could accommodate the bus riders. Here, an auto occupancy rate of 1.2 would be appropriate for sizing parking space needs;
- B - It may also be appropriate to consider at this point a joint usage facility for the area's car pool program;
- C - Preliminary site layout and engineering work should be accomplished;
- D - Passenger amenities are important to a successful park-and-ride program, they should be fully developed and include:
 - 1 - Waiting shelter with benches and schedule information posted
 - 2 - Ample lighting both at the shelter and on the lot
 - 3 - Telephone
 - 4 - Signing both at the facility and along approach routes; and
- E - Basic construction and maintenance requirements should also be considered:
 - 1 - Incorporation of an adequate bus loading area
 - 2 - Design of adequate drainage at the site

- 3 - Provisions for those riders who are
dropped off and picked up
- 4 - Easy access to the main highway
- 5 - Responsibility for maintenance by appropriate
state or local agencies prior to installation.

BUS PRIORITY TREATMENT

Definition: Priority treatment of bus service involves many different schemes, including use of signal pre-emption, bus-only streets, and exclusive transit lanes.

Purpose: Generally, priority treatment of buses is aimed at overcoming traffic bottlenecks and therefore speeding up the delivery of transit services. An evaluation of routes using the route profile process or performance of routes based on many of the performance evaluations contained in Section III may determine the need for such an improvement.

I - Planning Steps

Generally, services offered by small- to medium-sized properties in Pennsylvania are not provided frequently enough on an individual route basis to warrant the capital expenditures involved in bus priority treatments. Therefore, routes must be viewed together where they have a common path which generally occurs in the downtown part of the transit system's hub city. If a large number of routes have a common path in the downtown area, the following data should be obtained to check feasibility of priority treatment.

- A - Traffic volumes capacity and turning movements along and perpendicular to the common route.
- B - Profile of bus movements along the common route both in number and time.
- C - Speed checks of buses operated and the number of blocks within the common route.
- D - Location of signals and their phasings.
- E - On-street parking policies.
- F - Street widths.
- G - Major activity centers located on the route.

II - Evaluation Steps

An exclusive bus lane or a bus-only street, when justified, provides a significant travel time saving to the transit user. The transit property also benefits by cost savings and revenue increases resulting from more attractive services. Signal preemption results in benefits that are not as significant and are usually implemented at a few bottleneck intersections.

- A - An exclusive bus lane operating in the direction of normal traffic flow is relatively easy and inexpensive to implement. On a common route where the volume of buses is significant to utilize a major portion of the curb lane, the operation will be somewhat self-enforcing. Lack of small headways along the route, at least two minutes and preferably much lower, will result in autos infringing on the lane. Additionally, an exclusive lane should have a higher people-moving capacity than the lane would have if used by automobiles. For example, if a common route has a maximum density of 30 buses during a peak hour in one direction, its usage gives an average headway of two minutes. Assuming 45 passenger buses, the people-moving capacity would be 1,350. Therefore, assuming an auto occupancy rate of 1.5, the lane auto volume with 900 cars per hour would be equal to the bus capacity. In this example, without a large differential in bus versus auto capacity, an exclusive lane would not be justified.

A curb exclusive bus lane has the following general characteristics:

- 1 - Applicable with 1,200 to 1,600 bus passengers per hour;
 - 2 - Most desirable on a one-way street with two other traffic lanes;
 - 3 - Capital costs for signing and pavement marking is about \$5,000 per mile; and
 - 4 - Time savings per bus will range from 1.5 to 5 minutes per mile.
- B - To devote several blocks of a street to bus traffic only generally requires more bus volumes than small- to medium-sized Pennsylvania properties provide. Requirements are generally more demanding than for an exclusive bus lane in terms of average bus headways along the common route, since resistance for such a change is typically very strong.

General requirements for bus-only streets include:

- 1 - 3,600 or more passengers per hour;
 - 2 - Ability for auto and truck services to access adjacent buildings from alleys or other streets;
 - 3 - Capital costs of \$1,000,000 and upward per mile; and
 - 4 - Time saving of 1.5 to 8 minutes per bus per mile.
- C - When a bus approaches a signalized intersection, the green phase can be either extended or advanced so as to allow the bus to clear the intersection without stopping for the signal. Evaluation of such a system depends largely on the amount of delays experienced at a signalized intersection. If delays are significant, five minutes or more per mile, then the system should be considered. Costs for the preemption unit are about \$1,000 for each bus transmitter and \$1,000 for each signal receiver.

III - Implementation

Implementation of a priority bus program is a large undertaking. It requires more extensive analysis and planning than conducted in this profile. Most important is the close coordination required between transit personnel and traffic department personnel responsible for the street and/or signal systems. Implementation of transit system changes resulting from the priority programs should also be accomplished including:

- New schedules (vehicle and manpower) for affected routes to reflect the faster running times;
- Public information and promotional programs describing the change; and
- Installation of the necessary signs, waiting shelters or equipment.

SECTION V:
FARE CHANGES

CONTENTS

SECTION V - FARE CHANGES

	<u>Page</u>
DEVELOPMENT OF EVALUATION METHODOLOGY	V-1
Define Evaluation Criteria	V-2
Analytical Tools	V-5
DISCRETE ACTIONS FOR FARE REVISIONS (Step 1)	V-9
Adult Cash Fare Actions	V-9
Fare Promotion Program Actions	V-11
Summary of Potential Discrete Actions	V-14
RIDERSHIP AND REVENUE IMPACTS OF DISCRETE ACTIONS (Step 2)	V-14
DEVELOPMENT OF ALTERNATIVE FARE STRUCTURES (Step 3)	V-15
EVALUATE ALTERNATIVE FARE STRUCTURES (Step 4)	V-15
SELECT AND IMPLEMENT PREFERRED ALTERNATIVE (Step 5)	V-15
Fare Structure Implementation	V-16
Appendix V-A: Annotated Bibliography	

LIST OF TABLES

<u>Table No.</u>		<u>Following Page</u>
V-1	Fare Structure Criteria Ranking	V-5
V-2	Sample Discount and Estimated Ridership and Revenue Impact Resulting From Fare Promotion Program	V-9
V-3	Fare Structure for Selected Transit Systems in Pennsylvania	V-9

SECTION V - FARE CHANGES

LIST OF TABLES (Continued)

<u>Table No.</u>		<u>Following Page</u>
V-4	Hypothetical Array of Discrete Fare Change Actions	V-14
V-5	Impact of Discrete Actions	V-14
V-6	Impact of Discrete Actions	V-15
V-7	Examples of Fare Program Alternatives Fiscal Integrity Focus	V-15
V-8	Fare Structure Alternative Evaluation	V-15
V-9	Fare Structure Implementation Check List	V-16

LIST OF FIGURES

<u>Figure No.</u>		<u>Following Page</u>
V-1	Fare Increase Percent Versus Ridership Loss	V-7
V-2	Fare Increase Percent Versus Revenue Gain	V-7

SECTION V

FARE CHANGES

Fares are perhaps the most sensitive and visible element of transit services. Motorists can travel from interstate highways to county roads to city streets without ever being cognizant of the financial outlays for signing, striping, maintenance, construction, etc. In contrast, the transit rider is constantly reminded of the cost of his journey each time he boards a bus. What public proceedings bring out a more vocal opposition than a request for a fare increase?

This sensitive aspect of transit service is explored in this section of the manual. The emphasis will be on details of accomplishing fare related changes and the resulting impact on revenue and ridership of specific fare change actions. The process developed to accomplish fare changes involves five steps which are:

1. Discrete actions for fare revisions;
2. Ridership and revenue impacts of discrete actions;
3. Development of alternative fare structures;
4. Evaluate alternative fare structures; and
5. Select and implement preferred alternative.

However, prior to the presentation of the details involved in each step, criteria are defined for evaluating fare changes and analytical tools are given for predicting ridership and revenue impacts due to fare changes.

DEVELOPMENT OF EVALUATION METHODOLOGY

As discussed in Section I and Section II of this manual, a thorough policy review of fare structure objectives, criteria, and performance level guidelines is critical to making fare structure changes. If fare structure objectives along with the

consequencies of their adoption are not considered by Pennsylvania transit properties in liaison with their funding governments, and if feedback is not provided to properly direct policy decisions, the resulting fare structure changes may be much more difficult to implement.

The evaluation methodology should proceed according to two steps: (1) Definition of criteria; and (2) Development of analytical tools.

Define Evaluation Criteria

In planning for fare structure changes, the first and perhaps the most important step is to determine what the Authority wishes to accomplish from the change. Does the Authority desire to increase revenue by ten percent? Does the Authority wish to simplify the fare structure? These and other questions must be answered.

The process for answering these questions should involve the delineation of criteria with significance levels assigned to each. Criteria for making fare structure changes include:

- Fiscal Integrity — With the existing Commonwealth financial assistance program dependent on the amount of cost covered by farebox revenue and with the general concern of Pennsylvania transit systems to minimize local financial support, this measure is probably the most important one.

Transit not only benefits the rider. In terms of energy conservation, relief of traffic congestion, air and noise pollution abatement, support of regional development and provision of mobility for elderly, handicapped and student groups, transit also benefits the general public. In Pennsylvania, therefore, transit is paid for by a combination of user charges and federal/state/local tax dollars. User charges pay a percentage of system operating cost, which for 1977-1978 for medium-sized Pennsylvania properties ranged between 25 percent and 63 percent. Furthermore, in Pennsylvania senior citizens are offered free use of transit services in off-peak periods. This Free Transit Program for Senior Citizens is provided for by the Commonwealth wherein the transit property is reimbursed for the estimated revenue loss resulting from granting free service to senior citizens.

In every transit authority budget, there is a trade-off between system revenue, public funding assistance and transit service level. A funding

shortfall can be corrected by a fare increase, an increase in public funds or a service cut, or by a combination of these. One of the vital functions of a transit authority, assisted by management, is to make this difficult trade-off decision.

As discussed earlier in this Manual (see Section II - Performance Level Guidelines - Fare Policy:

Page FRE-4), a suggested criteria for making fare increases is to implement them every two or three years, or when costs have escalated by more than 25 percent since the last fare increase occurred.

- Fare Structure Simplification — The greatest advantage of transit is its low cost. Many people can use bus service in Pennsylvania for an entire month for about \$15, compared to a full cost of \$100-150 per month for a car.

In order to market this cost advantage, the general public should know the price of each and every transit service. While base fare is probably commonly known, people who try to make a specific bus trip for the first time encounter a variety of other prices. Zone fares are particularly confusing, both because of the number of zones and because of the location of zone boundaries. Transfers, passes, special user group discounts (senior citizens, students, children), express surcharges and special services' fares further complicate the fare structure.

- Fare Promotion Programs — Other things being equal, the fare structure that can attract the most transit trips is preferred. Beyond fare simplicity and convenience, how can a fare structure increase transit riding?

At relatively little revenue loss, special fare promotions can be designed to draw attention to new or improved services, and to try to establish a transit riding habit. For example, a free ride coupon could be included with promotional literature delivered door-to-door in the vicinity of a bus route. A transit "sale" could be held, perhaps on a Saturday, featuring free rides on the system before noon. Just as private industry uses price competition in the form of "sales" and "loss leaders" to attract business, Pennsylvania can do the same and some properties are already doing so.

Certain forms of fare prepayment are more conducive to increased transit tripmaking than others. While passes and tickets/tokens are equally convenient, for the pass, which is good for a specified time period,

there is no extra cost for making another trip. Patrons who buy passes may use transit up to 20 percent more frequently as a result.

To encourage riders, a transit fare tariff should be flexible enough to allow for "sales" and promotions. On the other hand, there should be survey monitoring of such fares to see to what extent new riders are being attracted to the system.

- Passenger Equity — While transit fare equity is hard to define precisely, equity considerations generally fall into three categories: riding distance, quality of service, and patron's ability to pay.

- Riding distance — It is a commonly accepted principle that patrons who ride further should pay more. Yet, no fare collection system has been developed for transit buses which enables easy enforcement of this principle. Instead, most Pennsylvania systems rely on zone boundaries to collect distance premiums. There are several problems inherent in zone boundaries:
 - - They are difficult for the general public to comprehend; and
 - - Zone fares are administratively cumbersome to collect (tight enforcement requires the handing out of zone checks and closing the rear bus door after crossing a zone boundary).
- Quality of Service — Premium services, which offer the patron a higher standard of dependability, speed, comfort or convenience, may command a premium price. A five cent or ten cent express bus surcharge is an example of this. Bus services which can take advantage of some form of preferential treatment to bypass cars during rush hour are prime candidates for a premium fare.
- Patron's Ability to Pay — The last ingredient in fare equity is ability to pay. The relative importance of the fare to different user groups should be taken into account before setting the same price for everyone. Even when transit was a private industry, there was some consideration of ability to pay as evidenced by the widespread practice of student discounts. With transit as a public service,

fare discounts for elderly and handicapped patrons are universal, and some systems have agreements for social service agency payment of fares for their clients.

- Ease of Administration and Operation — A fare structure must lend itself to easy (low administrative cost) collection of, and accounting for, route revenues. Security of revenue is also a consideration. With a zone structure employed, and a multiplicity of fare plans for different types of services and different ridership groups, the type of fare collection hardware employed certainly has the potential to aggravate or improve the situation.
- Effect on Energy and the Environment — A fare structure may have the ability to influence a modal shift from the private automobile to transit. A significant modal shift to transit can reduce the level of hydrocarbon emissions and concomittantly improve the ambient air quality. It should be noted, however, that a fare structure designed to effect energy conservation must be enacted in concert with other measures such as a downtown parking disincentive program.

What is probably most obvious from the above discussion is that the criteria do not "work together"; that is, a change to enhance satisfaction of one criterion may affect another criterion detrimentally. Thus, there are trade-offs to be made, so that a balance may be struck between the different criteria. These trade-offs can be made by assigning significance levels to each criteria. As set forth on Table V-1, each of the six criteria can be ranked as to its relative importance in making the fare structure changes.

Analytical Tools

Utilization of mass transit service is a function of several factors including the demand characteristics (such as population density, socioeconomic characteristics of the area residents) and the supply characteristics (such as route spacing, headways, area coverage, type of service, price of service, etc.). Demand for transit service, however, is closely related to two important supply characteristics - price and level of service. Variation in the price, the level of service, or both, generates changes in the utilization of transit.

An increase in price causes a decrease in ridership. The relationship between price and transit utilization is

TABLE V-1

FARE STRUCTURE CRITERIA RANKING

<u>Criteria</u>	<u>Relative Importance</u>				
	Least 1	2	3	4	Most 5
Fare Structure Simplification					
Fiscal Integrity					
Fare Promotion Programs					
Passenger Equity					
Ease of Administration					
Effect on Energy and the Environment					

known as the demand function. Several studies have been performed in recent years which quantify the relationship between transit price level and transit utilization. These studies are summarized in the annotated bibliography appended to this section.

Definitions of Elasticity — Transit planners have historically used price elasticity as a measure to predict changes in transit utilization attributable to changes in level of price. This price elasticity states that, for a given percentage change in price, a certain percentage change in patronage will result.

The literature on transit price elasticities generally refers to two elasticity measures, although others are mentioned - - arc elasticity and shrinkage ratio.

Historically, the shrinkage ratio was the most commonly used price elasticity tool.⁽¹⁾ However, as a result of extensive research in this field, the arc elasticity method appears to be the more accurate method. Therefore, the arc elasticity of demand is suggested for use by Pennsylvania properties. It is calculated as a ratio of the percentage change in transit utilization divided by the percentage change in price when the base of the price percentage change is the average of the before and after values. Arc elasticity can be expressed mathematically as follows:

$$\begin{aligned} R_1 &= \text{Average daily ridership before fare change;} \\ R_2 &= \text{Average daily ridership after fare change;} \\ F_1 &= \text{Average fare before fare change; and} \\ F_2 &= \text{Average fare after fare change.} \end{aligned}$$

Then,

$$\text{Arc Elasticity} = \frac{R_2 - R_1}{(R_1 + R_2)/2} \div \frac{F_2 - F_1}{(F_1 + F_2)/2}$$

For small changes in ridership, the Arc Elasticity formula can be simplified as:

$$\text{Arc Elasticity} = \frac{R_2 - R_1}{R_1} \div \frac{F_2 - F_1}{(F_1 + F_2)/2}$$

(1) The shrinkage ratio states that for each one percent increase in fare, there is a one-third of one percent decrease in riders.

Transit Fare Elasticities — It is generally accepted throughout the transit industry that demand for transit services is inelastic with respect to transit pricing. However, there is still some disagreement on the degree of inelasticity. For example, based on data obtained from BARTA and LANTA, two elasticity factors were observed. BARTA increased its fare in 1974 from 35 cents to 40 cents, which resulted in an elasticity factor of -0.14. LANTA in 1979 also increased its base fare from 35 cents to 40 cents and at the same time, raised its off-peak fare from 25 cents to 30 cents. A composite elasticity factor of -0.25 was obtained for LANTA's combined peak and off-peak fare change.

The wide range of elasticities reported above and in the literature is not surprising, with evidence that riders in different cities and among various transit submarkets react differently to pricing changes. In fact, more recent data on ridership impacts due to fare changes indicate that the loss is generally not as great as predicted. Whether it is due to better quality of services provided, higher costs of gasoline, or other factors, the trend appears to be that fare changes are having a lesser impact on ridership.

Estimate of Fare Elasticities — The impact on ridership and revenue of fare revisions may vary considerably with the transit submarket under review. For example, it would be expected for peak period ridership which generally consists of a large percentage of workers that are captive riders to be more inelastic in comparison to off-peak riders that are generally non-captive. A single elasticity measure, therefore, should not be applied to all rider groups. In fact, even within a particular ridership group or route type, variations are expected among Pennsylvania properties. Therefore, the following elasticity measures are recommended for use by small- to medium-sized properties in Pennsylvania.

● Local Routes:	-0.20 to -0.30
● Express Routes:	-0.30 to -0.40
● Elderly & Handicapped Riders:	-0.30 to -0.35
● Student Riders:	-0.30 to -0.40
● Peak Ridership:	-0.10 to -0.20
● Off-Peak Ridership:	-0.30 to -0.40
● Transfer Riders:	-0.30 to -0.40

For these elasticity factors, ridership and revenue estimates were developed in graphic form and are displayed in Figure V-1 and Figure V-2, respectively. An example of use of these graphs follows.

FIGURE V-1
FARE INCREASE PERCENT VERSUS RIDERSHIP LOSS

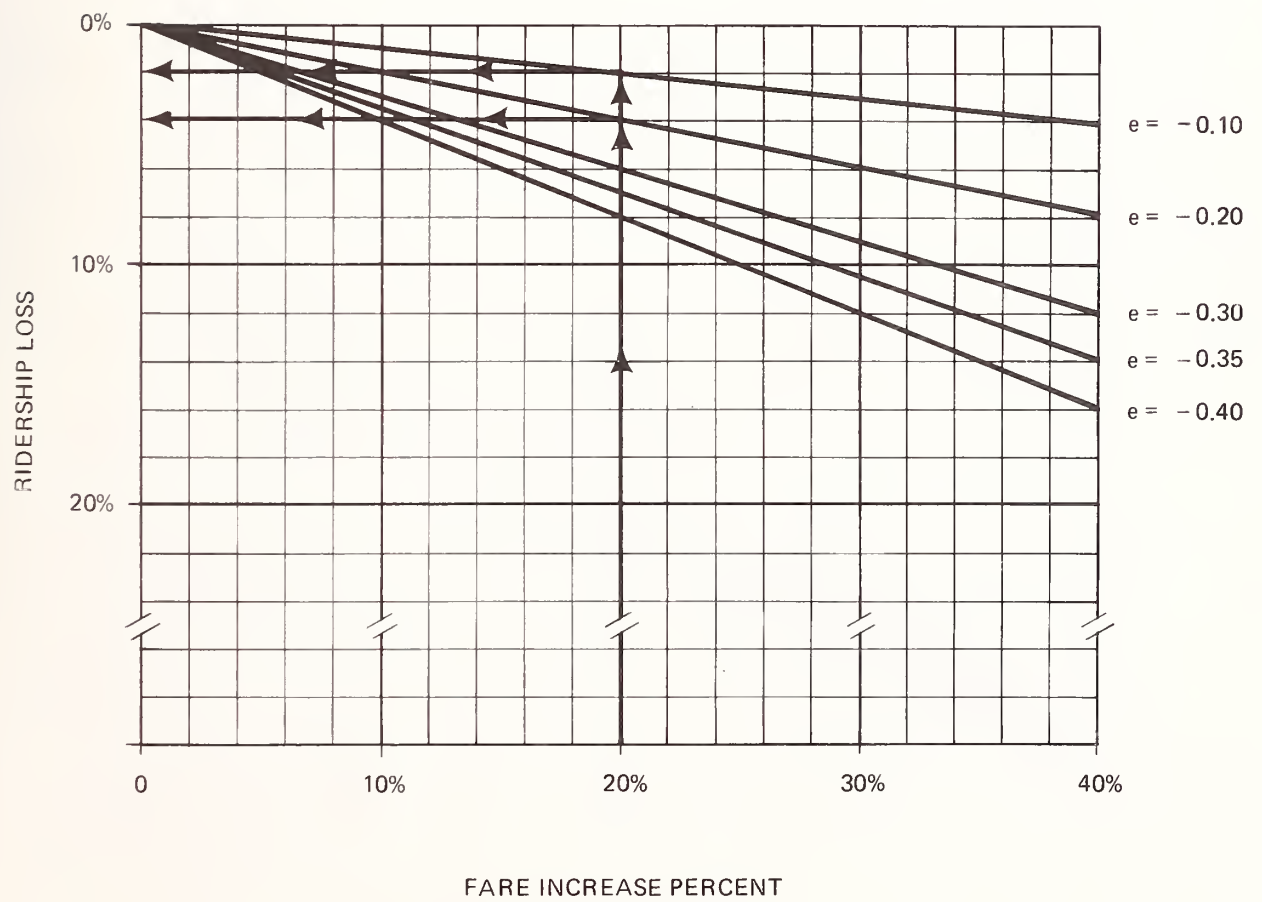
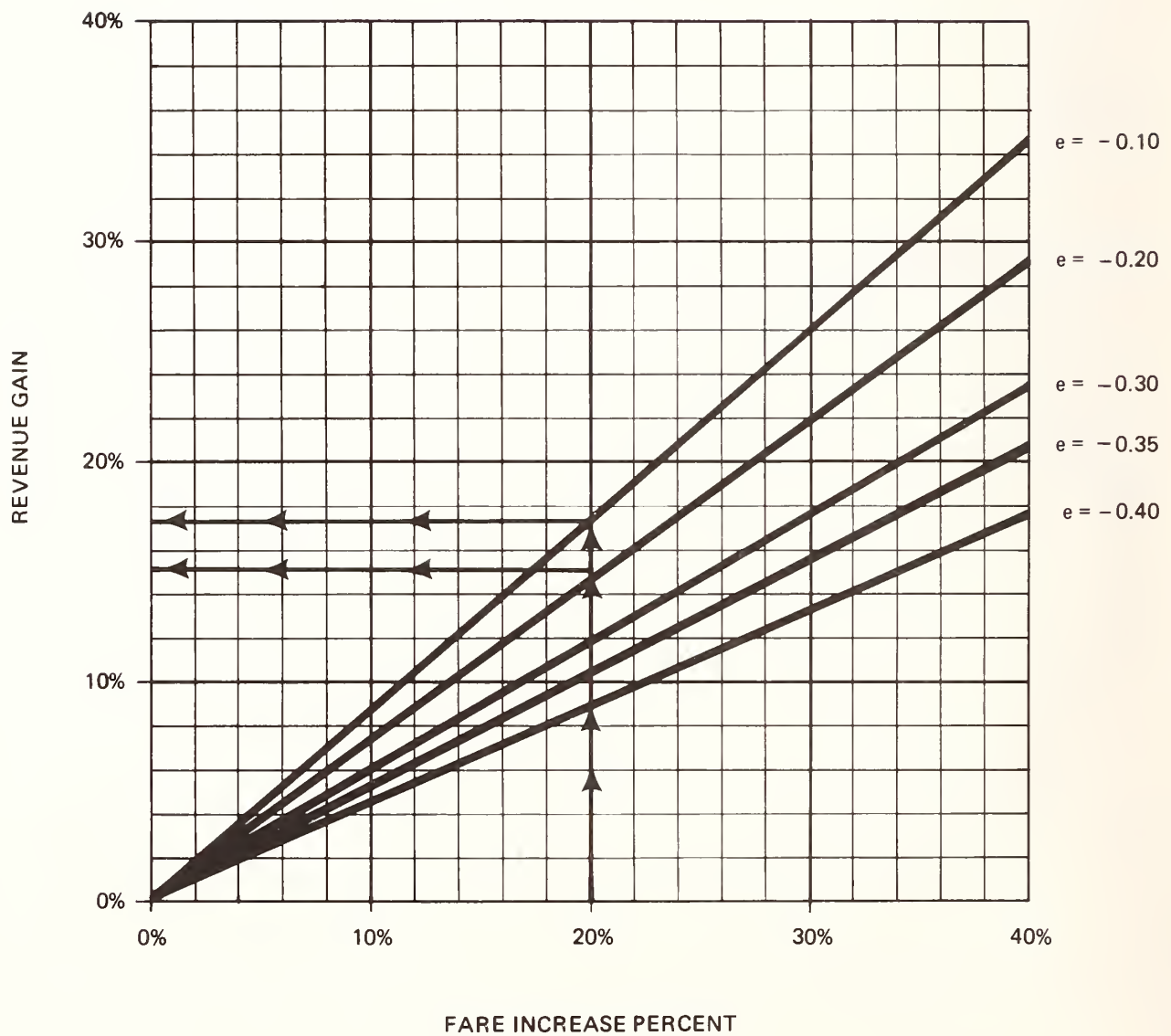


FIGURE V-2
FARE INCREASE PERCENT VERSUS REVENUE GAIN



- (1) Identify the nature of the fare change, e.g., the peak period fare will increase from 45 cents to 55 cents.
- (2) Determine the fare change percentage, e.g.,

$$\frac{55 \text{ cents} - 45 \text{ cents}}{55 \text{ cents} + 45 \text{ cents}/2} = \frac{10 \text{ cents}}{50 \text{ cents}} = 20 \text{ percent}$$

- (3) From Figure V-1, identify the appropriate fare increase percent and the associated elasticity factor (e) for the fare change. Determine the ridership loss percentage at the intersection of the fare increase percent and "e" curve. For example, with an "e" of -0.10 to -0.20, which is the range associated with peak ridership and with a 20 percent fare increase, the projected ridership loss after the fare change will be between two percent and four percent.
- (4) Finally, using the same fare increase percent and elasticity factors (e), from Figure V-2 the revenue gain will be determined. For example, the revenue gain will be between 15 percent and 17 percent of existing peak period revenue.
- (5) Finally, select the appropriate ridership and revenue values. If there is insufficient information to identify which side of the range is most appropriate, then the mid-point should be selected which for this example would be a three percent ridership loss and a 16 percent revenue gain.

Ridership Improvement Through Fare Promotion Programs — Impacts on ridership and revenue resulting from implementation of fare promotion programs are dependent on the level of discounts over the full fare charge. Furthermore, another major consideration in predicting this impact is the extent to which the program will be used by the riders. For example, a monthly pass which may be purchased for perhaps 36 times the full fare charge offers a discount of almost 20 percent (assuming 21.5 working days per month). However, the once-a-month outlay of \$16.20 (36 times a 45 cent fare) may be difficult for many people to budget. It is expected, therefore, that the number of people who would take advantage of such a program would be minimal. Consequently, the revenue impact would likewise be minimal.

As set forth in Table V-2, except for implementing off-peak reduced fares, the expected impact on ridership and revenue resulting from implementing a sample set of fare promotion programs would be minimal.

DISCRETE ACTIONS FOR FARE REVISIONS (Step 1)

A transit fare structure is a composite of a number of elements, including various levels of fare with respect to types of service, various methods of payment of fare and various procedures used to identify eligibility of a passenger to use a given type of fare.

Pennsylvania transit fare structures generally consist of a base fare, zone fares, express premium fares, free fares for the elderly and, during off-peak periods, reduced fares for handicapped persons and students, passes and various charges for special event services, as set forth in Table V-3. In theory, revisions to a fare structure could involve almost limitless permutations. At the same time, consideration must be given to the effect of revisions on individual user groups, not only the "bottom line", since various combinations of changes may yield, overall, similar ridership/revenue total results.

To analyze potential revisions to the Pennsylvania system's structure, therefore, a "building block" approach is adopted. In this section, alternative revisions are discussed, one by one, as "discrete actions": changes which might be made to individual elements of the fare structure. These discrete actions have been placed into two groups - - those involving the adult cash fares and those considered as fare promotion programs.

Adult Cash Fare Actions

There are basically two generic types of fare structures, although there are numerous variations in existence in transit systems throughout the country: a flat fare structure and a zone fare structure. Discrete fare structure changes involving both along with special considerations involving each one - - transfer charges and premium fare for express bus service - - are discussed below.

Base Fare — Several medium-sized Pennsylvania transit systems have just one flat fare. Others have a base fare for the urban area with a zonal charge for trips into the suburban areas.

TABLE V-2
SAMPLE DISCOUNT AND ESTIMATED RIDERSHIP
AND REVENUE IMPACT RESULTING FROM FARE PROMOTION PROGRAM

Program	Sample Discount	Estimated Ridership Impact	Estimated Revenue Impact
Off-Peak Reduced Fares	10¢ below full fare	Use arc elasticity formula applied to off-peak ridership	
Multi-Ride Tickets or Tokens	10%	Slight Increase	Minimal
Reduced Fare Downtown	50%	Increase	Slight Increase
Unlimited Ride Pass			
Weekly	(a)	Minimal	Minimal
Monthly	20%	Minimal	Minimal

(a) Weekly passes are commonly priced at 10 times the full fare.

TABLE V-3
FARE STRUCTURE⁽¹⁾ FOR SELECTED
TRANSIT SYSTEMS IN PENNSYLVANIA

	Base Fare		Number of Zones	Zone Charge	Transfer Charge	Student Discount	Senior Citizens		Handicapped		Express Premium	Exact Fare	Multi-Ride Tickets		Pass	
	Peak	Off-Peak					Peak	Off-Peak	Peak	Off-Peak			Yes/ No	Discount No	Weekly	Monthly
AMTRAN	.50	.50	2	.10	Free	No	No	Free	No	Yes	None	No	Yes	Yes	No	No
BARTA	.45	.45	3	.05	.05	Yes	No	Free	No	Yes	No	Yes	Tokens	Yes	No	Yes
CAT	.45	.45	4	.10	.05	No	No	Free	No	Yes	.05	Yes	Yes	No	No	Yes
COLTS	.35	.35	6	Varies	Free	Yes	No	Free	No	Yes	N/A	Yes	Yes	No	No	Yes
EMTA	.45	.35	3	Full Fare	.05	Yes	No	Free	No	Yes	N/A	Yes	Tokens	Yes	No	No
LANTA	.50	.40	1	N/A	.05	No	No	Free	No	Yes	No	Yes	Yes	No	No	Yes
LCTA	.40	.40	2	.10	.10	Yes	No	Free	No	Yes	.10	Yes	No	No	No	Yes
RRTA	.50	.50	4	Varies	Free	Yes	No	Free	No	Yes	No	No	Yes	No	No	Yes
Williamsport	.35	.35	1	N/A	Free	Yes	No	Free	No	Yes	None	No	Tokens	Yes	No	No
YATA	.50	.50	2	.10	Free	Yes	No	Free	No	Yes	N/A	No	No	No	No	Yes
CCTA	.50	.50	1	-	.05	No	No	Free	No	Yes	No	Yes	Tokens	No	No	No

⁽¹⁾fares effective July 1, 1980

Two discrete actions are possible with a flat fare revision: an increase in fare to generate more operating revenue; or a decrease in fare to increase system ridership. Impacts on ridership and revenue due to each type of change are discussed later in this section of the Manual.

Zone Structures — A zone structure is aimed at providing service throughout the service area in an equitable manner. There are many fare changes that can be accomplished involving a zone system, including:

- An evaluation of the fare charged per route (see Section III - Performance Evaluation - Provide Equitable Fares Throughout the Day: Page FRE-2) may indicate a need to impose a zone structure if none presently exists.
- Number of existing zones could be increased or reduced. (The RRTA in Lancaster in 1976 reduced the number of zones from seven to five.)
- Zonal boundaries could be changed, which generally may result from many factors including jurisdiction boundaries, major highway crossing, loading patterns.
- Zonal charges could be increased or decreased.
- A zone structure could be eliminated and a single systemwide flat fare adopted.

Transfer Charges — The fact that some percentage of riders must transfer between vehicles is an inevitable element of city public transportation networks. While the transit system can provide extensive coverage to potential users, it cannot provide direct service to the limitless combination of possible passenger origins and destinations. Although it is an admirable objective to minimize the need for two- or three-bus journeys, there will also be those who must incur a time and convenience penalty associated with vehicle interchanging.

Historically, when private transportation companies throughout the nation generated revenues sufficient to offset costs, charges were not made for those needing transfer receipts. Nevertheless, as it became more difficult for certain transit agencies to cover accelerating operating costs, a charge for transfers was viewed as a convenient mechanism for augmenting system revenue without incurring the wrath of all network users.

There are a number of transfer charge arrangements. For example, the levy may be in direct proportion to the number of interchanges made. Thus, a five-cent or ten-cent charge may be imposed each and every time the user transfers. On other systems, a tariff may be levied on an initial transfer while subsequent interchanges may be made at no additional cost.

Express Service Premium Fares — Many cities have instituted express bus services between outlying residential districts and the CBD or other major employment generators. In most instances, express bus services are equipped with newer vehicles offering full seating capacity for anticipated demand. For this reason, a charge, in addition to the comparable local service fare, is levied on express bus patrons.

Usually, a surcharge of five or ten cents per ride is collected from premium service users. While it would be possible theoretically to relate the percentage increase in fare with the percentage travel time saved over local transit, such a policy is not practiced because of difficulty in administration. A premium fare (see Section III - Performance Evaluation - Provide Equitable Fares Throughout the System: Page FRE-2) should be charged if the express service offers a time advantage of 20 percent or more over the regular route for the non-stop portion.

Fare Promotion Program Actions

A major component of a sound marketing program is pricing strategy consistent with promotional programs. The purpose of this section is to review a number of fare promotion demonstration programs and discuss their applicability to transit in medium-sized properties in Pennsylvania.

Off-Peak Reduced Fares — Reduced fares for off-peak users of transit service have been instituted in numerous communities, principally for senior citizens but also for shoppers and, in some cases, all system users such as in Allentown.

The rationale for lower fares during base operating periods, perhaps 75 percent of the peak period ride fare, emanates from both demand and supply considerations. In terms of demand, reduced fares are seen as a means of stimulating ridership particularly during periods when policy headways govern schedule requirements. Cost considerations justify lower fares for base period riders since only marginal costs (miles and hours) rather than total costs, which include capital requirements, are expended to service off-peak needs.

One conclusion that has emerged from the experience with reduced fare experiments is that reduced fares alone do not produce any net revenue for the transit system. Whether or not such a promotional program actually stimulates ridership is debatable. It is quite clear, however, that a substantial number of riders availing themselves of such a program are already regular system users.

Multiple-Ride Tickets or Tokens — Many transit agencies throughout the country utilize multiple-ride tickets or tokens for the convenience of regular system patrons. By purchasing a quantity of tickets or tokens, the rider is spared the necessity of carrying sufficient and correct amounts of coins and currency as required for exact-fare systems. In addition, multiple-fare purchases are frequently offered with a quantity discount.

In determining the application of multiple-ride tickets or tokens to the present transit environment in Pennsylvania, two major issues should be discussed: 1) whether a multiple-ride fare would be best administered by tickets, tokens or some combination mechanism; and 2) the determination of an appropriate discount rate, if any, to accompany quantity ride purchases.

Reduced Fare Downtown Shuttle — Some Pennsylvania transit systems employ just a flat base fare, with many having a zonal fare structure for inter-area (suburban-city) rides. While a flat fare is easy to administer and simple to comprehend, increasingly higher flat-fare levels tend to dissuade potential patrons from utilizing the transit system for short-distance tripmaking.

To remedy in part the discriminatory aspects of the flat fare with respect to short-distance travel, a number of transit agencies have introduced a reduced-fare zone - - usually in the downtown area. This fare demonstration program involves two alternative strategies.

- Introduction of a reduced-fare zone in the downtown area where persons utilize buses on regular routes at a reduced rate; or
- Institution of a specially-designed route for downtown circulation, for which a reduced fare is usually charged.

Reduced-fare zones in the downtown area have been instituted in many cities. Such a policy is particularly amenable to the needs of travelers when buses in the CBD follow a common or easily understandable routing through the central area.

The use of downtown circulation routes has found widespread application in numerous American cities. Services are usually equipped with vehicles offering a range of seating capacities and are scheduled at frequent intervals. Unlike traditional transit services which experience accentuated demand in morning and afternoon rush periods, patronage on downtown shuttle services is most concentrated during noontime hours.

It would appear that imposition of a reduced-fare zone in cities served by small- to medium-sized Pennsylvania systems would improve utilization of their present transit networks without incurring the undue costs associated with the implementation of an entirely new service. Sufficient capacity generally exists on present midday bus trips to accommodate additional users. Assuming that the potential diversion of riders at the existing fare level is minimal, a reduced fare of perhaps 20 cents or 25 cents would attract short-distance users and improve the overall operating performance of the present transit network.

Unlimited Ride Pass — As a further means of stimulating patronage, a number of transit systems in Pennsylvania have instituted the use of passes which are valid for unlimited rides within a specified fare zone. Passes may be issued for weekly or monthly passage and are usually priced at 10 to 15 and 34 to 44 times higher, respectively, than the base fare.

The typical home-to-work user, who employs the transit network for ten weekly trips, would not find weekly passes to be attractive instruments of fare payment. Transit tripmaking for this sub-market is not elastic with respect to price since members of this group employ alternative means to satisfy other trip needs. On the other hand, the weekly pass becomes desirable to those riders who are completely dependent on the transit system to satisfy their total mobility requirements.

Monthly passes are employed in a number of cities in Pennsylvania. Typically, the price of a monthly pass varies from a multiple of 34 to 44 times the base fare rate. Some transit systems have sold these passes to employers at a discount, with the employer selling the passes to the employees at a further discount.

In summary, a weekly pass appears more adaptable to the needs of transit dependents since a monthly pass costing from \$15 to \$20 would require an initial investment beyond

the reach of the overwhelming number of transit captives. On the other hand, an average multiple of 36 times the given fare is attractive to the home-to-work commuter since there are approximately 21 to 22 workdays (or 42.44 trips) in each month.

Other Fare Promotion Programs — There are numerous other fare promotion programs that have been implemented throughout the country, some of which are listed below.

- Ride and Shop Program — where the patronage pays for the inbound trip, and the merchant provides a ticket for the outbound and reimburses the transit system.
- Annual Passes — one charge for an unlimited number of rides throughout the year.
- Student Discount — a reduced fare for students using the system for school transportation.

Summary of Potential Discrete Actions

The final step in identifying discrete fare change actions is to construct an array of potential changes by fare category. For example, a hypothetical array of fare change actions is set forth on Table V-4. For each type of fare category, the existing fare structure is described along with several alternative ways the category could be changed.

RIDERSHIP AND REVENUE IMPACTS OF DISCRETE ACTIONS (Step 2)

Fare revisions must be evaluated to determine their impacts on different rider groups and on the systemwide revenue. This step in the fare evaluation process, therefore, involves using the elasticity formulas presented graphically on Figures V-1 and V-2 to determine the ridership and revenue impacts of each discrete action.

Of course, the completion of this process assumes that the transit system has available the data needed to perform the analysis. These would primarily include existing ridership levels by each discrete action category. For example, if a fare change affecting transfer riders is contemplated, it is necessary to know the number of transfer passengers before the fare change can be properly evaluated.

Results from this impact step will be an array of changes in ridership and revenues due to each discrete action which could be transcribed onto the form set forth as Table V-5.

TABLE V-4
HYPOTHETICAL ARRAY OF DISCRETE FARE CHANGE ACTIONS

	Current Hypothetical Fare Structure	Discrete Fare Change Actions		
		Minimum Revenue Impact	Intermediate Revenue Impact	Maximum Revenue Impact
Peak Adult Fare	45¢	+5¢	+10¢	+15¢
Off-Peak Adult Fare	35¢	Maintain Existing	+5¢	+10¢
Zone Fare	30¢ per zone	Maintain Existing	+10¢	+20¢
Transfers	Free	Free	5¢	10¢
Express Surcharge	None	None	5¢	10¢
Student Fares	35¢	Maintain Existing	+5¢	+10¢
Monthly Pass	10% Discount	Maintain Existing	5% Discount	Eliminate Discount

TABLE V-5
IMPACT OF DISCRETE ACTIONS

Type of Action: _____ Elasticity Factor: _____

Annual Existing Ridership: _____

Annual Existing Revenue: _____

Existing Fare: _____

Discrete Action	Fare Change		Projected Ridership Loss		Projected Revenue Gain	
	Absolute	Percent *	Absolute	Percent	Absolute	Percent
Minimum						
Intermediate						
Maximum						

General Ridership Class Effected: _____

* New fare minus old fare divided by the midpoint between new and old fare.

For example, assuming that a transit authority selects an elasticity factor of -0.10 for peak period adult fares, then the ridership and revenue impacts could be determined for discrete peak period adult fare charges as set forth on Table V-6.

DEVELOPMENT OF ALTERNATIVE FARE STRUCTURES (Step 3)

Once discrete actions for fare revisions are assessed, fare structure alternatives should be formulated to fulfill the fare change objectives and criteria. For example, if a transit authority lists Fiscal Integrity on Table V-1 as the most important criteria, then several alternatives should be constructed to fulfill this objective. If another criteria or a group of criteria are deemed most important, then other sets of alternatives should be developed. The building blocks or discrete actions that are determined to satisfy the most important criteria should be combined into overall alternative fare programs.

Table V-7 sets forth an example of three alternative fare programs that are possible to achieve fiscal integrity, i.e., increase systemwide revenue. For each fare category, the ridership and revenue impacts due to the noted change should be determined from the process identified in the prior section.

EVALUATE ALTERNATIVE FARE STRUCTURES (Step 4)

An evaluation criteria was established in the first part of this section whereby a transit authority could set forth what its objectives were in making a fare structure change. The purpose of this fourth step is to assess each fare structure alternative against the criteria set forth on Table V-1 to determine which fare alternative should be selected.

Table V-8 sets forth the process to conduct the evaluation of alternative fare structures. It involves merely multiplying the relative importance score placed on the nine criteria times the degree by which each alternative structure satisfies each criteria. The weighted score for each criteria would be summed to arrive at the total score for the particular alternative being evaluated.

SELECT AND IMPLEMENT PREFERRED ALTERNATIVE (Step 5)

The final step in the review of fare structure alternatives is the ranking of alternatives by their respective scores obtained in the prior step. At this point, the authority staff

TABLE V-6
IMPACT OF DISCRETE ACTIONS

Type of Action: Peak Period Adult Fare Elasticity Factor: -0.15

Annual Existing Ridership: 10,000

Annual Existing Revenue: \$ 4,500

Existing Fare: 45¢

Discrete Action	Fare Change		Projected Ridership Loss		Projected Revenue Gain	
	Absolute	Percent *	Absolute	Percent	Absolute	Percent
Minimum	+5¢	10.5%	-150	1.5%	+\$383	8.5%
Intermediate	+10¢	20%	-300	3%	+\$720	16%
Maximum	+15¢	28.6%	-450	4.5%	+\$1,035	23%

General Ridership Class Effected: Workers

* *New fare minus old fare divided by the midpoint between new and old.*

TABLE V-7
EXAMPLES OF FARE PROGRAM ALTERNATIVES
FISCAL INTEGRITY FOCUS

	Alternative A-Minimal		Alternative B-Selective		Alternative C-Major	
	Fare	Ridership Change	Revenue Change	Fare	Ridership Change	Revenue Change
Peak Period Adult	+5¢			+15¢		+15¢
Off-Peak Adult	+5¢			+5¢		+10¢
Zone Fare	Existing			Existing		+20¢
Transfers	Existing			+5¢		+10¢
Express Surcharge	+5¢			Existing		10¢
Student Fares	+5¢			Existing		+10¢
Monthly Pass (10% discount)	Existing			5% Discount		Eliminate Discount
Total Impact						

TABLE V-8
FARE STRUCTURE ALTERNATIVE
EVALUATION

<u>Criteria</u>	<u>Relative Importance Score *</u>	<u>X</u>	<u>Degree of Satisfaction**</u>	<u>=</u>	<u>Weighted Score</u>
Fare Structure Simplification					
Fiscal Integrity					
Fare Promotion Programs					
Passenger Equity					
Ease of Administration					
Effect on Energy and the Environment					

Alternative ____ Score

* Developed in Table V-1.

** Score of between 0 to 5 with 0 representing least satisfaction
and 5 representing greatest satisfaction of criteria.

should ensure that the alternative which has the highest score does satisfy overall authority objectives. If it does not, then the plan should be fine-tuned by adding or deleting elements. If it does, the plan should be moved forward to implementation.

Fare Structure Implementation

This section identifies the tasks which must be completed by a Pennsylvania Transportation Authority prior to implementation of fare structure changes. Generally, the tasks involve reviewing the impacts of the proposed changes, informing the operators and public, and setting up a data collection effort to monitor the impact of the change. A check list describing the implementation tasks is presented in Table V-9.

TABLE V-9
FARE STRUCTURE IMPLEMENTATION
CHECK LIST

Implementation Actions

Completion
Check-off

Administrative

- Inform Funding Agencies of Fare Change Impacts
 - City
 - County
 - Penn DOT
 - UMTA
- Revised budget projections to incorporate fare change Impacts
- Inform Penn DOT of fare changes with respect to potential adjustments in Senior Citizens free fare reimbursement

Fare Change Justification

- Determine reasons/justification for fare change, e.g.,
 - rising fuel costs
 - rising labor costs
 - inflation

Public Information

- Advertize and conduct public hearing
- Revise information material
 - public time tables
 - system map
 - decals and/or inside bus cards
 - bus stops
- Prepare and distribute fare change notices
 - on-buses
 - media

In-House Training

- Bus Operators
- Phone information personnel
- Accounting system for new prepaid fare programs

Purchasing

- Design and procurement of prepaid fare materials

TABLE V-9
FARE STRUCTURE IMPLEMENTATION
CHECK LIST
(Continued)

Implementation Actions

Completion
Check-off

Monitoring

- Inform riders to expect delays the first few days of fare change implementation
- Check on passenger and operator adherence to new fare charges
- Compare actual revenue and ridership levels with projections
- Check on passenger confusion with new fare structure

APPENDIX V-A

ANNOTATED BIBLIOGRAPHY

APPENDIX V-A

ANNOTATED BIBLIOGRAPHY

- 1) "Traveler Preference for Fare Alternatives as a Transportation Planning Input," George S. Day and James W. Schmidt, National Research Council, Highway Research Board, Transportation Research Record 527, 1974, Washington, D.C.

This paper deals with the effect of fare policy and transit service plans on mode-choice behavior. The focus of the research was on the coordination of the existing San Francisco surface transit with the new BART system. A submodal choice model is developed which reflects traveler behavior and is responsive to policy variables. However, the major conclusion is that access time and relative income equated to value of time proved to be most significant in determining mode choice.

- 2) "Effect of Fare Reduction on Transit Ridership in the Atlanta Region: Summary of Transit Passenger Data," John W. Bates, National Research Council, Transportation Research Board, Transportation Research Record 499, 1974, Washington, D.C.

This paper analyzed the effect of a drastic fare reduction, 40 cents to 15 cents, on the Metropolitan Atlanta Rapid Transit Authority on March 1, 1972. The major conclusions are:

1. The increase in ridership for the 12 months ending June 30, 1973 was 30.2 percent, of which 91 percent is due to trips made by new riders and only 9 percent is due to increased tripmaking by old riders. It concludes that the fare reduction taken alone is more significant in attracting new riders to transit than are service changes taken alone. However, there is a large portion

of new riders who are attracted by other, undetermined factors and/or a combination of fare reduction and service changes.

2. Almost two-thirds of weekday new transit riders previously made the trip now made by transit in an automobile either as the driver or as a passenger. Over 40 percent of weekday new riders previously made the trip now made by transit by driving an automobile. Increased mobility is evidenced by the 26 percent of new riders who previously walked or did not make the trip at all. Over 20,000 automobile trips have been removed from the streets entirely or at least for the major part of the trip - - 58 percent of these during the peak-volume periods.
3. New riders are generally younger and wealthier than the old riders, with a higher proportion of males and whites. The new riders tend to ride later during weekdays and not as much on weekends. A larger proportion of new riders have an automobile available but choose to ride transit, primarily because of the low fare. The new riders show a higher propensity to make trips other than home-to-work transit. The amount of park-and-ride and kiss-and-ride access to transit service has more than doubled, even though MARTA has not as yet implemented specific actions encouraging this activity.

- 3) "The Effect of Fare Reduction on Public Transit Ridership," John R. Caruolo, Roger P. Roess, U.S. Department of Transportation, Urban Mass Transportation Administration Research and Education Division, May, 1974, Washington, D.C.

The study was undertaken to determine the effects of various reduced fare programs on transit ridership. A listing of all reduced fare programs in North America is provided. The concept of elasticity was defined and determined for the various programs. Empirical evidence was obtained and analyzed from senior citizen programs, reduced base fare programs, free fare programs and promotional programs. It was found that base fare programs produce significant ridership increases.

The estimates of one elasticity for recent base fare reductions vary from a low estimate of -0.18 to a high of -0.42. Senior citizen transit demand was found to be more elastic than overall ridership demand. The arc elasticities between -0.11 to -0.68 were observed for off-peak hour senior citizen fare reduction programs. Off-peak travel, in general, is more elastic than peak hour travel. The report notes that even with significant ridership increases, reduced fare programs result in a revenue loss overall. However, these programs are evaluated as successful in achieving their particular social and environmental objectives.

- Transit demand might be more responsive to improved collection and distribution services than to increases in line-haul speed.

- 5) "Effect of Fares on Transit Riding," John F. Curtin, National Research Council, Highway Research Board, Highway Research Record 213, 1968, Washington, D.C.

This paper documents the seminal research on the relationship between fares and transit demand. In this analysis, data behind the industry accepted "shrinkage formula" is presented, based on 77 transit fare increases in the two-cent to ten-cent range observed throughout the United States in the 1958-1963 period. The formula states that for every one percent change in fare, there will be approximately a one-third of one percent change in transit ridership for the transit market as a whole. The paper does not investigate the effect of fare changes on transit sub-markets (senior citizens, rail rapid riders, etc.).

- 6) "Pricing and Welfare in Urban Transportation," Masatoshi A. Abe, Traffic Quarterly, July, 1973.

The author uses a multiple regression equation and time series data obtained from the Milwaukee and Suburban Transit Corporation to determine the relationship between transit fare patronage and various service variables such as route coverage (bus miles, hours of

service, headway factors and average fare). The major conclusion is that improved bus service - - lower fares as well as wider and faster coverage which would be affected by subsidies - - would not only attract more commuters from automobiles to bus transit, but in doing so will also reduce the average operating cost of bus service.

- 7) "No-Fare and Low-Fare Transit: An Evaluation of Their Feasibility and Potential Impact on the San Francisco Bay Area," Christopher Lovelock, et al, June, 1973, Metropolitan Transportation Commission. San Francisco Bay Area, NTIS #PB-273190.

This study generally outlines no-fare and low-fare transit operations and experiments from around the world, presents the rationale for public funding support of transit and examines the cost and benefits of free transit in the Bay Area.

- 8) "Transit Fare and Ridership: A Review," Carmen Difiglio, Transportation Development Division, Highway Users Federation, D.C., December, 1974.

Using time series data analysis, cross sectional analysis, demonstration projects, data, the author measures the relative sensitivity of transit patronage to fare and service characteristics. His general conclusion is that fare elasticity of transit demand is low, whereas service improvement elasticity of transit demand is relatively high. The paper concludes that transit funds should be spent to improve transit service rather than to reduce transit fares.

- 9) "The Consequences of Transit Fare and Service Policies: A Classified Bibliography," Michael A. Kemp and Rebecca L. Rea, Urban Institute, Washington, D.C., NTIS #PB-253101, April, 1976.

Various volumes on the subject are classified under separate headings for ease of reference. The headings include:

1. The demand for transit service;
2. The fare and service elasticities of demand;
3. Transit operating costs;
4. The economics of transit pricing;
5. Public subsidies for transit operations;
6. Low-fare and no-fare transit;
7. Transit fare structures;
8. Transit fare and the distribution of income;
9. Transit and the transportation disadvantaged;
10. Transit planning, operation and evaluation;
11. Marketing transit; and
12. General reference material.

This report is a bibliography and no conclusions are drawn.

- 10) "The Patronage Effects of Free-Fare Transit," James I. Scheiner, Traffic Quarterly, January, 1975.

This report focuses on the transit experience immediately following the Hurricane Agnes floods in Wilkes-Barre, Pennsylvania in 1972. For 101 days, free bus service was in operation throughout the Wyoming Valley Flood plain, followed by a succession of fare increases. Data from the demonstration in Wilkes-Barre suggest that free transit will immediately attract significant numbers of additional patrons, with the percentage of patronage increase dependent on the current average fare of the transit system. Patronage increases due to free fare, with services and other factors remaining constant, range from 13 percent for a system with a 10 cent average fare per boarding passenger to 86 percent for a system with a 50 cent average fare. A typical transit system, with an average fare in the 30-35 cent range, could expect ridership to immediately increase 50 percent with the institution of free fare.

- 11) "Exploding the Myths of Prepaid Transit," James I. Scheiner, Transit Journal, February, 1976.

This report discusses four of the common arguments advanced for and against free transit. Major conclusions are:

- Free transit could be expected to immediately increase ridership in a typical U.S. transit system by about 50 percent, holding service constant. If additional service is needed to handle heavy loads, this service increase will induce patronage above that of the fare reduction.
- The diverse nature of local government expenditure patterns across the country suggests that free transit should not be an issue of national cost. Rather, free transit is another option to be considered by local transit agencies, for either various special groups or systemwide.
- In Wilkes-Barre, frivolous riding was a minor problem only during summer months when children were out of school.
- Free transit by itself will not substantially reduce the use of autos in most of the nation's urban areas.

- 12) "Report to Congress Concerning the Demonstration of Free-Fare Mass Transportation," U.S. DOT UMTA, July, 1975.

This report states the initial assumptions and design specifications advanced for the first wide-range free-fare demonstration projects.

- 13) "The UMTA Transportation Pricing Program," Bert Arrillaga, Office of Service and Methods Demonstrations, Office of Transportation Management and Demonstrations, Presented at the Conference on Transportation Pricing Alternatives, Transportation Research Board, March, 1976.

In this paper the author outlines the various transportation pricing programs planned for demonstration under UMTA sponsorship.

- 14) "Southwest Ohio Regional Transit Authority Fare Study: Summary Report," ATE Management and Service Company, Inc., Cincinnati, Ohio, August, 1976.

This study was done to determine the sensitivity of the Cincinnati metropolitan transit area to various fare policies and alternatives. Two important conclusions were drawn including:

- The demand for public transit service in Cincinnati is sensitive to a variety of factors. The transit price is just one of these factors and it is not as important as the service level.
- The demand for public transit in Cincinnati is price inelastic. That is, a change in price results in less than a proportional change in demand. This condition is especially prevalent for peak hour work trips. Thus, unequivocally, one can state that an increase in the price of service will yield additional revenue.

- 15) "Effect of Fare Structure on Urban Transit Use," John William Schumann, Drexel University, June, 1972.

This study attempts to examine all aspects of the relationship between fares and transit ridership. The major conclusion to be drawn from this study is that transit fares are not one of the major determinants of transit use. While this general conclusion is drawn, it is stated that there are variations in the magnitude of the effect of fares depending on trip purposes and timings.

- 16) "Preference Elasticities of Transit Fare Increases and Decreases by Demographic Groups," Elene P. Donnelly, Transportation Research Board, National Academy of Service, Transportation Research Record 589.

In this paper, the author has discussed the results of preference elasticities for transit fare increases as well as decreases based on a December, 1974, statewide public opinion survey sponsored by the New York Department of Transportation.

The author concludes that preference elasticity is significantly higher for fare increases from 35 cents to 50 cents (-0.49 for total population) than for fare decreases from 35 cents to 20 cents (-0.24 for total population).

- 17) "Differential Time of Day Transit Fare Policies: Revenue Ridership and Equity," David T. Hartgen and David L. Weiss, Paper presented at the fifty-sixth annual meeting of the Transportation Research Board, January, 1977.

This paper examines the impact of differential time-of-day fares (e.g., lower off-peak/higher peak) on transit ridership, revenue and equity to transit ridership, revenue and equity to transit riders in the State of New York. The authors conclude that 1) no differential fare combination, either equitable or not, can be found that increases both the ridership and revenue; 2) certain differential fare policies exist which markedly improve equity and at the same time increase either ridership or revenues with a less than 5 percent loss in the other; 3) fare increases are not reversible; and 4) it is preferable, whenever possible, to encourage differential fare policies which hold or increase ridership, at a slight loss in revenues.

- 18) "Elasticity of Transit Demand with Respect to Price: A Case Study in the Suburban Washington, D.C., Area of Northern Virginia," Ralph E. Shofer, Paper presented at a Transportation Research Board conference on Urban Transportation Pricing Alternatives, Easton, Maryland, May, 1976.

In September, 1975, the Washington Metropolitan Area Transit Authority introduced differential peak and off-peak period fares. In this paper, the author presents results of the observed transit-demand elasticities with respect to price on selected routes. The author concludes that the premium express bus passengers are less sensitive to fare increases than passengers of traditional local services. The author observed -0.03 and -0.27 elasticities of transit patronage with respect to price for premium express bus route and traditional arterial bus route, respectively.

- 19) "A Review of Reports Relating to the Effect of Fare and Service Changes in Metropolitan Public Transportation Systems," Dempster K. Holland, prepared for U.S. Department of Transportation, June, 1974.

In this report, the author presents a summary of literature relating to demand elasticities for public transportation systems. The author concludes that transit ridership demand is generally inelastic with respect to transit fares, that is, increase in fares will decrease patronage but will result in a net increase in revenue. The author found that increased frequency of service will increase patronage, but no clear pattern to estimate the amount of such increase was observed.

The author also observed that increase in service has more effect on inducing patronage among middle and upper income persons than among lower income persons. Socioeconomic characteristics of the general public are major determinants of the level of transit patronage.

- 20) "Patronage Impacts of Changes in Transit Fares and Services," Patrick Mayworm, Armando Lago, J. Mathew McEnroe, prepared for U.S. DOT, September, 1980.

This report presents information on public transit fare and service elasticities of demand. Data were obtained from a comprehensive review of studies performed in the United States and other countries, especially the United Kingdom. Estimates of individual fare and service elasticities were obtained from analyses of individual fare and service changes, and from direct-demand and mode-choice models based on time-series and cross-sectional data.

This report confirms the fact that transit demand is inelastic with respect to fares and services; that is, the proportional change in transit patronage in response to fare and service variations is less than the proportional change in fares and services. More importantly, the data presented in this report reveal that there is a large degree of consistency in the aggregate system-wide demand elasticities. Although there is variation in the disaggregate elasticity values, this variation is reduced and remarkable stability emerges when the analysis focuses on individual disaggregate categories. This underlying consistency, which exists across many type of cities and even countries, suggests that significant shifts in patronage could result without a deterioration in revenues from manipulations in fare and service levels.

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.

This document is being distributed through the U.S. Department of Transportation's Technology Sharing Program.

DOT-I-81-41

U.S. Department of
Transportation

DOT LIBRARY



00399675

Office of the Secretary
of Transportation

400 Seventh St., S.W.
Washington, D.C. 20590

Official Business
Penalty for Private Use \$300

DOT-I-81-41

Postage and Fees Paid
Department of
Transportation
DOT 518



TECHNOLOGY SHARING
SPECIAL STUDIES IN TRANSPORTATION PLANNING (SSTP)
PROGRAMS OF THE U.S. DEPARTMENT OF TRANSPORTATION