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Prototype Bus Service Evaluation System:

Tidewater Transportation District Commission

April 1981

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16 Abstract

This report describes the development and testing of a transit service evaluation system by the Tidewater Transit District Commission (TTDC) in Norfolk, Virginia. The project is a second phase to an UMTA funded study of bus service evaluation and has two objectives: 1) to develop a service evaluation system utilizing existing techniques; and 2) to test and verify that such a service evaluation system is a practical and effective method for service evaluation. This report assesses the TTDC evaluation in place at the start of the project, describes the development of a new service evaluation system for the TTDC which includes the selection of service indicators, measures and standards. A description of a trial implementation of the performance evaluation system is included as well as the results of the evaluation of TTDC's fixed route transit services. Data collection methods and costs to support the evaluation system are reported. The new evaluation system has proven to be a useful tool for both transit management and locally elected officials in the development and funding of TTDC's services.

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Prototype Bus Service Evaluation System

Final Report
April 1981

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U.S. Department of Transportation

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PROTOTYPE BUS SERVICE

EVALUATION SYSTEM

Prepared By

Tidewater Transportation District Commission

Prepared For

U.S. Department of Transportation
Urban Mass Transportation Administration
Office of Planning Assistance

April 1981

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Waiting for the Bus

Credit Tidewater Regional Transit with candor. Its in-house appraisal showed serious warts on its performance record. It made no attempt to brush over them. A report to the Tidewater Transportation District Commission showed that:

- Buses on only four of 47 TRT routes regularly meet their schedules.
- Eighteen routes are excessively accident-prone.
- More than half of the 84 TRT buses are below par in appearance.

The report shows that TRT has a long way to go if it is to reach beyond its captive riders—those without private transportation—and lure into its buses the thousands of middle-income commuters who prefer to go by car.

Some of the problems will be hard to solve. The meeting of schedules is one of them. A bus is considered to be off schedule if it is more than a minute early or more than four minutes late.

A number of factors can throw a schedule off. Long coal trains, tie-ups in the tunnels, and tourist-traffic gluts during the Virginia Beach resort season are unavoidable and unpredictable.

But the frequent cause of late runs or missed stops—and perhaps of accidents—is a driver's unfamiliarity with the route. This is noted most frequently on express routes, which are run only during morning and evening rush hours. Union work rules require that TRT pay a driver overtime if his work day stretches beyond 11 hours—even though he may actually work fewer than eight of those hours. So instead of assigning a specific driver to each express route, TRT assigns express buses to drivers on other routes who are available at the time.

To keep the buses spotless and unlittered would require extra cleaning personnel, says James C. Echols, executive director of the Tidewater Transportation District.

If TRT were a prosperous system, the people could be hired. But TRT is a long way from being self-supporting. Only 44 percent of its expenses are met by passenger fares. The rest of the money comes from the federal government and from the localities it serves. Greater subsidies are unlikely and higher fares discourage ridership. TRT must aim for greater efficiency and more passengers.

Despite all the negative factors turned up in the report, TRT is not, on balance, an unpleasant way to go.

The buses are comfortable. Though they're not spotless, the litter aboard them is rarely offensive. Some drivers may need some public relations courses, but many of them are friendly and helpful. Buses can never compete with the automobile for speed. But most can make a trip in 45 minutes that would take a half-hour in a car. And you can read your morning paper en route on the bus.

The advantages of bus travel are still considerable. And the more passengers TRT can generate, the better it can act to take the hassle out of taking the bus.

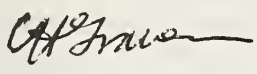
Source: The Virginian Pilot, 11/16/80.

FORWARD

Many transit operators have a critical need for a service evaluation system which can measure existing service performance. To assist these operators, UMTA's Office of Planning Assistance, through its Special Studies Program, initiated operator prototype studies in Boston and Norfolk. The purpose of these studies is to develop and test systems for bus service evaluation. The emphasis of these studies is on how local operators can use existing planning techniques to meet their evaluation needs.

This document represents the second report from these studies. It presents the development of a prototype bus service evaluation system for the Tidewater Transit District Commission in Norfolk, Virginia. We believe this prototype will be of value to transit operators who are interested in developing or improving their evaluation systems.

Additional copies of this report are available from the National Technical Information Service (NTIS), Springfield, Virginia 22161. Please reference UMTA-VA-09-7001-81-1 on the request.



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CHAPTER 1

INTRODUCTION

The demands on public transportation have increased in the last few years. The public, faced with rising costs and limited resources, has been reluctant to increase operating assistance. Instead, the public has advocated improving transit operating efficiency as a means to curb costs.

While the demand for improved operating efficiency has become more important, so has the demand for expanded transit services. In part due to the recent emphasis on energy and air quality, public officials have felt an increased pressure to expand transit services. Often this service expansion is proposed for low density areas where transit demand is not well suited for fixed route bus services, e.g., demand is low, sharply peaked or both. The provision of this type of service only compounds the problem of increasing costs and deficits. The transit operator is thus in a difficult position. He must try to improve both operating efficiency and service availability at the same time.

To be able to balance these opposing objectives, the operator must be able to manage the service resources that are available. He must be able to evaluate service performance to identify inefficient or ineffective utilization of resources. He must be able to identify desirable new service opportunities. To make these determinations the transit operator needs a systematic service evaluation program which can measure existing service performance, identify new potential areas of transit demand and provide some insight into the analysis of service alternatives.

The Tidewater Transit District Commission (TTDC), Norfolk, Virginia is among many transit properties interested in updating and evaluating their service evaluation programs. The TTDC, along with the Massachusetts Bay Transportation Authority (MBTA), Boston, Massachusetts received special Section 8 grants from the Planning Research and Evaluation Division of the Urban Mass Transportation Administration (UMTA), U.S. Department of Transportation to develop prototypical bus service evaluation programs. These projects have two objectives: 1) to develop a service evaluation program which utilizes existing planning techniques to identify new and improved bus service opportunities; and 2) to test and verify that such a service evaluation system is a practical and effective method for service evaluation.

This is the second of two reports produced as part of the TTDC Prototype Study. The first report, *Bus Service Evaluation Procedures: A Review,** was a joint review with MBTA of the state-of-the-art of

*Available from the NTIS, Springfield, Virginia 22161, Report No. PB296-314/AS

bus service evaluation techniques across the country. It includes a literature review and survey of 71 transit properties in the United States and Canada regarding bus service evaluation procedures currently in use.

This report describes the develop and testing of the service evaluation system developed by the TTDC. The report is organized as follows:

- Chapter 2 provides a description of the TTDC and its service area
- Chapter 3 reviews and assesses current TTDC evaluation procedures
- Chapter 4 describes the development of a new service evaluation process for the TTDC including the selection of service indicators, measures and standards.
- Chapter 5 gives the results of the trial implementation of the new system and an evaluation of the system.
- Chapter 6 provides some general conclusions on the usefulness of the performance evaluation system.
- An Appendix describes in more detail the data collection techniques employed to support the new evaluation system.

CHAPTER 2

DESCRIPTION OF TTDC

The Tidewater Transit District is composed of five cities in southeastern Virginia: Norfolk, Portsmouth, Chesapeake, Virginia Beach and Suffolk (Figure 1). It covers 1,079 square miles and contains approximately 800,000 people. About two-thirds of the area is rural in nature.

The principal employer in the area is the U.S. Navy with five major installations and a total employment of approximately 75,000. There are two central business districts, Norfolk and Portsmouth. These are separated by a river and, therefore, are not a strong single focus of employment. Total regional employment is about 300,000.

The TTDC is responsible for planning, regulating and operating public transportation and related facilities in the area. It provides fixed route transit, ridesharing, and contract shared-ride taxi service. In fiscal year 1978-79 TTDC operated 5,900,000 bus-miles and 420,000 bus-hours of service with 141 peak period buses over 41 routes. Annual ridership was 12,700,000. TTDC also provides ridesharing services including a fleet of 100 vans for vanpooling and 50 vans for special services for the elderly and handicapped. In addition, TTDC contracts for shared-ride taxi services and assists private commuter bus operators.

TTDC is organizationally divided into three functional departments: finance, operations and service development. Service evaluation is the responsibility of the service development department under the supervision of the transportation planner (Figure 2). General direction is provided by the superintendent of schedules and the service development manager. A transportation technician and four transportation surveyors work full time on service evaluation and development.

The Metropolitan Planning Organization (MPO) for the region is composed of representation from the same five cities as the TTDC, the Virginia Department of Highways and Transportation, the Southeastern Virginia Planning District Commission (SVPDC) and the TTDC. SVPDC is the regional comprehensive planning agency and provides the staff support to the MPO.

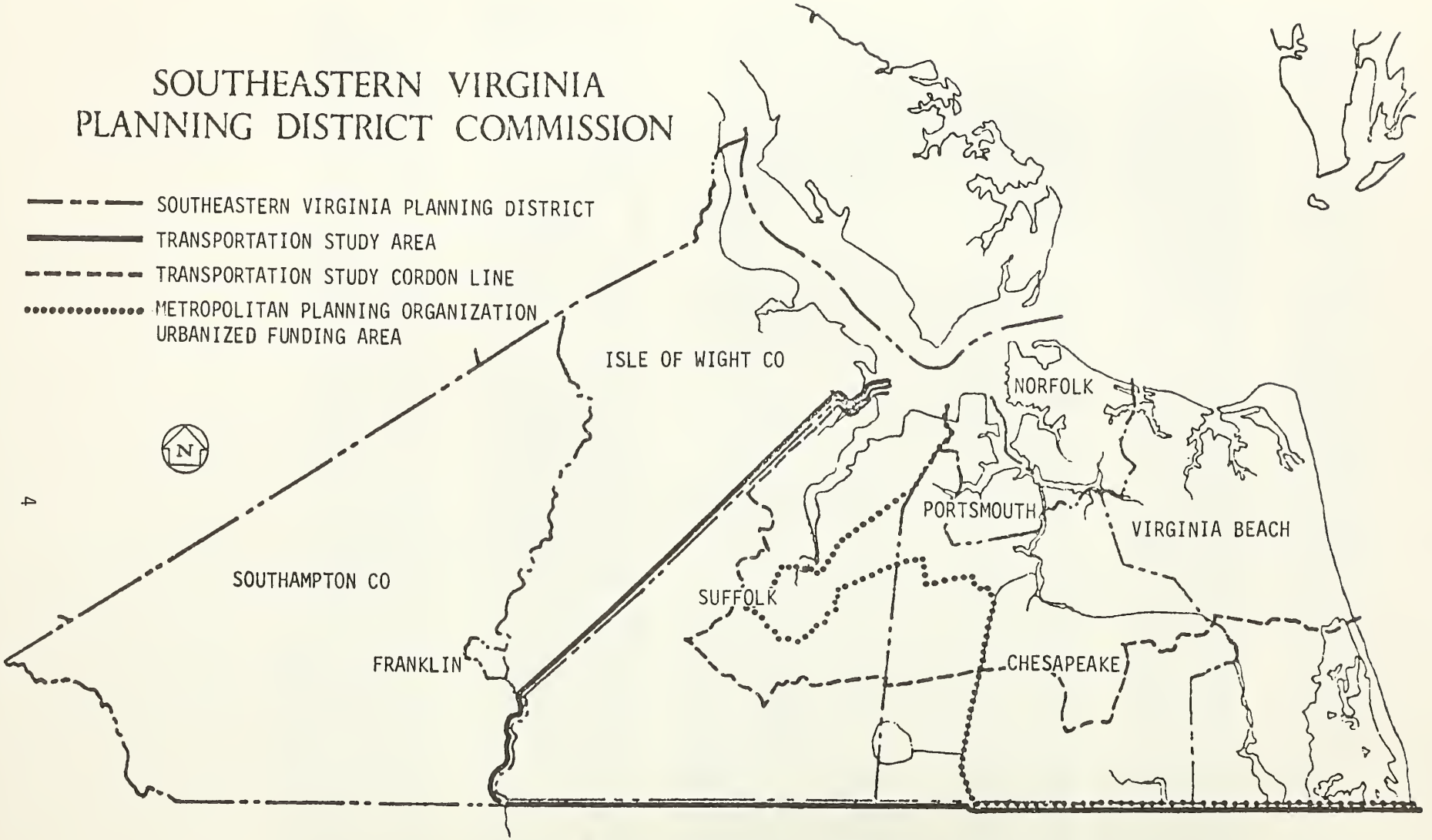
SOUTHEASTERN VIRGINIA
PLANNING DISTRICT COMMISSION
SOUTHEASTERN VIRGINIA PLANNING DISTRICT
TRANSPORTATION STUDY AREA
TRANSPORTATION STUDY CORDON LINE
METROPOLITAN PLANNING ORGANIZATION
URBANIZED FUNDING AREA
N
ISLE OF WIGHT CO
NORFOLK
PORTSMOUTH
VIRGINIA BEACH
SOUTHAMPTON CO
SUFFOLK
FRANKLIN
CHESAPEAKE

FIGURE 1

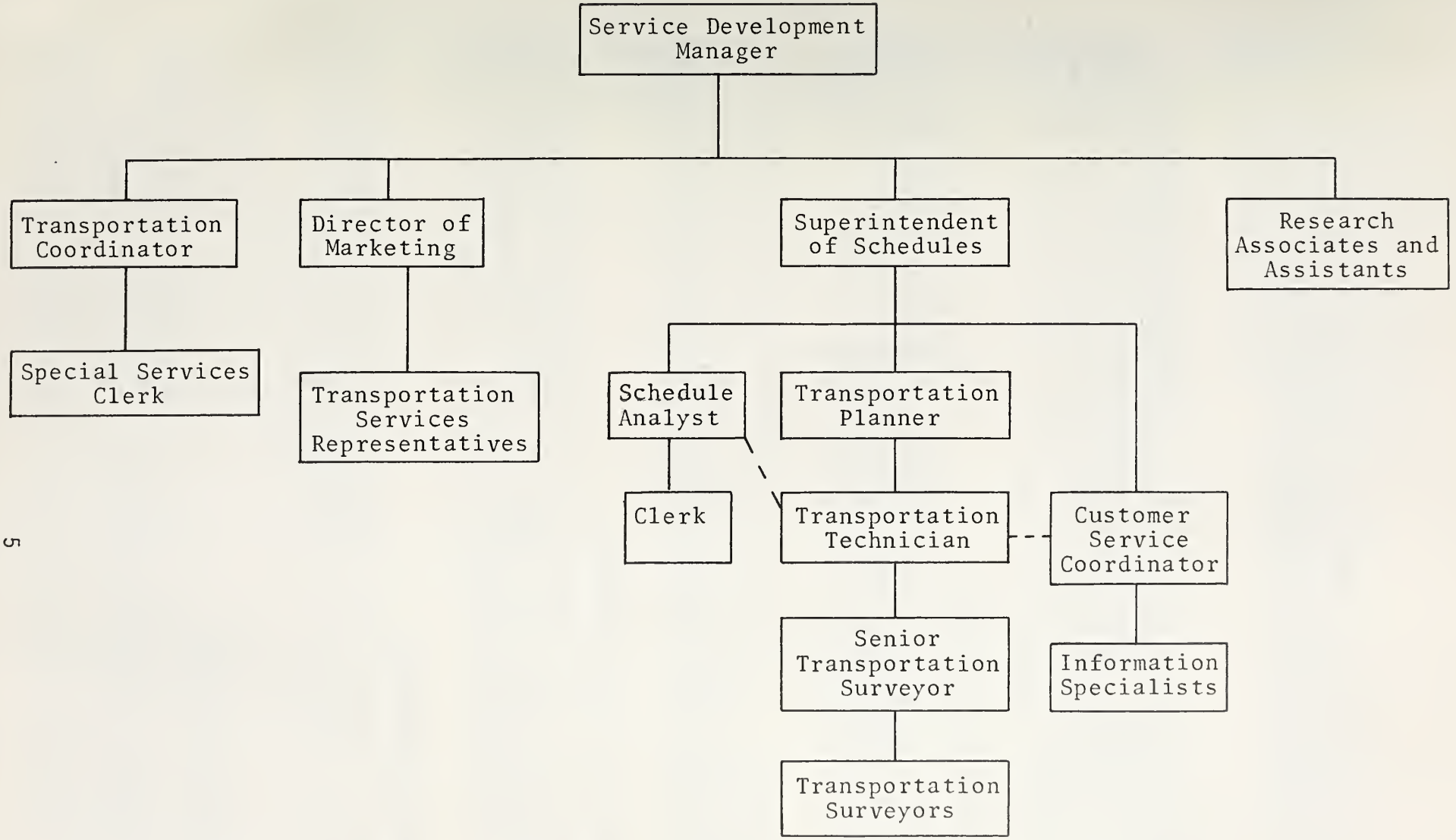

FIGURE 2

SERVICE DEVELOPMENT DEPARTMENT

CHAPTER 3

EXISTING TTDC EVALUATION PROCEDURES

INTRODUCTION

This chapter documents and assesses the evaluation system employed by the Tidewater Transportation District Commission at the beginning of this study. The first section of this chapter describes the system. The second section of the chapter assesses the evaluation system in relation to the goals of service evaluation and identifies selected deficiencies.

EXISTING TTDC EVALUATION PROGRAM

TTDC employed 15 evaluation techniques to measure system performance and support service decisions. These were divided into two categories: financial indicators and service indicators. These are given below with a description of the measures, reporting frequency, data collected, analysis and cost of each of the indicators.

Financial Indicators

There were nine indicators that were derived from financial, ridership and operating data. These are each described in detail below.

Total Annual Cost Per Employee

Total annual cost per employee was calculated annually by dividing system expenses by the total number of employees. It was used as a measure of labor productivity. Lower costs per employee should mean more efficient utilization of labor.

Total Cost Per Bus-Hour

Total cost per bus-hour was calculated monthly by dividing transit expenses by in-service hours. This indicator was used in the allocation of costs to each city since costs are allocated on the basis of the number of bus-hours of service provided in each city.

Total Cost Per Bus-Mile

Total cost per bus-mile was calculated monthly by dividing total transit costs by total system bus mileage. This indicator provided a measure of the efficiency of the revenue equipment utilization.

Total Cost Per Passenger

Total cost per passenger was computed by dividing transit costs by ridership data. Ridership data were obtained from either boarding and alighting counts or from revenue using the most recent average fare determination. This indicator is a measure of how efficiently the system meets demand.

Revenue Per Passenger

Revenue per passenger (or average fare) was calculated quarterly for the system and by route and estimated monthly from ridership data obtained in boarding and alighting counts and revenue line checks. When calculating route revenue, ticket and pass sales were apportioned to each route according to a route's percentage of total ridership.

Deficit per Passenger

Deficit per passenger was computed by subtracting revenue from cost and dividing by passengers for the system monthly and each route quarterly. This indicator was used to determine route performance.

Ratio of In-Serivce Hours to Pay Hours

The ratio of in-service hours to pay hours indicates the proportion of time vehicles are in productive, revenue producing service. A value of one is the highest level attainable. This indicator was computed annually from accumulated schedule information and payroll data.

Revenue Per Bus-Mile

Revenue per bus-mile was computed monthly by dividing revenue by in-service bus-miles. Demand density and quality of services were intended to be measured by this indicator.

Operating Ratio

Operating ratio is a systemwide measure computed as the ratio of annual revenue to annual expenses.

The financial indicators were not well utilized in service evaluation as there were no standards for these indicators. However, they were compared month-to-month, quarter-to-quarter and year-to-year in order to establish a trend.

The most frequently used indicator was deficit per passenger. Decisions to cut or modify service on a route were often based on deficit per passenger. An informal standard of one dollar per passenger was used to determine if the deficit was excessive.

The finance department collected the revenue and cost data used for the indicators. Revenue is counted daily and costs are reported according to the Section 15 system of accounts and procedures. Additional data collection costs were not incurred as this effort is part of the finance department's regular duties.

Service Indicators

There were six indicators used by TTDC which are derived from ridership and operating data. They are each described in detail below.

Safety

The indicator for safety was a systemwide measure of accidents per 100,000 miles. This indicator was compared month-to-month to determine relative system safety.

All accidents were recorded and reported to the director of safety by drivers and supervisors. Accidents were reviewed daily and reported monthly as part of the safety department's regular duties. The director of safety collected and assessed accident information primarily for accident prevention, training and legal purposes but there was no standard. The cost to obtain accident rate data was approximately 60 man-hours or $600 per year.

Reliability

Reliability was measured by schedule adherence. Schedule adherence is defined as the percentage of buses on-time for a given route. A bus was defined as on-time if it was 2 minutes early to 3 minutes late. TTDC had an informal standard of 80 percent on-time for the system.

Schedule adherence checks were made by transportation surveyors stationed at selected check point locations which formed a cordon line around the Central Business District (CBD) and which covered all routes. The surveyors were stationed at these points from 6:00 A.M. until 6:00 P.M. and recorded the data for each bus that passes that point. Data collected were bus arrival time, bus number, route number and scheduled arrival time.

Schedule adherence checks were conducted on a bi-monthly basis and cost approximately 2,250 man-hours or $9,000 annually. A report was made giving the number and percent of buses which are early, on-time and late by route.

Loading

Loading indicators were used both to assess passenger volumes and the need for bus stop improvements. Total passengers, per trip,

peak load per trip and passenger load at the load point per trip were indicators used to identify overcrowding or underutilized service. Total passengers by stop was used to determine where bus stop shelters or signs should be located. No formal standards were adopted for either the loading or bus stop indicators.

Boarding and alighting counts were conducted for all bus routes in the system. Multicity routes were surveyed every quarter and all other routes at least once a year. These counts were made by a surveyor who rode each trip of every route observing the number of passengers boarding and alighting at every bus stop.

The data from boarding and alighting counts also provided the basis for computing all other indicators which required ridership for the system or by route or by city. The data were also used to allocate revenues to each city in the calculation of subsidy requirements.

All analyses and profiles were tabulated manually. Data collection and analysis for boarding and alighting checks and route profiles cost approximately 7,250 man-hours or $29,000 per year. This cost often varied due to the number of checks performed.

Directness of Service

A transfer is required by passengers using more than one bus route to complete their trip. Transferring is a disincentive to riding the bus since direct routing is more convenient. Therefore, the percent of riders transferring is an indicator of system directness. A transfer analysis was conducted annually based on the transfer usage for two weekdays, one Saturday and one Sunday.

Transfers were marked by route of origin. A passenger transferring to another route surrendered the transfer slip to the driver upon boarding. The driver placed the slip in an envelope marked with the route number (route of destination). The transfers were counted to construct a table that showed the amount of transferring among all routes.

Separate tables were made for weekday, Saturday and Sunday transferring. These tables emphasize those routes which have high amounts of transferring between them. The transfer pattern for the five routes with the highest number of transfers was further broken down by: 1) other routes that issued the most transfers; 2) other routes that received the most transfers; and 3) other routes that had the most transfer interchanges. These routes were reviewed for possible modifications.

An informal standard of a maximum of 20 percent transfers of the total daily passengers as acceptable was set. However, there was neither a formal standard for the system nor a standard to determine when routes should be modified to decrease transferring.

The transfer analysis cost approximately 70 man-hours or $300 per year. The cost was comprised of labor costs for the planner, transportation technician and surveyors who counted the transfers.

Demographic/Geographic Indicators

Demographic data were obtained from Census data. Geographic surveys were made by field observations to determine condition of streets, ability of buses to make turns, possible bus routings, housing density, location of major generators and similar information. Census data used were as follows:

1. Population per tract
2. Mean house value per tract
3. Number of minority persons per tract
4. Employment per tract

The TTDC calculated two measures based on these data:

1. Percent of population served (within ¼ mile of a bus route) - this indicator was calculated annually and indicated the market penetration of the service offered over the entire system area.
2. Percent of employment served (within ¼ mile of a bus route) - this indicated the market penetration of transit into the labor force in the system area and was calculated annually.

Neither indicator had a set standard.

The data collected were used by the service development department for route planning, especially in newly developing areas. In addition, other areas of possible service realignment were studied. The cost of demographic and geographic observations was approximately 2,000 man-hours or $16,000 per year.

Requests, Suggestions and Complaints

Requests, suggestions and complaints served as outside inputs into the evaluation system. The source of this input included local jurisdictions, political officials, TTDC members, citizen groups, individual citizens and busmeisters. Busmeisters are regular bus riders who regularly report problems and suggestions concerning the route they ride.

The TTDC information center and marketing director took many of the complaints, suggestions and requests through telephone calls and complaint forms provided on the bus. The complaints and requests were reviewed by the marketing director and forwarded to the appropriate personnel. The transportation planner received requests for new service and handled complaints about bus stops and shelters. Complaints and suggestions from various groups relating to schedules such as frequency of service and buses being late were handled by the superintendent of schedules. The transit operations manager was responsible for complaints about maintenance and operators.

Operator complaints were handled by the superintendent of transportation. Maintenance complaints were handled by the superintendent of maintenance and usually relate to bus cleanliness and inoperable bus components such as windows.

These efforts were performed on a daily basis as part of regular duties so additional costs were not incurred with respect to evaluation. Information center operators, supervisors, the transportation planner and secretaries each spent several hundred hours per year receiving and responding to complaints. The total cost for this effort is estimated to be approximately 1,600 hours or $12,800 per year.

As shown in Table 1, the total effort required to obtain data and compute each indicator was 15,055 man-hours at a cost of $81,000.

Reports

Each of the indicators was included in reports (Table 2) which were distributed to the appropriate personnel for review at various times of the year. Reports provided for the routine review of the indicators and were presented monthly, bi-monthly, quarterly and annually.

Monthly reports provided information on systemwide status and were issued to TRT managers, the executive director and the commissioners. The report provided revenue and cost comparisons for the system, and general operating characteristics.

System reliability was reported bi-monthly. Schedule adherence was reported for each route and for the system. The quarterly report provided information by route, city and system for the average day of the quarter. Quarterly report preparation cost approximately 500 hours or $5,500 per year.

The annual report presented a comprehensive summary of TTDC's evaluation efforts. The information from the monthly, bi-monthly, quarterly and service change reports were included in the annual report. Schedule adherence, ridership, expenses, revenues and information center calls for the system were plotted by month (with the same data from the previous year for comparison) to assist in determining seasonal trends and the impact of promotional efforts and service changes. In addition, analyses of special projects such as market research and route evaluations were included. All performance indicators were included in the report as well as route evaluations.

TABLE 1

MAN-HOUR AND DOLLAR COSTS

Indicator	Cost	Man-Hours
Financial Indicators	$9,400	850
Service Indicators		
Safety	600	60
Reliability		
Schedule Adherence	9,000	1,250
Trail Checks	3,900	975
Loading	29,000	7,250
Directness of Service	300	70
Demographic/Geographic	16,000	2,000
Requests/Suggestions	12,800	1,600
TOTAL	$81,000	15,055

TABLE 2

REPORTING SUMMARY FOR EXISTING EVALUATION SYSTEM

Indicator	Monthly	Bi-Monthly	Quarterly	Annually
Financial				
Total Cost/Employee				X
Total Cost/Bus-Hour	X			
Total Cost/Bus-Mile	X			
Total Cost/Passenger	X			
Revenue/Passenger	X		X	
Deficit/Passenger	X		X	
In-Service Hours/ Pay Hours				X
Revenue/Bus-Mile	X			
Operating Ratio				X
Service				
Accidents/100,000 Miles	X			
Schedule Adherence		X		
Loading			X	X
Transfers				X
Demographics				X
Complaints	X			

The annual report also represented the transit operations planning effort for the year and described how various studies were performed and strategies implemented. Data collection tools and techniques were described and documented. The annual report cost approximately 150 man-hours or $1,500 to prepare. The annual report was submitted to the Metropolitan Planning Organization (MPO) as the final report on TTDC's Unified Planning Work Program (UPWP) activities.

Assessment of Existing Evaluation Program

An examination of TTDC's current system revealed the lack of utility of many measures and the shortcomings of an unsystematic approach. The following deficiencies were noted.

1. There was No Rationale Forming the Basis of the Evaluation Program. There was no basis for the selection of the indicators chosen to evaluate services. The objectives of service development were not defined. The basis for evaluating routes was ambiguous. There was not a consistent strategy for evaluating routes. At the time, there were neither written guidelines for specific checks nor a written service evaluation program. A formal procedure would allow all departments to know their specific responsibilities and systemize data collection and reporting procedures.

2. Some Indicators Were Not Used. The utility of many performance indicators was questionable. For example, average speed was calculated monthly for incorporation in the monthly report. However, the only apparent use of this indicator was estimating hours of new servide. Other indicators that appeared to be superfluous or duplicative included ratio of in-service hours to pay hours, passengers per vehicle mile, and passengers per hour.

3. Only a Few Standards Were Quantified. Many of the performance indicators had neither a formal nor informal standard that represented an acceptable level of performance. Without some minimum standard to which performance measures can be compared, service evaluation was of little use to the decision making process.

4. The Program Concentrated on Existing Services with Little Emphasis on Searching for New Service Opportunities. There was a critical need to focus on areas of potential transit demand. Emphasis should be placed on developing simple andreliable indicators of potential demand areas.

5. There was No Rationale for Scheduling Data Collection. Data were not collected on a systematic basis to ensure compatibility over time or to ensure random sampling. Data were collected monthly, bimonthly, quarterly and annually, but specific assignments were not made to ensure compatibility. For example, the transfer analysis was conducted once annually. Seasonal variations in ridership may affect accuracy.

CHAPTER 4

DEVELOPMENT OF NEW PERFORMANCE EVALUATION SYSTEM

INTRODUCTION

This chapter describes the development of the indicators, measures and standards of performance for the performance evaluation system that was developed in this study. The first section describes how a Delphi method was used to identify the objectives of service development and performance indicators desired by TTDC managers and city officials. Next, the criteria used to select numerical values for the indicators and measures developed from the Delphi study are given. The concepts of transit travel choice and transit costing are discussed in order to determine which specific indicators would form a theoretically sound basis for the evaluation measures. Finally, evaluation measures and associated standards are presented in detail.

This new, proposed service evaluation program, as detailed in the remainder of this chapter, was presented to the Commission which adopted it for a 1 year trial period. The results of this trial application are presented in Chapter 5.

DELPHI STUDY

A Delphi study was conducted to determine the TTDC information that is needed by local officials as well as by TTDC managers. The basic goal of the Delphi procedure was to obtain a consensus from a group of participants without the opinion shaping pressures of a group environment. The method was used to eliminate committee activity, and to reduce the influence of certain psychological factors such as undue persuasion, the unwillingness to abandon publicly expressed opinions and the bandwagon effect of majority opinion. Direct debate is replaced by a designed program of sequential questionnaires, interspersed with information and opinion feedback derived from previous questionnaires.

The participants in the Delphi study were the following:

- The TTDC Executive Director
- The TTDC Operations Manager
- The TTDC Finance Manager
- The Executive Director of the Southeastern Virginia Planning District Commission (MPO)
- A Planning Analyst with the City of Norfolk
- The Assistant City Manager of Chesapeake
- The Assistant City Manager of Portsmouth
- A Planning Engineer from the Virginia Department of Highways and Transportation
- An Administrative Analyst with the City of Suffolk

In the first round the participants were asked to report information that they needed to evaluate existing and new transit service options. The responses of the first round were tabulated and each participant was then asked to rate each criterion in one of the following three ways: 1) required for evaluation; 2) required for general knowledge; or 3) not required.

Of the 37 potential evaluation criteria presented, the participants reached a consensus on only 12. These 12 criteria were determined by the participants to fall into the three categories as shown in Table 3.

It is interesting that five criteria "being required for evaluation" involved cost and revenue. This tends to indicate that the local officials were primarily concerned with the financial performance of transit services in the Norfolk area. This is consistent with the findings of the report on bus service evaluation procedures by the TTDC and MBTA.

Through the Delphi study, TTDC also developed the following two major objectives for transit service development:

1. Maximize route ridership subject to an upper limit on deficit per passenger. To maximize ridership, TTDC should focus service development efforts on those indicators which most influence ridership. Service should be adjusted to meet the measures and standards associated with these indicators.

2. Minimize the operating cost required to carry a given ridership. In order to minimize costs, they must be equitably allocated. By focusing on the principal components of cost and cost allocation, cost of providing service can be minimized.

Other properties which have developed service evaluation procedures have focused heavily on the concepts of efficiency and effectiveness. TTDC's objectives also focus on these concepts; the first objective evaluates effectiveness while the second measures efficiency. These concepts of effectiveness are dependent upon efficiency. To maximize ridership at a given deficit limit, the operating cost must be minimized for the ridership on the route.

CRITERIA FOR SELECTING INDICATORS AND MEASURES

The objectives of service developed through the Delphi study were focused on two elements, cost and ridership. Numerous indicators are used or have been proposed to measure how these elements are affected by transit service characteristics. To aid in the selection of specific indicators, the following criteria were developed:

TABLE 3

Consensus Criteria for Service Evaluation

CRITERION	REQUIRED FOR EVALUATION	REQUIRED FOR GENERAL KNOWLEDGE	NOT REQUIRED
Cost per Hour	X		
Cost per Passenger	X		
Estimated Revenue	X		
Schedule Adherence	X		
Percent Riders Transferring	X		
Annual and 3-year Capital Projections	X		
Total Maintenance Hours per "x" Bus Miles	X		
Revenue Per Bus Hour		X	
Passengers Per Hour		X	
Ridership by Trip Purpose		X	
Number of Persons Commuting by Mode		X	
Cost per Bus Trip			X

1. The indicator must be at least partially under TTDC's control. Indicators such as air and noise pollution, traffic congestion and fuel availability affect transit usage, but are beyond TTDC's capability to influence.

2. The indicators should reflect what other transit authorities have found to be successful in service evaluation.

3. TTDC should have the ability to collect the data required for each indicator. The ease and cost of data collection should be considered.

4. The basis for the indicators should be apparent. The indicators should be understandable to those involved in service evaluation.

The indicators that were selected can be grouped into two categories: those that relate to the level of service provided to the riders and those related to the economic performance of the system.

Level of Service

Transit level of service can be divided into two principal components: 1) travel time through the system, and 2) quality of the service.

Travel Time

Travel time through the transit system consists of time required to access the bus route (both at the origin and destination), time spent waiting to board the bus, actual time spent traveling on the bus and time needed for transferring between buses if necessary to complete the trip. Based on this breakdown of transit travel time, TTDC selected the following indicators:

1. Travel Time - to measure on-board bus travel

2. Route Coverage - to indicate accessibility to the bus route at both the origin and destination

3. Frequency of Service - to indicate waiting time

4. Directness of Service - to indicate transferring

5. System Reliability - to indicate the variance of total travel time in the transit system.

Quality of Service

The quality of the trip is the rider's perception of the trip environment. When the quality of the trip is enhanced, the potential

for greater ridership is increased. When making a transit trip, the rider's environment is the bus stop location and the interior of the bus. The comfort of waiting at a bus stop is an indicator of the rider's environment at the bus stop. Comfort is defined here as the degree of protection from inclement weather.

For measuring comfort on the bus, six indicators were selected:

1. The condition of the vehicle
2. Driver courtesy and skill
3. Loading
4. Safety
5. Convenience of boarding
6. Public awareness

The condition of bus and driver courtesy and skill were selected because they are the two complaints most often cited by riders. Loading and safety were selected because they are commonly used by other properties. Loading reflects whether passengers must stand on the bus and safety reflects their risk of being injured; each should be minimized. The convenience of boarding the vehicle was also selected as an indicator since it is important to elderly and handicapped riders.

Finally, public awareness is another measure of quality of service as potential riders need to know about service availability in order to use the system.

Economic Performance

The economic performance of a transit system reflects the efficiency by which the system provides service. The costs of operating the system are typically measured as total operating costs. These costs are partially offset by system revenues which come primarily from fares. Deficit per passenger was the indicator selected for measuring the relationship between costs of service, amount of ridership and fares paid by the riders. Costs of service and deficit per passenger are discussed below.

Costs

To evaluate transit services total operating costs, and not total costs (operating + capital costs), are commonly used. Models have been developed which allocate costs to routes based on hours and miles of service and vehicle requirements. TTDC selected the following cost allocation formula:

$$C_X = aV_X + bM_X + cH_X$$

Where:

C_X = Cost of route x

V_X = Number of peak vehicles required for route x

M_X = In-service bus miles for route x

H_X = In-service bus hours for route x

a,b,c = Average cost per vehicle, mile and hour, respectively, for the system

The average costs per vehicle mile, hour and peak vehicle were derived from the Section 15 system of accounts. For TTDC, as shown in Table 4, each line item was assigned to the three variables based on a determination as to which of the three measures of output was best related to each cost item. The average cost for each variable was then calculated by summing the cost of all the accounts assigned to each variable and dividing by each statistic. For TTDC the resulting formula was:

$$C_X = 10{,}260V_X + 0.51M_X + 12.81H_X$$

Deficit Per Passenger

The measure which combines the effects of costs, fares and ridership is deficit per passenger. It can be used both for monitoring system performance and for service development. It can be used on a route level basis to assess the effectiveness and efficiency of the route.

MEASURES AND STANDARDS

In this section, measures and standards that were developed for each indicator are discussed. The standards and measures were based on the objectives and criteria previously cited, the review of other transit operators, and TTDC's experience and needs.

Level of Service

Travel Time

The indicator for travel time was selected to be the in-vehicle component of travel time. Studies have shown that bus transit attracts more riders as its travel time begins to approach automobile

TABLE 4

TTDC COST ALLOCATION SYSTEM

Bus-Hour Related Costs

Description	Account Number	FY1979 Budget
Operator's Wages (Transportation Department)	501.01	$3,738,425
Other Salaries & Wages (Transportation Department)	501.02	271,078
Fringe Benefits (Transportation Department)	502.99	1,366,231
Annual Physical - Operators (Transportation Department)	503.03	3,544
Temporary Help (Transportation Department)	503.04	400
	Total Hourly Expenses	$5,379,678

55% of total expenses.

Bus-Miles Related Costs

Hourly Wages (Maintenance Department)	501.02	$ 836,535
Fringe Benefits (Maintenance Department's hourly employees)	502.99	289,959
Annual Physicals (Maintenance Department)	503.03	850
Tempory Help (Maintenance Department)	503.04	2,400

TABLE 4 (cont'd)

Mileage Related Costs (con't)

Description	Account Number	FY1979 Budget
Contract Maintenance (Maintenance Department)	503.05	$ 47,101
Fuel and Lube Oil (Transportation Department)	504.01	668,062
Tires and Tubes (Transportation Department)	504.02	155,077
Repair Parts (Maintenance Department)	504.98	527,062
Accident Repair Recoveries (Mainenance Department)	506.02	(12,094)
General Liability Insurance (General Administration)	506.03	492,786
	Total Mileage Expenses	$3,007,738

30% of total expenses.

Peak Vehicle Related Costs

Wages & Salaries (Scheduling & Marketing Departments, Maintenance Department salaried employees, General Administration)	501.02	$ 588,097
Fringe Benefits (Scheduling & Marketing Departments, Maintenance Department salaried employees, General Administration)	502.99	118,208
Management Fees (General Administration)	503.01	118,500
Advertising Fees (Marketing Department)	503.02	15,000

TABLE 4 (cont'd)

Peak Vehicle Related Costs (con't)

Description	Account Number	FY1979 Budget
Professional & Technical Fees (General Administration, Marketing Department)	503.03	$ 85,936
Temporary Help (Scheduling & Maintenance Departments)	503.04	40,720
Contract Maintenance (General Administration)	503.05	3,196
Custodial Contract (Maintenance Department)	503.06	13,100
Security Service (General Administration)	503.07	1,320
Fuel & Lube Oil (Maintenance Department)	504.01	16,632
Tires and Tubes (Maintenance Department)	504.02	3,514
Materials & Supplies (General Administration Marketing Department)	504.98	153,026
Utilities (General Administration)	505.01	106,284
Physical and Property Damage (Maintenance Department)	506.01	30,403
Theft Insurance (General Administration)	506.05	2,000
Other Insurance (General Administration)	506.98	852
Dues & Subscriptions (General Administration)	509.01	6,986

TABLE 4 (continued)

Peak Vehicle Related Costs (con't)

Description	Account Number	FY1979 Budget
Travel and Meetings (General Administration)	509.02	$ 41,808
Tolls (General Administration)	509.03	1,486
Bad Debts (General Administration)	509.07	- - - -
Media Advertising (Marketing Department)	509.08	58,878
Education (General Administration)	509.09	2,709
Postage (General Administration)	509.98	10,320
Interest Expenses (General Administration)	511.01	1,795
Total Lease & Rentals	512.99	25,860
	Total Peak Vehicle Expenses	$1,446,630

15% of total expenses.

TOTAL EXPENSES FY1979 $9,834,046

travel time. Thus, travel time was defined as the ratio of bus to automobile travel time over the entire length of a route.

Travel time was to be obtained by determining the average, one-way trip time during the A.M. peak, in the peak direction, from one end of the route to the other. Bus data was to be obtained from trial checks. Auto travel time was to be determined by a surveyor making two trips in a car along the bus route.

The travel time ratio was to be computed for each route at least annually and after a significant route or schedule change or as conditions warranted.

From the survey of other transit authorities and the literature, the following maximum standards for the travel time ratio were selected:

Service	Travel Time Ratio
Regular	2.0
Express	1.5

Route Coverage

Route coverage measures the potential for people to use transit based on their proximity to service. Higher population densities and shorter access times to transit service tend to produce more transit riders. Routes should be designed so that the number of people with access to the system is maximized.

Route coverage was to be measured by the number of dwelling units per acre within a 5 minute walk (¼ mile) of a bus route. Past studies have shown that income also influences the potential for ridership. For ease of data collection, mean house value were to be used as a proxy for income in order to stratify the accessibility standards. Dwelling units per acre were to be obtained from the MPO, city assessor and field observations. Mean house values were to be obtained from real estate assessments.

The standards for this indicator were obtained from the survey of transit authorities and the literature and from local characteristics. The standards were selected as follows:

Mean House Value	Minimum Dwelling Units/Acre
Low (less than $30,000)	2
Medium ($30,000-$45,000)	7
High (more than $45,000)	15
Multi-Family Units	Over 7

Frequency of Service

This indicator reflects the average time that riders are required to wait for a bus as well as the availability of service. By reducing waiting time, the attractiveness of transit travel to potential riders can be improved. Frequency of service was to be measured by headway (time between buses). Headways were to be reviewed at least annually and when there is a schedule change. The following standards are generally accepted by the transit industry:

Operating Period	Maximum Headway
Peak	30 minutes
Other	60 minutes

Directness of Service

An indicator of directness of service is the percentage of transfers on a route. This measure was to be computed from data collected at least annually and as conditions warranted.

The standard for this measure was derived from a survey of transit operators and the characteristics of TTDC's transit service. The minimum ridership on a TTDC route was approximately 150 riders per day. Thus, the standard was that if 150 or more of a route's riders require a specific transfer, a new or through route will be established or a scheduled transfer initiated with a maximum 5 minute waiting time.

Reliability

Reliability deals with the rider's confidence in the bus arriving on time throughout the transit system. Reliability was to be measured by schedule adherence which was defined as the percentage of buses arriving on time. On time was to be defined as a bus arriving at a stop 0 minutes early to 5 minutes late.

The percentage of buses on time was to be computed for each route from data collected at least quarterly. The following standards were proposed for schedule adherence:

Route Headway	Minimum Percent On Time
1-29 Minutes	85
30 Minutes and Over	95

These standards reflect the fact that ridership is more sensitive to waiting time for infrequent service than more frequent service.

Quality of Service

Waiting Comfort

Waiting comfort was to be measured by the degree of protection offered against inclement weather. The measure was the presence of a shelter or other protection at a bus stop. The standard to be used was that all bus stops with 50 or more passengers per day boarding must have a shelter or other protection from inclement weather. This standard was based on conditions in the Tidewater area and industry experience.

The presence of a shelter or other protection at warranted locations would be determined from data collected at least annually. The number of shelters at those stops where shelters are warranted on the route were to be reported in the annual report.

Condition of Bus

The measurement of the condition of the buses was to be derived from rider complaints and attitudinal studies conducted for TTDC. Interior cleanliness is the most often cited condition. The measure was a qualitative index of the attributes of a bus' condition listed below. A bus must attain eight points to pass inspection and 80 percent of the buses on a route must pass inspection.

Attributes	Maximum Points
Climate Control	2
Interior Cleanliness	3
Exterior Cleanliness	1
Repair of Seats	2
Interior Lighting	1
General Repair	1
TOTAL	10

In-service bus inspections were to be performed during boarding and alighting counts. Bus conditions for each route were to be calculated from data collected and reported annually.

Driver Courtesy and Skill

The measure and standard for driver courtesy were based on TTDC's experience and complaint records. The measure to be used was to be citizens' complaints against drivers. If two or more complaints (against the driver or for prohibited actions on the bus) are received on any individual driver within a month, the driver would be investigated. Complaints would be received on a daily basis and reviewed monthly and annually.

Loading

Loading was to be measured by load factor which indicates how many people must stand on a bus on a given route. It is defined as the ratio of the number of passengers at the maximum load point on a route (where total persons on board is the greatest) to the total seating capacity during the peak hour and in the peak direction. Data covering the full hour would be used in the calculation. The load factor was to be computed for each route at least annually.

The standards for this indicator was that the load factor may not exceed 150 percent on regular bus routes nor 100 percent for express service. If these standards were exceeded, regardless of the duration that the standards are exceeded, additional service should be investigated.

Safety

Freedom from personal harm is important to everyone in their daily activities. The measure of safety was the number of accidents per 100,000 vehicle miles on a route. The standard was a maximum of six accidents per 100,000 miles, which is the national average for fixed route bus systems. Accidents per 100,000 vehicle miles of a route were to be calculated monthly by route and system total.

Public Awareness

Public awareness deals with the public's knowledge of the transit system. In order to use the bus service, one must know about route and schedule information. There are different levels of awareness associated with the choice, target and captive markets. From a market research report done by TTDC, it was found that:

1. Sixty percent of Tidewater homes are in the choice market which is defined as those one and two car households where the number of licensed drivers is equal to or greater than the number of cars.

2. Thirty-three percent of Tidewater households are in the target market which is those households where the number of licensed drivers exceeds the number of household cars.

3. Fourteen percent of Tidewater households are in the captive market which is described as those households in which no cars are owned.

The measure to be used was selected to be the percent of the population who are aware of the transit system and are within the TTDC service area.

The standards below apply to individuals 18 years and older who work and are within a 5 minute walk of bus service.

Level of Awareness	Minimum Percent Responding Positively
1. Knowledge that bus service exists within 5 minutes walk of home. (Minimum level for the choice market)	60
2. Knowledge that bus service exists between home and work. (Minimum level for the target market)	30
3. Knowledge of schedule information. (Minimum level for the captive market)	15

The measures would be computed from data collected at least every 2 years.

Vehicle Boarding Convenience

Convenience of access to the vehicle is a factor which particularly affects the elderly and handicapped. For this reason, the measure to be used was to be the percentage of buses on a route with a given level of elderly and handicapped riders which are especially accessible to the elderly and handicapped.

A recent study estimated that approximately 15 percent of the population of the Tidewater area was elderly and handicapped. The average TTDC route ridership is approximately 850 riders per day. The measure of vehicle boarding convenience was to be the percent of buses on a route which are specially accessible to the elderly and handicapped. If 85 or more elderly and handicapped persons per day patronize a route, a minimum of 90 percent of the buses assigned to the route must be equipped with the kneeling feature. This measure and the number of elderly and handicapped who patronize a route would be calculated annually.

Economic Performance

Deficit Per Passenger

The deficit per passenger for each route was to be computed from route revenue, cost (using the cost allocation formula described earlier) and ridership data. All routes would then be ranked by deficit per passenger and would be monitored to determine their trend in this indicator. Routes with a deficit per passenger greater than

$1.00 or an increasing trend of deficit per passenger would be investigated to determine how the service can be changed to improve this indicator.

The deficit per passenger was also to be used to develop the annual transit service program. The commission was to annually establish the total amount of the budget. All new service proposals would be ranked along with the current routes. The deficit per route would then be summed for each route going down the list. At some point, the accumulated deficit would exceed the total deficit set by the budget. All services ranked above that point would be provided. Thus, this indicator would serve as a rational tool for meeting the ever-changing demands for transit services within the limited financial resources available.

DATA COLLECTION AND REPORTING

The previous sections discussed the proposed evaluation system in terms of the data required for each measure, the source of the data, how often data are to be collected and how the measure is to be reported. This section describes how the data which make up the performance monitoring system developed were to be collected and analyzed, the reporting of the measures and the estimated cost of the entire evaluation process.

It is now common practice to view data collection, analysis and reporting as a management information system (MIS). This perspective was useful in designing the system to ensure that it met the design criteria. It also makes the system understandable to all those who use it. A management information system facilitates decision-making by providing readily accessible data to the decision maker.

Reporting

Table 5 is a listing of the measures that were proposed to be reported in the monthly, quarterly and annual reports. Monthly reports would give information *only* on a systemwide basis. The quarterly report would provide the status of the transit service program and give information *for each route* and by city and for the system.

Each year a comprehensive report would be prepared which would be a compilation of monthly, quarterly and all other reports prepared during the year, with the addition of several measures that are calculated only annually. This annual report would include information for each route and for the total system.

Data Collection and Analysis

This section summarizes the estimated level of effort on an annual basis to collect and analyze the data required for the performance evaluation system. Most of the effort would be in data collection and supervision carried out by the transportation surveyors and

TABLE 5

REPORTING SUMMARY FOR PROPOSED EVALUATION SYSTEM

Indicator	Monthly	Quarterly	Annually
Travel Time			X
Route Coverage			X
Frequency of Service		X	X
Directness of Service			X
Reliability		X	X
Waiting Comfort			X
Condition of Bus			X
Driver Courtesy and Skill	X		
Loading			X
Safety	X	X	X
Vehicle Boarding Convenience			X
Public Awareness			X
Deficit per Passenger	X	X	X

transportation technician. The Appendix contains a discussion of how the required data would be obtained. Analysis, evaluation and reporting, including the development of corrective actions and service proposals, would be the remaining effort carried out by the transportation planner, schedule analyst, superintendent of schedules and research analyst. There were eight full time and 10 part time (transportation surveyors) staff assigned to service evaluation and development at TTDC. Below are the wage and benefit rates covering these positions at the time this was written.

Staff	Hourly Rate Including Benefits
Transportation Surveyors	$3.77
Transportation Technician	6.26
Research Analyst	6.19
Transportation Planner	10.51
Schedule Analyst	10.03
Superintendent of Schedules	11.00

Table 6 is a sun ary of the level of effort that was projected for the data collection activities to support the evaluation indicators. The estimated effort and costs required to support the new performance evaluation system were compared to the one previously employed at TTDC as was shown in Table 1. Note that the new system would require almost 4,000 fewer man-hours and cost $11,000 less annually to develop and report.

TABLE 6

Summary of Estimated
Level of Effort

	Manhours	Cost
Trail Checks	440	$ 3,500
Timed Runs by Auto	150	1,200
Utilization of Existing Data	950	6,150
Schedule Adherence Checks	1,025	6,150
Boarding and Alighting Counts	6,500	29,000
Citizen Surveys (consultant)	50	2,300
Field Surveys	2,000	15,700
Transfer Analysis	90	600
New Service Evaluation	500	5,300
Total Service Evaluation and Development	11,705	$69,900

CHAPTER 5

TRIAL IMPLEMENTATION

INTRODUCTION

The implementation phase of the Prototype Evaluation Study began during the end of fiscal year 1979, specifically, May, June and July. The implementation phase was utilized to assess the reasonableness of the criteria established to evalute service. This chapter discusses problems encountered during implementation, needed modifications to the evaluation system, results and costs associated with the evaluation.

MODIFICATIONS

During the first and second weeks of May, 1979, meetings were held with managers of various departments to discuss their responsibilities for supplying data to be used in the new service evaluation program. These meetings were held in an effort to identify the potential problems associated with the proposed evaluation procedures particularly in data collection and manpower estimation. Although the data needed for the study were known,it was not clear which department would be the most appropriate to supply the data. The meetings also were utilized to confirm the manpower requirements of each department to compile the requested information.

As a result of the meetings, several alterations were made in the assignment of data collection responsibilities, the data required and the frequency of data collection.

The specific problems that were identified and modifications related to the various indicators are discussed below.

Waiting Comfort and Load Factors

These indicators utilize boarding and alighting counts to summarize the number of passengers boarding and the number on the bus at each stop. Boarding and alighting counts are extremely time consuming so shortcuts to obtain this information were devised.

Once the peak load points for each route had been determined, much time could be saved by placing schedule adherence surveyors at those points to also observe the load. Also, some time was saved by accumulating the data from the route profile only up to the peak load point.

Where a count of boarding passengers at each stop is needed to measure waiting comfort, visually scanning the route profile can save a great deal of tedious analysis. In addition, surveyors, when collecting boarding and alighting data, can record the stops where there are passengers boarding above a predetermined number.

Vehicle Boarding Convenience

Since TTDC had just received a large delivery of new buses with the kneeling feature and because of the promulgation of 504 regulations regarding nondiscrimination of the handicapped, it was felt that the usefulness of this indicator was greatly diminished or at best uncertain. The entire system now deploys enough accessible buses such that the standard was always exceeded on all routes. Therefore, this indicator was dropped from the evaluation system.

RESULTS

An evaluation of TTDC's services showed that TTDC's performance passed more standards than it failed. The system's performance as compared to each indicator was as follows. Each referenced table appears at the end of this chapter.

Travel Time Ratio

Table 7 shows the travel time ratio performance of nine randomly selected routes versus the comparable auto travel time. All sample routes surveyed passed the standard for travel time ratio, including the Route 20 express route.

Route Coverage

The data required for this indicator could not be completely collected and analyzed as median housing value was not maintained at a level of disaggregation needed to support this indicator. An adjustment in the indicator was made in its trial application to consider residential density within ¼ mile of transit service as the sole measure of route coverage, without stratification by mean housing value. After examining density data the standard was modified to state that all subareas within TTDC's service area with a density greater than or equal to 15 dwelling units per acre should be within ¼ mile of a bus route. The subareas were defined as statistical planning areas as determined by the Southeastern Virginia Planning District Commission. There were approximately 900 statistical planning areas with TTDC's service area.

Compilation and examination of the data on residential density and service coverage indicated that a total of eight statistical planning areas with a residential density greater than 15 dwelling units per acre were not within ¼ mile of an existing TTDC bus route. Seven of these areas were within Norfolk and one was in Virginia Beach.

TABLE 7

TRAVEL TIME

Nine routes were chosen at random to determine travel time ratios. This indicator was not computed for all routes due to time limitations during the trial period. The sample consists of one express route, and eight regular routes.

Route No.	Name	Bus/Auto Travel Ratio	Standard
3	Chesapeake	1.6	2.0
11	Liberty Park	2.2	2.0
20	Virginia Beach Local	1.4	2.0
20	Virginia Beach Express	1.3	1.5
22	Great Bridge	1.3	2.0
23	Crosstown	1.2	2.0
41	Cradock	1.3	2.0
48	Pughsville	1.6	2.0
49	S. Norfolk	1.4	2.0

These areas were to be priority candidates for further investigation as to new service development.

Frequency of Service

TTDC service performed poorly with respect to this indicator. Table 8 indicates that 20 of the 41 routes exceeded the headway standards for either the peak or off-peak time periods, or both. Many of the routes not meeting the standard were tour buses or recreation buses, which do not require a high frequency. Taking this into consideration, the frequency of service for this reporting period was generally satisfactory. However, Portsmouth routes did have a low frequency of service and they were to be analyzed in more detail to detect and correct problems.

Directness of Service

As shown in Table 9, only one route pair exceeded the standard for directness of service of 150 transfers per day. The Route 3 to Route 1 combination had 241 weekday transfers. The same route pair had the second and third largest amount of transfer activity in the system on Sunday and Saturday, respectively, as well. No other route pair was close to exceeding the standard. No action was taken on this route pair at that time as operational problems precluded the interlocking of Routes 1 and 3. However, a close watch was to be maintained on this route pair with an eye towards future improvements.

Reliability

Table 8 also displays 1979 Fourth Quarter Statistics for reliability as measured by route schedule adherence. TTDC performed poorly with respect to this indicator as only 3 of the 41 routes met or exceeded the schedule adherence standards of 85 percent on time for headways less than 30 minutes and 95 percent on time for headways greater than or equal to 30 minutes.

The routes within Portsmouth had the poorest reliability and the 10 worst routes were analyzed in more detail to determine possible solutions. Only 10 could be analyzed at first due to manpower limitations, yet this indicator allowed TTDC staff to concentrate on improving those routes with the poorest reliability first. It was determined that six routes could be corrected by schedule adjustments. Two routes had to traverse the Hampton Roads Tunnel and were subject to uncontrolled, sporadic traffic delays. Two other routes with the poorest reliability were eliminated due to poor ridership.

Condition of the Bus

Only 20 percent of the buses received eight or more points and passed the standard. This was an unacceptably low pass rate for those buses checked. Possibly, the bus drivers were not reporting defects

TABLE 8

TIDEWATER REGIONAL TRANSIT
Transit Service Program Quarterly Report
4th Quarter Statistics
April, May, June 1979
(Average Daily Statistics)

NO.	ROUTE NAME	CITY	IN-SERV. HOURS	IN-SERV. MILES	PEAK PERIOD VEHICLES	COST $	BOARDING PASS.	REVENUE $	DEFICIT $	DEFICIT PER PASS.$	HEADWAY (MIN.) AM	BASE	PM	SCHEDULE ADHERENCE (%)	ACCIDENTS/ 100,000 MILES
1	Granby	N	97.4	1541	8	2321	3868	1215	1106	.28	14	24	14	65	6.1
2	Naval Base	N	77.5	1150	9	1885	3798	1155	730	.19	10	20	12	80	5.9
3	Chesapeake NOB/NAS	N	86.3	1465	6	2079	4608	1382	697	.15	15	30	15		
3	Navy Contract	NC	36.0	489	2	784	537	0	784	1.46	15	30	15		
	TOTAL		122.3	1954	8		5145	1382	1481	.29	15	30	15	65	6.4
4	Church Street	N	56.2	515	4	1114	3125	781	333	.10	15	20	15	66	7.1
5	Huntersville	N	29.6	270	2	582	1170	293	289	.24	25	25	25	86	13.0
6	Colonial	N	22.8	310	1.7	510	1220	317	193	.15	14	20	15	69	0
6	So. Norfolk	N	31.5	310	1.7	619	1380	384	235	.17	14	20	15	66	28.6
6	So. Norfolk	C	17.6	255	1.7	414	312	129	285	.91	14	20	15	66	28.6
	TOTAL		71.9	876	5	1541	2912	830	711	.24	14	20	15		
8	Little Creek	N	49.1	716	2.5	1090	1177	355	735	.62	30	50	30	73	6.7
8	Little Creek	C	7.3	79	2.5	211	567	193	18	.03	30	50	30	49	28.5
	TOTAL		56.4	795	5	1301	1744	548	753	.43	30	50	30		
9	Ghent	N	15.1	235	1.5	365	285	72	293	1.03	30	45	30	62	
9	Chesterfield	N	22.3	235	1.5	456	708	179	277	.39	30	45	30	73	
	TOTAL		37.4	470	3	822	993	251	571	.57	30	45	30		7.9
10	Larchmont/Colley/ Edgewater	N	41.1	425	3	843	1024	276	567	.55	20	20	20	70	2.8
11	Liberty Park	N	32.1	303	2	632	1439	381	251	.17	20	25	22	85	11.1
12	Southside-Indian River Road	N	13.5	165	.7	282	368	96	186	.50	32	40	30		
12	"	C	2.4	32	.7	69	13	7	62	4.78	32	40	30		
12	"	VB	2.3	22	.7	62	16	8	54	3.40	32	40	30		
	TOTAL		18.2	219	2	411	397	111	300	.75	32	40	30	39	5.3
13	Campostella	N	32.0	275	2	615	1368	383	232	.17	30	25	30	75	3.8
14	Bayview	N	15.0	201	2	360	172	45	315	1.83	35	60	50	78	5.5
15	Crosstown-Janaf	N	36.6	547	2	824	660	300	524	.79	60	60	60	83	2
16	Coronado	N	28.3	453	3	698	845	237	461	.54	30	65	25	86	0
17	Lakeland	N	31.1	439	3	725	662	179	546	.82	40	40	35	92	0
18	Lansdale	N	46.3	631	4	1053	1775	673	380	.21	25	55	25	72	6
20	Virginia Beach Blvd.	N	57.3	697	6	1289	1973	760	529	.26	20	40	20	52	
20	" " "	VB	60.1	1207	6	1606	1068	582	1024	.96	20	40	20	52	
20	" " " Express	VB	19.9	427	3	577	406	204	374	1.83	30	-	30	86	
	TOTAL		137.3	2331	15	3473	3447	1546	1927	.55					5
22	Great Bridge	C	21.3	343	2	518	395	170	348	.88	55	100	55	25	0
23	Crosstown	N	39.2	361	3	784	1186	314	470	.39	20	30	20	97	16.1
25	NOB Shuttle	NC	12.0	162	1	271	275	0	271	.98	90	90	90	NA	0
30	Kempsville Sun. Spc.	VB	19.4	340	2	493	221	98	395	1.78	75	75	75	NA	0
31	Pembroke Sun. Spc.	VB	19.4	306	2	474	194	91	383	1.97	75	75	75	NA	0
32	Shore Drive	N	15.0	301	1.5	400	345	114	286	.83	50	80	50		
32	Shore Drive	VB	16.0	228	1.5	373	72	41	332	4.61	50	80	50		
	TOTAL		31.0	529	3	774	417	155	619	1.48	50	80	50	95	2.6
33	Brandon Sun. Spc.	VB	12.1	110	1	243	32	10	233	7.30	75	75	75	NA	0
35	Laskin RD-NOB/NAS	VB	6.5	171	3	267	200	130	137	.68	10	-	10	83	0
36	Independence	VB	22.3	465	4	659	94	38	621	6.61	30	130	30	NA	2.2
40	Parkers Shuttle	N	5.6	54	2	161	274	0	161	.58	10	-	10	61	25
	Vocational Trip	N	Incorporated into Route #18								60	60	60		
	Naval Base Tour	N	5.0	50	1	121	20	27	94	4.70				NA	0
41	Cradock	P	8.3	135	.5	194	183	65	129	.70	80	80	80		
41	Cradock	C	4.5	70	.5	110	17	7	103	6.09	80	80	80		
	TOTAL		12.8	205	1	304	200	72	232	1.16	80	80	80	61	5.9

TABLE 8 (Cont'd)

TIDEWATER REGIONAL TRANSIT
Transit Service Program Quarterly Report
4th Quarter Statistics
April, May, June 1979
(Average Daily Statistics)

NO.	ROUTE NAME	CITY	IN-SERV. HOURS	IN-SERV. MILES	PEAK PERIOD VEHICLES	COST $	BOARDING PASS.	REVENUE $	DEFICIT $	DEFICIT PER PASS.$	HEADWAY (MIN.) AM	BASE	PM	SCHEDULE ADHERENCE (%)	ACCIDENTS 100,000 MILES
42	West Norfolk	P	12.2	225	1	308	96	35	273	2.84	105	100	105	54	6.7
43	Deep Creek	P	4.4	63	.3	99	94	29	70	.74	90	90	90	58	
43	Deep Creek	C	4.3	63	.3	98	23	11	87	7.91	135	135	135	58	
43	Westhaven	P	3.3	57	.3	82	96	34	48	.50	135	135	135	67	
	TOTAL		12.0	183	1	282	213	74	208	.97					6.7
44	Rollingwood-Simonsdale	P	22.4	253	2	482	644	219	263	.40	35	45	45	76	21.0
45	Cavalier Manor/Shuttle	P	88.1	842	6	1757	3193	773	984	.30	16	20	16	76(65 Tun)	8.6
46	River Park	P	12.4	129	1	257	320	93	164	.51	50	55	50	48	9.1
47	Green Acres-Churchland	P	10.5	180	.5	246	263	95	151	.57	70	70	85		
47	" " "	S	1.5	50	.5	61	85	53	8	.10	70	70	85		
	TOTAL		12.0	230	1	308	348	148	160	.46	70	70	85	65	16.7
48	Pughsville-Churchland	P	8.4	130	.3	186	366	135	51	.14	70	75	80		
48	" "	C	1.4	32	.3	44	20	9	35	1.77	70	75	80		
48	" "	S	1.4	34	.3	45	13	8	37	2.88	70	75	80		
	TOTAL		11.2	196	1	279	399	152	127	.32	70	75	80	50	18.7
49	Foundation Park (see Route 68, Chesapeake Section)														
50	Academy Park	P	13.3	171	1	292	360	122	170	.47	55	60	60	88	0
51	Elizabeth River Loop	P	24.3	393	2	584	510	162	422	.82	30	30	30	74	3.2
52	River Park/NNSY	P	1.1	15	1	52	79	32	20	.26	1 Trip			NA	0
53	Cavalier Manor/NNSY	P	1.1	15	1	52	73	29	23	.32	1 Trip			NA	0
54	Greenwood-NOB/NAS	P	5.4	102	3	215	96	52	163	1.70	3 Trips			NA	0
55	Bowers Hill	C	4.4	72	1	125	62	27	98	1.59	2 Trips			60	16.7
71	Obici-Kingsboro	S	6.4	106	1	169	138	41	128	.93	60	60	60	96	0
72	Lakeside-Riverview	S	5.2	50	1	123	80	24	99	1.24	60	60	60	57	0
73	Hollywood	S	6.3	85	1	156	105	32	124	1.18	35	35	35	85	0
74	Lake Kennedy	S	10.4	137	2	267	212	64	203	.96	30	30	30	88	0
75	Saratoga	S	5.1	44	2	149	94	28	121	1.29	35	35	35	85	0
76	South Suffolk	S	11.5	73	1	215	151	45	170	1.12	30	30	30	71	0
	Norfolk	N	895.5	11577	73.1	19887	33480	9925	9954	.30					
	Virginia Beach	VB	178.1	2128	23.2	4758	2303	1202	3556	154					
	Portsmouth	P	215.2	2710	19.9	4813	6373	1875	2938	.46					
	Chesapeake	C	63.2	948	9.9	1592	1409	553	1039	.73					
	Suffolk	S	47.8	577	8.8	1190	878	295	895	101					
	SYSTEM TOTAL		1385.1	17940	134	32232	44443	13850	18763	.41					
	Navy Contract	NC	41.6	651	3	1055	812	0	1055	130					
	GRAND TOTAL		1433.9	18591	137	33287	45255	13850	19437	.43				.72	6.2

NA - Not Available
* During the quarter, 1,695,433 miles were driven and 98 accidents recorded.

TABLE 9 - DIRECTNESS OF SERVICE

WEEKDAY

ROW TO		1	2	3	4	5	6	8	9	10	11	12	13	14	15	16	17	18	20	22	23	25	32	35	40	41	42	43	44	45	46	47	48	49	50	51	55	71	72	73	74	75	76	NOT USED	TOTAL
1	Granby																																											
2	Naval Base	68																																											
3	Chesapeake-NAS-NOB	241	77																																										
4	Church Street	70	42	47																																								
5	Huntersville	25	26	8	12																																							
6	Colonial-South Norfolk	69	82	56	59	20																																						
8	Little Creek	48	54	34	22	13	41																																					
9	Ghent-Chesterfield	45	34	24	24	9	60	27																																				
10	L.M.-Colley-E.Water	39	11	32	30	15	37	31	10																																			
11	Liberty Park	78	61	35	40	12	84	25	11	32																																		
12	Southside	23	21	8	12	3	7	18	9	14	11																																	
13	Campostella	85	73	51	35	20	51	27	20	39	32	6																																
14	Bayview	30	23	20	5	0	4	15	7	3	6	2	4																															
15	Crosstown	58	16	29	22	1	15	21	2	4	2	1	1	3																														
16	Coronado	13	25	8	15	2	28	5	7	13	16	5	11	4	2																													
17	Lakeland	13	25	15	9	2	15	5	5	8	12	4	8	2	1	1																												
18	Lansdale	45	42	29	26	6	39	22	18	25	21	11	21	2	14	6	3																											
20	Va. Beach Blvd.	97	118	85	50	21	113	44	30	53	21	25	57	21	19	20	7	29																										
22	Great Bridge	44	15	13	13	3	10	7	4	13	11	1	8	1	2	3	5	4	15																									
23	Crosstown	84	57	50	78	27	66	28	3	21	4	2	9	5	3	13	7	28	4	2																								
25	N.O.B. Shuttle																																											
32	Shore Drive	8	9	5	2	1	11	4	4	4	2	3	7	3		1	1	6	8	1	1																							
35	Laskin Road	5	4	4	1	2	3	1	2	3			4	1		3	1	2		1	2																							
40	Vepco Parking Lot																																											
41	Cradock	4	5	3			2	1	3	1	1		1					5		2																								
42	West Norfolk	1	1	1	2			1	1	1	1		1		1	1		1																										
43	Deep Creek	5	5	2	1	1	1	2	1	3			1	1			1	1	2	1				8	1																			
44	Rollingwood-Simonsdale	4		2	1		3	2					2		1	1	1	1	1	1				4	2	2																		
45	Cavalier Manor	46	67	49	17	3	20	9	20	9	23	1	14	2	1	9	1	27	52	5	9	8	1	20	2	10	82																	
46	River Park	3	4	3	1		1	2	2	4	1	2	2	1		2	1	1	2	1				3			1	23																
47	Green Acres	2		1			1		1		1								2					5		2	7	20																
48	Churchland-Pughsville	2		1	3				2		1		4			1			2		1			5		4	20	24	1															
49	Foundation Park	1																											6															
50	Academy Park	2	5	7	1	1	2	4	3	2	3	1	1	1		1		1	2	2				3		6	28	18	5	10	16													
51	Elizabeth River Loop	8	10	6	2	1	2	6	3	4	6	2	3	1		1	1	7	8	2	1	2	1	9		4	10	14	4	4	12	6												
55	Bowers Hill	2					1									1				2			1			1	3	13	1		3	5											
71	Obici-Kingsboro																																											
72	Lakeside-Riverview																																											
73	Hollywood																																											
74	Lake Kennedy																																											
75	Saratoga																																											
76	South Suffolk																																											
	School																																											
	TOTAL	1272	912	628	483	165	617	309	168	256	175	66	159	46	43	64	29	113	98	20	11	10	3	57	5	29	101	112	17	14	31	11											

(These routes received insufficient transferring to merit consideration)

TABLE 9 (Cont'd)

Directness of Service

SATURDAY

HOW TO		1	2	3	4	5	6	8	9	10	11	12	13	14	15	16	17	18	20	22	23	25	32	35	40	41	42	43	44	45	46	47	48	49	50	51	55	71	72	73	74	75	76	NOT USED	TOTAL
1	Granby																																											
2	Naval Base	44																																											
3	Chesapeake-NAS-NOB	130	38																																										
4	Church Street	22	16	22																																								
5	Huntersville	14	14	8	8																																							
6	Colonial-South Norfolk	24	34	30	22	16																																						
8	Little Creek	18	26	22	12	6	16																																					
9	Ghent-Chesterfield	18	10	6	8	6	18	10																																				
10	L.M.-Colley-E.Water	14	18	11	24	8	22	10	8																																			
11	Liberty Park	30	32	16	20	20	44	18	4	16																																		
12	Southside		16	4	4	6	4	6	2	4	2																																	
13	Compostella	30	44	22	22	28	54	18	2	18	10	4																																	
14	Bayview	26	12	10	4	0	6	14		6	2		4																															
15	Crosstown	22	26	20	26	20	8	8		6			4																															
16	Coronado	2	10	6	8	4	14	8		4	10	4	18																															
17	Lakeland	4	8	8	4		4	4	2	6	8	2	10			2																												
18	Lansdale	28	20	12	14	4	16	6	10	6	14	2	16	6	8	4	6																											
20	Va. Beach Blvd.	36	30	24	20	22	36	20	2	12	8	2	28			8	6	2																										
22	Great Bridge	16	6	2	4	2	2	2	6		4		4			2	2	4	10																										
23	Crosstown	42	16	14	36	14	32	18	2	10			4	2		2	8	8	2	4																									
25	N.O.B. Shuttle																																											
32	Shore Drive																																											
35	Laskin Road																																											
40	Virpco Parking Lot																																											
41	Cradock	4	12	6	2		2	2	2		2	2	4					2	12																									
42	West Norfolk		36																																									
43	Deep Creek			2				2		2																2																		
44	Rollingwood-Simonsdale	2														2										10		8																
45	Cavalier Manor	24		14	6	2	12	8	2	6	4		10			2	4	14	18	4						6		10	8														
46	River Park								4	1	4						1									14		2	15	7														
47	Green Acres						1																			2				16	2													
48	Churchland-Pughsville	3	2	1									1													1		2	2	14	1	1												
49	Foundation Park																																											
50	Academy Park							2																		1			12	7	2	1	2										
51	Elizabeth River Loop	3	6	2		2	2		2	4	2							3		1						4		3	7	11	5												
55	Bowers Hill																																											
71	Obici-Kingsboro																																											
72	Lakeside-Riverview	(These routes received insufficient transferring to merit consideration)																																										
73	Hollywood																																											
74	Lake Kennedy																																											
75	Saratoga																																											
76	South Suffolk																																											
	School																																											
	TOTAL	562	433	262	244	160	293	156	48	101	70	16	103	8	8	22	27	33	42	9						40		20	44	55	10	2	2									

TABLE 9 (Cont'd)

Directness of Service

SUNDAY

FROM/TO		1	2	3	4	5	6	8	9	10	11	12	13	14	15	16	17	18	20	22	23	25	32	35	40	41	42	43	44	45	46	47	48	49	50	51	55	71	72	73	74	75	76	NOT USED	TOTAL
1	Granby																																											
2	Naval Base	35																																											
3	Chesapeake-NAS-NOB	134	46																																										
4	Church Street	15	2	10																																								
5	Hintersville	1	1	1	3																																								
6	Colonial-South Norfolk	6	12	13	11	11																																						
8	Little Creek	13	16	7	5		2																																					
9	Ghent-Chesterfield	2	2	1	2		6	2																																				
10	L.M.-Colley-E.Water	24	14	18	2		4	4																																				
11	Liberty Park	20	15	15	5	3	23	11		15																																		
12	Southside	4	3	1	1	2	2			1	7																																	
13	Campostella	32	24	37	6	9	38	16	5	27	22	7																																
14	Bayview	4	4	9				1		2																																		
15	Crosstown	13	12	28	2	2	4	3		5	1	1	3																															
16	Coronado	2	5	5		1	5	1	3	1	6	1	7																															
17	Lakeland		1	2					1																																		
18	Lansdale	10	3	6			6		1	4	3	2	3																															
20	Va. Beach Blvd.	9	4	14			3			7	2		9																															
22	Great Bridge	1	1	3			3	1		1	6		10																															
23	Crosstown	15	4	9		2	10	2		6			1																															
25	N.O.B. Shuttle																																											
32	Shore Drive																																											
35	Laskin Road																																											
40	Vepco Parking Lot																																											
41	Cradock																																											
42	West Norfolk																																											
43	Deep Creek																																											
44	Rollingwood-Simonsdale																																											
45	Cavalier Manor	13	38	30	1		4	14	1	5	1		10																															
46	River Park																																											
47	Green Acres																																											
48	Churchland-Pughsville																																											
49	Foundation Park																																											
50	Academy Park																																											
51	Elizabeth River Loop																																											
55	Bowers Hill																																											
71	Oblci-Kingsboro																																											
72	Lakeside-Riverview																																											
73	Hollywood																																											
74	Lake Kennedy																																											
75	Saratoga																																											
76	South Suffolk																																											
	School																																											
	TOTAL	340	169	179	37	30	110	55	11	74	48	11	43																															

(All other routes received insufficient transfers to merit consideration)

often enough. A recommendation was to have specific employees check each bus that comes in every night. This should help all of the areas, especially interior cleanliness, repair of seats, and general repairs. Another suggestion was to have a more strict guideline for bus drivers reporting defects and inspecting their bus.

Driver Courtesy and Skill

According to Table 10, 25 of the 320 drivers employed by TTDC received at least one complaint during June, 1979. Of these 25 drivers, 8 received two or more complaints, which exceeded the standard for this indicator, and prompted investigations. In certain of these cases drivers were cautioned by supervisors to improve their behavior. This indicator gave TTDC information on general trends in the nature and type of complaints received and will be useful in pointing towards areas of useful driver training such as customer relations.

Loading

As displayed in Table 11, all routes, both express and regular, passed the loading standards comfortably. The system average of 0.49 was well below the standards of 1.5 and 1.0 for regular and express routes, respectively. In fact, TTDC may have had too low a loading and certain routes will be investigated for termination or modification by looking at the indicator of deficit per passenger.

Safety

Table 8 also indicates that 19 of the 41 routes exceeded the standard of six accidents per 100,000 miles during the April through June 1979 period. Three routes exceeded 20 accidents per 100,000 bus miles and are prime candidates for review and corrective actions.

The routes which violated the standard were brought to the attention of the safety department which conducted a detailed analysis of accidents on the problem routes. A letter will be given to all drivers each month or quarter detailing the most common kinds of accidents on each problem route so they will exercise additional caution.

Public Awareness

Table 12 displays the results of the level of public awareness by each market segment. An initial review shows that the standard was passed for each market segment. However, in applying the indicator TTDC staff came to the conclusion that for the choice market the standard of 60 percent having knowledge of available service was too low. For the target and captive markets the standards were confirmed as reasonable and TTDC was doing an acceptable job in getting system information to those markets. A revised standard for the choice market should be 90 percent of households are aware that bus

TABLE 10

DRIVER COURTESY AND SKILL

Month of June

Driver No.	No. of Complaints	Driver No.	No. of Complaints
1277	2	1295	1
1293	1	2630	1
1152	1	2090	1
1303	3	1263	2
1426	2	1384	2
1518	1	1472	3
1172	1	1056	1
1476	1	1353	1
1189	1	1187	1
2660	2	1067	7
1201	1	1016	1
1080	1		
1060	1		
1138	1		

TABLE 11

LOADING

Route Number and Name	# of Trips	# of Seats	# of Passengers	(4 : 3) Load Factor
1 Granby	3	141	85	.60
2 Naval Base	4	188	97	.52
3 Chesapeake-NOB/NAS	4	188	95	.51
4 Church Street	2	90	42	.47
5 Huntersville	3	135	61	.45
6 Colonial	4	188	94	.50
6 South Norfolk	5	235	126	.54
8 Little Creek	2	94	62	.66
9 Ghent	3	135	33	.24
9 Chesterfield	3	135	90	.67
10 Colley Ave.-Larchmont	3	141	33	.23
10 Edgewater	2	94	45	.48
11 Liberty Park	3	141	111	.79
11 Campostella	3	141	90	.64
12 Soutside	2	90	66	.73
15 Crosstown	2	90	22	.24
16 Coronado	2	90	63	.70
17 Lakeland	3	135	63	.47
18 Lansdale	3	141	66	.47
20 Va. Beach Blvd.	4	188	146	.78
22 Great Bridge	2	90	37	.41
23 Crosstown	3	141	109	.77

TABLE 11 (Cont'd)

Route Number and Name	# of Trips	# of Seats	# of Passengers	(4 ÷ 3) Load Factor
32 Shore Drive	1	47	29	.62
35 Naval Base Express	1	45	29	.64
40 Parkers Shuttle	5	225	124	.55
41 Cradock	1	45	12	.27
42 Shea Terrace	1	45	9	.20
43 Deep Creek	1	45	13	.29
43 Westhaven	1	45	16	.36
44 Rollingwood-Simonsdale	2	90	34	.38
45 Cavalier Manor	3	135	58	.43
45 Tunnel Bus	3	135	67	.50
46 River Park	1	45	23	.51
47 College Dr.-Merrifields-Churchland	1	45	29	.64
48 Pughsville-Huntersville-Churchland	1	45	30	.67
49 Foundation Park	1	45	33	.73
50 Academy Park	1	45	29	.64
51 Elizabeth River Loop	2	90	22	.24
54 Greenwood Dr.-NOB/NAS	1	45	17	.38
71 Obici Hospital	2	70	10	.14
72 Lakeside-Riverview	1	35	12	.34
73 Kingsboro	1	35	5	.14
74 Lake Kennedy-Norfolk Rd.	3	105	20	.19
75 Saratoga	3	105	15	.14
76 South Norfolk	3	105	5	.05
SYSTEM TOTAL	105	4,683	2,277	.49

TABLE 12

PUBLIC AWARENESS SURVEY

Level of Awareness	Survey Results	Standard (Minimum)
1. Knowledge that bus service exists within 5 minutes walk of home or a park-and-ride within 3 miles of home in path to work. Choice market.	69.3%	60%
2. Knowledge that bus service exists between home and work. Target market.	43.2%	30%
3. Knowledge of schedule information. Captive market.	30.2%	15%

service is available within a 5 minute walk or 3 mile park and ride distance of home. Since it was found that slightly more than 69 percent of households surveyed were aware of service availability, it was recommended that the marketing program be examined so as to increase the choice market's awareness of TTDC service availability.

Deficit Per Passenger

Table 8 also indicates the deficit per passenger for each route for the Fourth Quarter of FY 1979. The overall TTDC systemwide average was a deficit of $0.43 per passenger. Fifteen of the 41 routes exceeded a deficit of $1.00 per passenger and were investigated in detail in an attempt to improve performance.

After detailed investigation, four of the routes were terminated, and six routes are being considered for contract service. The other five routes have had service hours and routings adjusted in an attempt to improve their deficit per passenger values. They were to be monitored closely to ascertain if improvements occurred.

This indicator was included in the previous TTDC evaluation system and it has still been found to be very useful to management and the board in identifying routes which require modification or termination.

It is important to be cautious in the assessment of both performance and standards. There is a danger assuming that when standards are met they are too "easy" and when standards are failed they are too "strict." Adjustments to initial standards most likely will be made. Better understanding of the theory, objectives and assumptions underlying service evaluation and a wider range of experience implementing this evaluation system is needed. The indicators which TTDC performed poorly have focused attention on TTDC's deficiencies. Resources are being directed to making needed improvements.

COSTS

The actual costs and level of effort to implement the evaluation system on a trial basis closely approximated the estimates given previously (Table 6) as the actual costs were constrained by budgetary considerations to the earlier estimates.

However, certain implementation or start-up costs were also incurred. Such costs can be considered one-time costs, which involved the development of reports, memos, forms, etc., necessary to compile the data required for the evaluation of services. This cost was approximately 113 man-hours or $1,020. It must be noted that TTDC already had a substantial portion of the reports, forms, etc., needed. Starting from scratch, this cost could be doubled.

Of course, the entire development of the prototype evaluation system was a legitimate start-up cost. Any transit operation would have to review its current evaluation system and capabilities and develop objectives, indicators, standards, procedures, reports, etc., to initiate its own customized evaluation system. It is estimated that such an effort would require from 1,000 to 2,000 man-hours by skilled planners, managers and assistants. Starting from scratch, but utilizing this prototype extensively, it is felt that 1,000 man-hours is a good estimate.

The total was close to $85,000, including start-up costs and data collection activities which are also used for other functions within TTDC. This value compares favorably with the $81,000 spent on the previous evaluation process while yielding more useful information on system performance.

CHAPTER 6

CONCLUSIONS

The prototype reported here has successfully addressed the deficiencies of TTDC's former service evaluation process. Primarily, it has provided a rationale for service evaluation and development which is understandable not only to the transportation managers and analysts, but also to Commissioners and city and other officials who make transportation policy and financial decisions. This is important to public officials under pressure to make effective and efficient use of public resources.

The prototype has given managers confidence that they have a comprehensive and systematic evaluation system which can detect strengths and weaknesses of the transit operation. For example, managers have been using the periodic evaluation reports to identify deficiencies and subsequently have focused service development efforts to correct them. Also, the prototype provides analytical support at several levels of detail appropriate for use by Commissioners, city officals, managers and analysts. Thus, there is a clear trail from data collection to implementation.

Most transit properties undertake some form of service evaluation to aid in the determination of what services they will provide. The evaluation techniques are often similar to those used in this prototype. The differences in approach among transit properties are dependent on the service evaluation and development objectives and the capability to perform the necessary data collection and analysis. Acceptance by elected officials also influences the evaluation approach.

Performance evaluation is not a one time effort. Likewise, the evaluation procedures must be reviewed and updated to account for changes in such things as technology, information systems, priorities, funding and new services. Since the initial implementation of the prototype, funding limitations have caused some reductions in data collection (for example, schedule adherence is now done semi-annually); however, new electronic fare boxes are expected to greatly improve the accuracy of ridership by route. Based upon acceptance of this prototype, TTDC is extending performance evaluations to cover its other services including vanpooling, special services for elderly and handicapped and dial-a-ride.

APPENDIX

The following sections estimate the resources required to collect data in support of the performance evaluation system. Some data were already collected by TTDC in support of other functions in the system while other data were required specifically for the performance evaluation system. Resource requirements are expressed in terms of both man-hours and dollars.

TRAIL CHECKS

Trail checks are conducted by a transportation surveyor in an automobile following a bus the length of its route. The data obtained are bus travel time, time between check points on the route, direction passengers go after alighting and the presence of shelters or other protection at bus stops.

For the proposed evaluation system, all routes were to be trail checked annually or as needed. The average, one-way bus trip for TTDC takes about 45 minutes. Each route was to have two A.M. and P.M. and base trips (total of six) checked requiring about 4.5 hours of a surveyor's time. For TTDC's 47 routes this resulted in approximately 212 hours annually for the system. Additional time was needed for surveyor dead time, compilation and supervision. The level of effort for data collection is 300 hours or $1,300. Evaluation and development of service proposals required 140 hours or $1,450. The automobile cost was found from the surveyor hours, average speed (13.5 MPH) then multiplying by 20¢ per mile and is estimated to be 3,000 miles and $600.

TIMED RUNS BY AUTO

Timed runs by auto are conducted by a transit surveyor driving an automobile from one end of the route to the other during the A.M. peak period. Two runs are made at the posted speed limit, or as traffic conditions allow, and an average time is calculated.

Timed runs by auto were to be performed on all routes annually or as needed. The average one-way bus trip for TTDC is 9.2 miles. Timed runs by auto were to be performed twice for each route. For TTDC's 47 routes, this resulted in approximately 1,730 miles. Dividing by an average speed of 25 MPH yielded an estimate of approximately 70 hours of the surveyor's time. Additional time would be needed for compilation and supervision. The level of effort for data collection was estimated as 100 hours or $425. Evaluation would require another 50 hours or $420. The automobile cost was estimated to be 1,750 miles and $350. The total cost to obtain timed runs was estimated as $1,195.

UTILIZATION OF EXISTING DATA

Much data can be obtained without primary collection from a variety of sources. Most of these sources are located in the various departments of TTDC. However, MPO supplied data and real estate assessments require the researcher to go to the Southeastern Virginia Planning District Commission or the city assessor's office, respectively.

The following is a list of sources and data obtained:

1. The Transportation Data Report (MPO Data) - residential density.

2. Real Estate Assessments - mean house value and residential density. The research would go to the appropriate assessor's office to determine mean house value. A template would be used to determine dwelling units per acre as well as the actual size of the area that will be accessible to the proposed service.

3. Schedule Information - headways, in-service vehicle miles, in-service vehicle hours, route miles, peak buses required and scheduled arrival time (used for schedule adherence checks).

4. Maintenance Records- road calls and other information when needed such as the fleet roster.

5. Safety Department Records - accidents per 100,000 miles (measure of safety).

6. Dispatcher Records - driver assignments (used with complaints to measure driver courtesy).

7. Shelter Installation Records - location of bus stops with protection from inclement weather (waiting comfort).

8. Financial Data - costs and revenues sued for allocating costs using the TTDC cost allocation model and for estimating ridership for inclusion in monthly reports.

9. Complaints Received - the number of complaints received against drivers or for prohibited actions on the bus (driver courtesy).

With the exception of the Transportation Data Report and real estate assessments, additional effort would not be required for data collection. For these two the estimated level of effort for data collection and supervision was 600 hours or $2,700. The level of effort for evaluation, and development of service proposals was approximately 350 hours or $3,450.

SCHEDULE ADHERENCE CHECK

Schedule adherence checks would be conducted by transit surveyors stationed at 13 checkpoint locations which form a cordon line around the CBD. The surveyors would be stationed at these points from 6:00 A.M. to 6:00 P.M. and record the data for each bus that passes that point. The data obtained were bus arrival time, bus number and route number; scheduled arrival time would be obtained from schedule information.

All routes were to be checked for schedule adherence quarterly. The level of effort for schedule adherence checks was determined by the number of checkpoints (13) times that number of hours (12) a surveyor would be stationed at each checkpoint and the number of checks made per year (4) which totals 625 hours. For TTDC the level of effort for data collection, compilation and supervision was 725 hours or $3,000. The level of effort for evaluation, analysis and development of corrective actions when needed was 300 hours or $3,150, for a total estimated cost of $6,150.

BOARDING AND ALIGHTING COUNTS

Boarding and alighting counts are conducted by a transit surveyor who rides each trip of every route. The data obtained include number of boarding and alighting passengers on each trip, condition of the bus, number of passengers at the maximum load point, location of the maximum load point, number of elderly and handicapped riders on a route, and the number of specially equipped buses that are assigned to the route.

The level of effort of data collection for boarding and alighting counts was determined by estimating the number of hours the surveyor rides the bus. Intercity routes would be checked quarterly and comprise 352 weekday hours, 252 Saturday hours, and 84 Sunday hours. All other routes (checked annually) comprise 958 weekday hours, 807 Saturday hours, and 391 Sunday hours. As only weekday, a Saturday and a Sunday were to be checked during a boarding and alighting count, a total of 689 hours would be checked annually. This brings the total hours a surveyor needs to ride a bus to approximately 5,000 hours. Allowing 20 percent additional time for compilation and supervision, the level of effort was estimated to be 6,000 hours or $23,700. Evaluation, analysis and development of service required approximately 500 hours or $5,300, for a total of $29,000.

CITIZEN SURVEY

The TTDC was to use in-house staff or contract professional surveyors to obtain the public awareness measures.

The survey was to be conducted by telephone using the city directory as the sampling frame. A systematic random sample would be taken from each city proportional to the population of the city. It was estimated that for a 3 percent error rate, a minimum of 1,000 completed

questionnaires will cost approximately $2,000. Analysis was estimated to take approximately 50 hours or $300, for a total estimated cost of $2,300.

FIELD DEMOGRAPHIC/GEOGRAPHIC OBSERVATIONS

Field surveys were to be conducted by various members of the service development staff to obtain the following data:

- Estimated dwelling units per acre (in just developed areas
- Estimated mean house value (in just developed areas)
- Route mileage
- Other data as needed

When performing field observations, the observer would be trained in making the appropriate estimates. The level of effort for data collection was based on past experience and was estimated to be 1,000 hours and $10,500.

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