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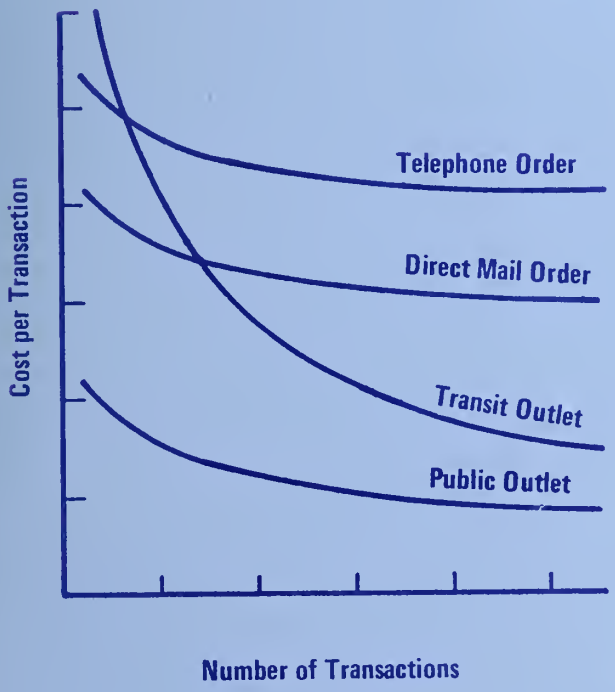
The Costs of Transit Fare Prepayment Programs: A Parametric Cost Analysis

Technical Report



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16. Abstract

Despite the renewed interest in transit fare prepayment plans over the past 10 years, few transit managers have a clear idea of how much it costs to operate and maintain a fare prepayment program. This report provides transit managers with the specific tools and resources needed to estimate the operating costs of existing programs and to forecast the expenses that will be incurred in programs that are being planned. The tools presented in this report are in the form of parametric equations using standardized costs. A review of the general findings in this report is also presented in a separate executive summary document.

Following a presentation of the approach to cost modeling used in this study, the authors describe in detail the costs of the 12 principal program functions. Parametric cost equations are developed and planning information is provided for each program function. Major cost comparisons and guidelines are presented in the last two chapters of this report.

This report shows that large fare prepayment programs incur a higher unit cost than small programs primarily because large transit companies spend significantly more money on advertising and on sales commissions to public outlets. The operating costs per prepaid plan sold range from $0.14 in small fare prepayment programs to $1.02 in very large programs. The average unit cost for all 11 fare prepayment programs analyzed in this study is $0.63. On a per trip basis, fare prepayment operating costs vary from one to five cents. The average cost per prepaid trip for all 11 programs is 2.2 cents.

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TECHNICAL REPORT

by

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February 15, 1982

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ABSTRACT

Despite the renewed interest in transit fare prepayment plans over the past 10 years, few transit managers have a clear idea of how much it costs to operate and maintain a fare prepayment program. This report provides transit managers with the specific tools and resources needed to estimate the operating costs of existing programs and to forecast the expenses that will be incurred in programs that are being planned. The tools presented in this report are in the form of parametric equations using standardized costs. A review of the general findings in this report is also presented in a separate executive summary document.

Following a presentation of the approach to cost modeling used in this study, the authors describe in detail the costs of the 12 principal program functions. Parametric cost equations are developed and planning information is provided for each program function. Major cost comparisons and guidelines are presented in the last two chapters of this report.

This report shows that large fare prepayment programs incur a higher unit cost than small programs primarily because large transit companies spend significantly more money on advertising and on sales commissions to public outlets. The operating costs per prepaid plan sold range from $0.14 in small fare prepayment programs to $1.02 in very large programs. The average unit cost for all 11 fare prepayment programs analyzed in this study is $0.63. On a per trip basis, fare prepayment operating costs vary from one to five cents. The average cost per prepaid trip for all 11 programs is 2.2 cents.

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STUDY OBJECTIVES AND BACKGROUND

INTRODUCTION

A renewed interest in transit fare prepayment methods began about ten years ago when many transit companies in acute financial positions were being acquired by local governments and other public entities. Fare prepayment programs were viewed by many as a marketing tool that could reverse the downward trend in transit ridership and at the same time improve the public transit operator's image in the community. The renewed interest in passes and permits was strengthened by the need to comply with the off-peak reduced-fares policy for elderly and handicapped riders mandated in the Urban Mass Transportation Act of 1964, as amended. In addition, many transit managers across the country viewed fare prepayment as a convenient alternative to cash payment as transit systems began adopting exact-fare policies.

Despite the renewed interest in fare prepayment, few transit managers have a clear idea of how much it costs to operate and maintain a fare prepayment program. Some costs, such as printing and sales commission charges, are well known because invoices are frequently received. There are, however, other costs which have seldom been quantified when estimating the full cost of operating a fare prepayment program. These costs include the cost of storing fare prepayment plans, the cost of accounting for sales, and the cost of delivering fare prepayment plans to sales outlets.

There are also many program trade-offs a transit manager can make which will affect cost. Staff distribution of monthly passes to suburban sales outlets, for example, can be replaced by courier service or certified mail delivery if sales volumes are low. This could result in a measurable cost savings without affecting the quality or security of the program. Understanding how individual program functions affect costs could help many transit companies improve the cost-effectiveness of their fare prepayment programs.

This report has been prepared to provide transit managers with the specific tools and resources needed to calculate the costs of operating a fare prepayment program. Because of the manner in which the cost equations are formulated, managers in almost any transit company can use this report for estimating their own program costs. In addition, this report presents a description of the factors that affect the costs in over 20 different functional areas that are common to most programs. It is only by first understanding the factors that influence program costs that one will be able to design a program that meets the needs of riders at minimum cost to the transit company.

STUDY OBJECTIVES

There are two principal objectives for preparing this report. The first objective is to provide transit managers and analysts with the specific tools and resources needed to estimate the operating cost of existing programs and to forecast the expenses that will be incurred in programs that are being planned. A series of easy-to-use parametric cost equations have been developed in over 20 different functional areas. Presented in Chapters 3 and 4, these equations can be used for computing monthly operating costs. Any transit company can use these equations by simply selecting values for the parameters that are appropriate in that setting. Standardized values and costs are also available for many of the parameters.

By presenting detailed information on the cost behavior of separate functional activities, this report also attempts to improve our understanding of how these costs are incurred. Each of the parametric cost equations developed in Chapters 3 and 4, describes the relationship between program characteristics and costs. Trade-offs can then be made among alternative program activities in order to minimize operating cost. For example, there are alternatives to having transit personnel deliver fare prepayment plans to sales outlets. Using a

courier delivery service will in some instances cost less if distances between outlets are far. These and other trade-offs can only be made if sufficient information is available to describe what factors affect costs. A detailed discussion of the major program trade-offs that can be made to minimize operating cost is presented in Chapter 5.

Although the parametric cost equations in this report do include one-time, capital costs as well as recurrent operating costs, there are some program costs that are not discussed. Initial short-term planning, start-up, and other program development costs, for example, are not considered. Instead, the report focuses on examining the costs of fully operational programs. In addition, the report does not include a discussion of the costs associated with lost revenue due to improper pricing.

Finally, this report is prepared only to provide detailed assistance in estimating program operating costs. The report does not attempt to quantify the benefits associated with the operation of fare prepayment programs. Obviously, one must be able to measure the benefits as well as the costs of fare prepayment programs in order to evaluate their value to a transit company and the community in which it serves.

TRANSIT FARE PREPAYMENT PLANS

Transit fare prepayment has been broadly defined as any method of fare payment other than cash at the time a trip is taken. Thus, fare prepayment involves purchasing evidence that can later be verified as substitutes for cash in payment for transit rides. Fare prepayment plans vary primarily according to boarding procedure and period of validity.

Fare prepayment plans have diverse features and options as shown in Table 1-1. Two general groups of fare prepayment plans exist:

- Trip-limited plans specify the quantity of trips that can be taken and are generally valid for an unlimited period of time. The price per trip is explicitly known. Tokens, tickets, and punch cards are examples of fare prepayment plans that fall into this category.

- Time-limited plans specify the time period during which trips may be taken. Since generally there is no limit on the quantity of trips that can be taken, the discount level is implicitly known; that is, the average price per trip depends on the frequency of transit usage. Passes and permits fall into this category.

Table 1-1

SELECTED DIMENSIONS OF TRANSIT FARE PREPAYMENT PLANS

Fare Prepayment Instrument	Period of Validity	Quantity Of Riders	Discount Policy W/R to Base Fare	Client Group	Select Transit Services	Time of Day or Week	Distribution Method
Trip Limited							
Tokens	Unlimited	1 Trip	Explicit	General Public	Multi-Modal	Peak Hours	On Vehicles
Tickets	Limited (Generally monthly)	10 trips 20 trips	(Discount independent of usage with larger plans offering larger discounts)	Commuter	Mode-Specific	Off-Peak Hours	Over-the-counter • Transit Offices • Banks • Department Stores • Other Institutions
Punch Cards		40 trips		Shopper	CBD-Service	A.M. OR P.M. Peak with Off-Peak Hours	
Time-Limited				Student	Express Service		Third Party • School • Social Service Agencies • Employers-Payroll Deduction
Permits	Daily	Unlimited	Implicit (Discount dependent on usage, with longer plans offering larger discounts)	Elderly & Handicapped	Park & Ride Service	Weekends	
Passes	Weekly	Limited		Tourist	New Service	Weekdays	Direct Mail
	Weekend			New Resident		Unrestricted	Telephone
	Monthly				Other Special Service		Automatic Transfer Payments at Banks
	Annually						Vending Machines
	Permanent						

Within these broad groups, plan variations reflect different physical formats and functions. For example, tokens and tickets do not carry expiration dates, are dropped into the fare box, and are amenable to zone-fare systems. The validation of punch cards requires holes to be punched by the driver, an operation that increases dwell time and thereby operating costs.

Permits must be displayed at the time of boarding and allow travel at reduced fares until the permit expires. Passes must also be displayed on boarding and afford the user the convenience of not carrying cash to make a trip. After an initial fixed charge for the pass, the rider may take an unlimited number of trips at no additional charge per trip. That is, passes encourge transit riding until the pass purchaser is satiated. Although passes specific to zones can be desiged for use in conjunction with zone-fare systems, permits are usually preferred because they enable differential zone fares to be charged more easily.

As shown in Table 1-1, there are numerous features of fare prepayment plans aside from form and boarding procedure. Designing fare prepayment plans essentially involves determing the proper combination of features, including the restrictions on usage, pricing policy, and method of sales distribution. However, the one feature that stands out because of its major cost implications is method of sales distribution. A discussion of alternative sales distribution methods is presented below.

FARE PREPAYMENT SALES DISTRIBUTION OPTIONS

Transit fare prepayment plans can be sold to the public in several ways varying from sales on board a transit vehicle to over-the-counter sales at transit-operated, public, and private outlets. New methods of sales distribution have recently emerged, such as direct mail order and telephone order; however, few transit companies employ these sales methods today. In the near future, new exotic methods of sales distribution may be used by transit companies, such as automatic transfer payments and vending machine sales. These methods, as well as traditional sales distribution methods, are currently being tested and evaluated in the Federally-sponsored demonstration project designed by Ecosometrics, Inc. for the Sacramento Regional Transit.[1] The principal sales distribution methods available to transit operators are discussed below.

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[1]See Patrick D. Mayworm, Armando M. Lago, and Beth F. Beach. A Comprehensive Demonstration of Distribution Systems for Transit Fare Prepayment: The Sacramento Regional Transit Project. Prepared for the Office of Service and Methods Demonstrations, Urban Mass Transportation Administration. Ecosometrics, Inc., Bethesda, Maryland, February 11, 1981.

On-Board Pass Sales

On-board sales of pass plans is used in several transit systems that offer day or weekend passes. Specifically, the rider deposits the amount of cash equal to the pass price into the farebox at the time of boarding. A pass is issued by the driver allowing the pass holder to take an unlimited number of trips during the period of validity.

Over-the-Counter Sales

Over-the-counter sales is the most traditional method of sales distribution. Customers can go to one of several types of sales outlets to purchase a fare prepayment plan. The major types of sales outlets include:

- transit-operated outlets,
- public and private outlets, and
- employer outlets.

Transit-operated sales outlets can be located at transit offices (called headquarters in this report) or at outlets located throughout the city. The latter may be owned by the transit company or rented on a monthly basis. Most transit systems operate their own outlets because they also permit the transit company to advertise and provide customer assistance.

Public sales outlets include banks, department stores, and other retailers, and are accessible to anyone interested in purchasing fare prepayment plans. Private sales outlets, however, sell only to their own clientele. Private sales outlets are usually located in government buildings and at the offices of social service agencies. The key distinction between public/private outlets and transit-operated outlets is that the former do not employ transit company personnel. However, very often public and private outlets will attempt to cover their marginal cost by charging the transit company a commission on sales revenues.

Finally, a rapidly expanding option for sales distribution involves selling fare prepayment plans to workers at their place of employment. This may be an over-the-counter cash transaction or the fare prepayment plans (usually passes) may be purchased through payroll deduction. For analytical purposes, there is little distinction between the cost of supplying employers with fare prepayment plans for sales to employees and the cost of sales distribution through other private and public outlets. Consequently, employer outlets are included in the category of public/private outlets in this report.

Direct Mail and Telephone Order Programs

Fare prepayment plans in some transit companies may be ordered through the mail. Payment for these transactions may be by check or by credit card. Following receipt of mail orders and verification of all credit card purchases, the fare agent will then mail back the item(s) requested.

Telephone order programs allow the customer to order and purchase a fare prepayment plan directly over the telephone using a major credit card. The customer will provide the agent with his/her credit card number and its date of expiration, name, address, and telephone number. Once the agent has verified the credit card account, the item(s) requested are then mailed to the customer.

Bank Transfer Payments

Automatic telephone payment (ATP) and pre-authorized funds transfer are two methods available to many bank customers to pay their personal bills through their financial institutions. Using ATP, individuals can pay their bills over the telephone. With a pre-authorized automatic bill paying service, individuals permit companies to debit their account for the balance due.

Both systems can be used by transit companies for placing orders. In general, once an individual's account has been debited and the appropriate funds transferred to the transit company's account, the transit company can then mail the customer the item(s) requested. Since these new methods have not be applied, they are not discussed in this report. They are, however, the subject of the demonstration project in Sacramento mentioned earlier.

Vending Machines

Fare prepayment plans can be purchased off the vehicle in vending machines located at transit centers and at major sales outlets. Except for the sophisticated machines used to dispense tickets and passes for rapid rail and commuter rail services, vending machines have not been used for the sales distribution of plans for bus use. For this reason, vending machine costs are not discussed in this report.

CASE SITES AND SITE SELECTION

Data on fare prepayment costs are not readily available from official accounting reports and management systems. Costing the activities inherent in the operation of fare prepayment programs requires a level of disaggregation of cost data not available in most accounting systems. For this reason, the authors decided to rely on interviews with several transit companies and on the reports of on-going demonstrations of fare prepayment for the necessary cost data. These demonstrations are supported by grants from the Office of Service and Methods Demonstrations (SMD) of the Urban Mass Transportation Administration (UMTA).

At the outset, it is important to note the limitation in study scope. In order to stay within the survey clearance guidelines specified by the Federal Government's Office of Management and Budget (OMB), only nine transit companies could be interviewed. To increase slightly the sample size, two case studies were selected from the UMTA/SMD demonstration program (Tucson and Sacramento) to supplement the data obtained from interviews with nine transit companies. Consequently, data from a total of 11 transit companies were used in the cost analysis presented in this report. Table 1-2 presents some general characteristics of the systems selected.

The transit companies chosen as case sites for this study were selected based on the following five criteria:

First: The transit companies selected should provide a good representation of fare prepayment plans (including passes, permits, tickets, punch cards, and tokens).

Second: The transit companies selected should provide a good representation of alternative distribution systems (including on-board sales, transit-operated, public/private, and employer outlets, and direct mail and telephone order programs).

Third: The transit companies selected should provide a good representation of alternative delivery systems (including staff delivery, courier service, and postal service).

Fourth: The transit companies selected should include a wide range of system sizes and fare prepayment program sizes, and represent different regions of the country.

Fifth: The transit companies selected should include, to the extent possible, efficient fare prepayment operations, disregarding those which appear inefficient on *a priori* grounds.

Table 1-2

GENERAL CHARACTERISTICS OF CASE SITES SELECTED

Urbanized Area	Transit Company	Urbanized Area Population	Population Rank	Peak Bus Requirements
Los Angeles, California	Southern California Rapid Transit District (SCRTD)	8,351,266	2	2,000
Philadelphia, Pennsylvania	Southeastern Pennsylvania Transporation Authority (SEPTA)	4,021,066	4	1,116
St. Paul/ Minneapolis, Minnesota	Metropolitan Transit Commission (MTC)	1,704,423	12	868
Seattle, Washington	Municipality of Metropolitan Seattle (METRO)	1,238,107	17	774
Cincinnati, Ohio	Queen City Metro	1,110,514	21	346
Portland, Oregon	Tri-County Metropolitan Transportation District of Oregon (Tri-Met)	824,926	28	475
Norfolk, Virginia	Tidewater Regional Transit	668,259	37	145
Sacramento, California	Sacramento Regional Transit District (RT)	633,732	39	186
Richmond, Virginia	Greater Richmond Transit Company (GRT)	416,563	56	175
Wilmington, Delaware	Delaware Authority for Regional Transit (DART)	371,267	61	90
Tucson, Arizona	SunTran	294,184	72	104

Source: UMTA. "A Directory of Regularly Scheduled, Fixed Route, Local Public Transportation Service in Urbanized Areas Over 50,000 Population." August 1981.

A wide range of fare prepayment plans are represented in the 11 case sites selected. As shown in Table 1-3, 17 categories of fare prepayment plans are included in the study, ranging from annual to day passes, and from 45-trip ticket books to tickets sold individually. Passes, permits, tickets, punch cards, and tokens are all represented. Note that nine of the 11 systems offer monthly passes.

Table 1-3

TRANSIT FARE PREPAYMENT PLANS
REPRESENTED BY CASE SITES

Transit Fare Prepayment Plan	Number of Case Sites
PASSES AND PERMITS	
Annual Pass	1
Semester Pass	1
Monthly Pass	9
Weekly Pass	2
Day and Weekend Pass	4
Tourist Pass	1
Base Pass and Permit	2
STAMPS AND STICKERS	4
TICKETS	
Books	
• 10-trip	5
• 20-trip	2
• 40-trip	1
• 45-trip	1
Strips of 10-trip	1
Rolls	1
PUNCH CARDS	
10-trip	1
20-trip	1
TOKENS	3

All the major sales distribution methods are also represented by the case sites. Table 1-4 presents the average number of monthly transactions[1] by distribution method for each of the 11 transit companies.[2] Four of the transit companies analyzed sell pass plans on board, the largest of which is the Sacramento day pass plan. Five companies have some form of direct mail order program, but one company, DART in Wilmington, has a telephone order program. Telephone order is currently used by less than five urban transit companies throughout the country. Over-the-counter sales outlets are adequately represented in the data base.

Table 1-4

AVERAGE NUMBER OF MONTHLY TRANSACTIONS BY SALES DISTRIBUTION METHOD - 1981

	On-Board Sales	OVER-THE-COUNTER SALES		Direct Mail Order	Telephone Order	Total
		Transit-Operated Outlets	Public/Private Outlets			
Los Angeles	0	61,020	204,286[a]	1,200	0	266,506
Philadelphia	0	126,787	94,151	0	0	220,938
St. Paul	34,927	7,857	63,437[a]	195	0	106,416
Seattle	24,826	2,323	55,750[a]	0	0	82,899
Cincinnati	0	255	4,118	0	0	4,373
Portland	0	21,314	40,823[a]	550	0	62,687
Norfolk	0	2,663	4,185	433	0	7,281
Sacramento	209,875	5,586	14,831[a]	0	0	230,292
Richmond	0	Negl.	29,600	0	0	29,600
Wilmington	0	Negl.	19,375	10	35	19,420
Tucson	2,000	0	4,628[b]	0	0	6,628

[a]Identifies the presence of employer outlets.

[b]Includes demonstration plans.

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[1]Throughout this report terms such as monthly transactions and fare prepayment instruments are used and the following definitions apply:

- A fare prepayment plan refers to the type of fare prepayment item purchased (e.g., monthly pass vs. ticket book).
- A fare prepayment instrument refers to the individual item handled or purchased (e.g., 30 instruments may refer to 30 monthly passes, 30 ticket books, or 15 of each).
- A fare prepayment transaction refers to the actual sales activity and is usually equal to the number of instruments sold (e.g., monthly pass with zone stamp include two instruments but only one sales transaction).

[2]Throughout this report the transit companies will be identified by city for convenience.

The three principal delivery methods for transporting fare prepayment plans from the transit company headquarters to sales outlets are represented. As shown in Table 1-5, all 11 transit companies use staff to deliver at least some of the fare prepayment plans to sales outlets. Only one company, SEPTA in Philadelphia, uses courier service. Certified mail is used in different degrees by four of the eleven case site.

Table 1-5

ORDER DELIVERY METHODS REPRESENTED BY CASE SITES

Order Delivery Method	Number of Case Sites
Transit Staff Delivery	11
Courier Service Delivery	1
Certified Mail Delivery	4

The fourth criteria used in the selection of case sites stated that a wide range of system sizes and program sizes be represented in the sample. In addition, the case sites selected should represent the different regions of the country.

As indicated in Table 2-1, different system sizes are represented in the sample, ranging from SCRTD's 2000 peak period bus requirement to DART's 90 buses. Similarly, Los Angeles sells over 266,000 prepaid instruments each month, while Tucson sells just over 6,000 each month. The case sites also represent each region of the country as shown in Table 1-6.

Table 1-6

REGIONS OF THE U.S. REPRESENTED BY CASE SITES

Geographic Regions	Number of Case Sites
Northeast	2
Southeast	2
Midwest	2
Southwest	3
Northwest	2

The last criterion is obviously difficult to document. Suffice it to say, that each of the 11 case sites was believed to operate efficient fare prepayment programs. With the exception of some functions in a few of the programs analyzed, this report will show that, indeed, the case sites do operate relatively efficient fare prepayment programs.

ORGANIZATION OF REPORT

This report is organized into six chapters and a small appendix. In addition, a separate executive summary complements this document by presenting an overview of the analyses and a summary of the general observations.

The second chapter of this report presents the methodological approach to cost modeling used in this study. The functional classification of costs and the structure of the parametric cost equations designed for estimating the operating expenses of fare prepayment programs are also described.

Chapters 3 and 4 describe in detail the costs of the 12 principal program activities. Chapter 3 describes the cost behavior of four transaction oriented activities. In Chapter 4, eight non-transaction oriented activities are analyzed and described. Parametric cost equations are developed and planning information is provided for each fare prepayment program activity.

Chapter 5 presents several important cross comparisons of the costs incurred by transit companies in different program areas. Specifically, Chapter 5 compares the costs of different transit systems, different fare prepayment plans, different methods of order delivery and sales distribution, and different printing frequencies.

The last chapter of this report is provided to assist the reader in using this document. Guidelines are presented on computing costs and short examples are provided. In the final section of Chapter 6, the authors conclude by presenting some general observations on fare prepayment costs based on the analyses of Chapters 3 and 4, and the cost comparisons of Chapter 5.

Finally, there are two appendices to this report. Appendix A presents the 24 key parametric cost equations that must be used to compute the costs of operating a fare prepayment program as described in Chapter 6. Each equation is followed by the parameter definitions and the standardized costs and values developed in this report. Appendix B presents a list of all the case sites and the key individuals interviewed as part of this research project.

2

OVERALL STRUCTURE OF THE PARAMETRIC COST ANALYSIS MODEL

2

OVERALL STRUCTURE OF THE PARAMETRIC COST ANALYSIS MODEL

This chapter presents the underlying methodological approach to cost modeling used in the study. The functional classification of costs and the structure of the parametric cost equations designed for estimating the operating expenses of fare prepayment programs are also described.

BASIC COST CONCEPTS

The cost model developed in this study fits into the general category of a parametric resource approach to cost estimation. In this approach, the cost analysis model focuses on incremental annualized costs in monthly equivalents that are standardized for the purpose of developing generalized parametric cost equations. These equations can then be used for estimating fare prepayment program operating costs in other settings and transit properties. The basic concepts used in the development of the cost analysis model are discussed below.

A Resource Approach to Cost Modeling

The first feature of the model is that it details the major categories of resources used in a specific fare prepayment activity. The model consists of a series of "building blocks" that relate resource requirements, such as man-hours of labor, square feet of space, units of the most important materials

and supplies, and units of equipment, to important output variables that affect costs. The most important variables that drive the costs of fare prepayment program activities include the number of outlets, the number of prepayment instruments sold, and the number of prepayment instruments printed.

Within the overall resource approach, the estimation of costs is relatively simple. First, the resource requirements are estimated as a function of the cost-driving variables. Second, the resource costs are estimated by applying actual local unit prices to the resource requirements previously estimated. For example, the resource requirements for delivering fare prepayment plans to sales outlets include the number of driver hours and vehicle miles. Both are a function of the number of outlets served and a direct relationship between the number of outlets served and the driver hours and vehicle miles required can be formulated. The second step in this example is to identify the driver wage rate and vehicle operating costs and apply these prices to the driver hour and vehicle mileage requirements.

The Standardized Parametric Cost Approach

The "building block" approach described above can also be characterized as a standardized, parametric approach to cost estimation. Three types of parameters are estimated and used in the cost analysis to describe the resource requirements used per unit of output. The three types of parameters used in this report include:

- resource parameters, which identify existing wages and costs, such as the average hourly rate for labor, fringe benefit rate for individuals, and the cost of certified mail;
- program parameters, which identify the characteristics of the fare prepayment program, such as the number of staff-run sales outlets, number of fare prepayment plans, and the average monthly mileage for staff delivery; and
- productivity parameters, which identify how efficiently the task is performed, such as the delivery time per outlet and the average time required to make a sales transaction at a sales outlet.

The cost equations are expressed in parametric fashion to gain flexibility in their use. For example, the reader may substitute his transit system's wage rates and other unique program characteristics for some of the relationships

used in the cost analysis equations. The parametric representation of productivity relationships are "standardized" across many settings and systems to permit generalizations to other transit fare prepayment programs. By normalizing many of the parameters used in the cost equations, some of the features of standardized costing are incorporated in the model.

The costs presented in this study comprise both actual and standardized parametric costs. Actual costs are estimated for each of the 11 transit systems investigated. However, the cost equations recommended for use in systems elsewhere include parametric representations of standardized productivity factors. This reflects the researchers' intention of presenting only the most relevant costs in each particular fare prepayment program activity.

Incremental Activities and The Treatment of Inherited Resources

The cost model presented in this report traces the resource cost of truly incremental activities associated with transit fare prepayment programs. Only those resource requirements associated with the operation of fare prepayment programs are identified and costed. For example, in estimating administrative costs, only those staff performing direct supervisory activities were considered. The resource requirements do not include allocations of the general manager's time or that of his staff. Thus, only truly incremental activities and requirements are considered.

However, in costing factors of each incremental activity, the costs of inherited resources are included and are valued at comparable replacement costs. Thus, the costs of inherited assets (such as vehicles and office space) are not disregarded and treated as "sunk" costs. To do so would have complicated the comparisons of costs across sites since each site uses its inherited resources differently.

Conversion of Capital and One-Time Costs to Monthly Equivalent Costs

All of the functional classifications of activities in the operation of fare prepayment programs can be separated into two categories: capital investment and monthly operating expenses. Operating expenses constitute the costs needed every year on a recurrent basis to operate a fare prepayment program. These expenses include salaries, fringe benefits, materials and supplies,

printing, storage, and other miscellaneous costs. Capital costs are one-time expenditures needed for both the initial implementation and continuation of the program. These costs include office facilities, vehicles, and other equipment. If a program is totally new (such as a demonstration project), the capital costs might also include one-time expenditures for the design of prepayment instruments, initial advertising, and planning activities. In this study, however, program development costs have been disregarded. Instead, the report focuses on examining the costs of fully operational programs.

The primary distinction between capital investments and monthly operating expenses is the length of time benefits are derived from each type of expenditure. Capital resources generally last many years, while monthly expenditures are consumed only during that period of time. To facilitate comparisons of alternative programs, these two costs have to be compared on an equivalent basis.

The best procedure for making the two costs comparable is to convert the capital investment costs into a series of uniform annual expenditures. To do this, capital costs are "amortized" over their useful life using the following formula:

Equivalent Annual Cost = (Capital Cost) X (Capital Recovery Factor (CRF))

Equivalent Monthly Cost = (1/12) X (Equivalent Annual Cost)

where: $CRF = i(1+i)^n/(1+i)^n-1$

and:

n = useful life

i = discount rate

The annualized and monthly equivalent capital costs computed in this manner can be combined with other operating expenses to give total annualized and monthly program costs.

FUNCTIONAL ACTIVITIES, COST CATEGORIES, AND COST ELEMENTS

The operation of a fare prepayment program involves approximately 21 separate functional activities. Together, the costs incurred in each of these activities incorporate the total costs of operating a fare prepayment program. These 21 functional activities are presented in Table 2-1 along with the 12 overall cost categories in which each of the functional activities is classified.

Table 2-1

OVERALL COST CATEGORIES AND FUNCTIONAL ACTIVITIES

Overall Cost Category	Functional Activity
Order Preparation Costs	• Order preparation for delivery to sales outlets • Order preparation for on-board pass sales
Order Delivery Costs	• Order delivery by transit staff • Order delivery by courier service • Order delivery by certified mail
Direct Sales Costs	• Direct sales at transit-operated sales outlets • Direct sales at public and private sales outlets • Direct mail sales and distribution • Telephone order sales and distribution
Recording and Accounting Costs	• Recording sales at transit-operated outlets and headquarters • Accounting for sales at all outlets and headquarters • Accounting for on-board pass sales
Design Costs	• Designing plans for printing
Printing Costs	• Printing fare prepayment plans
Inventory Costs	• Storing fare prepayment plans
Miscellaneous Handling Costs	• Sorting and shredding tickets and other miscellaneous activities
Advertising Costs	• Advertising fare prepayment program
Administrative Costs	• Supervising and administering fare prepayment program
General Overhead Costs	• Overhead at transit-operated sales outlets • Overhead at headquarters
Cost of Funds	• Interest lost due to delays in revenue deposit

From an analytical viewpoint, the cost categories and functional activities can be segmented into two basic groups: transaction oriented costs and non-transaction oriented costs. The first four cost categories presented in Table 2-1 are transaction oriented costs because order preparation, order delivery, direct sales, and recording and accounting costs are affected by the size and frequency of fare prepayment sales and deliveries. The second group of cost categories (i.e., non-transaction oriented costs) is not characterized as having a functional relationship with the volume of transactions, although some non-transaction oriented costs are correlated with sales volume. Expenditures on advertising, for example, will generally be greater in transit systems with high sales volumes. This relationship, however, is not due to the size of the program as much as it is due to a management decision on the importance of the fare prepayment program and the relative merits of advertising. Similarly, printing costs, which increase as sales escalate, are considered non-transaction oriented costs because printing fare prepayment plans is not a transaction oriented activity. This segmentation of the 12 overall cost categories into transaction and non-transaction oriented costs is the basis for the organization of this report. The four cost categories that comprise all transaction oriented costs are discussed first in Chapter 3. The eight non-transaction oriented costs are discussed and analyzed in Chapter 4.

A list of the major recurrent operating and capital one-time cost elements of all of the functional activities in a fare prepayment program is presented in Table 2-2. These cost elements represent the incremental resource requirements of most fare prepayment programs.

Table 2-2

COST ELEMENTS OF FARE PREPAYMENT PROGRAMS

Recurrent Operating Costs	Capital/One-Time Costs
Labor (wages and fringe benefits)	Vehicles
Materials	Equipment
• envelopes	• pass counters
• postage	• token wrappers
• ink	• photographic equipment
• business forms	• telephones
Space/rent	• ticket/pass shredders
Services	Promotional advertising
• commissions to outlets	
• courier service	
• design and printing	
• advertising	

The key variables affecting the costs of fare prepayment programs are presented in Table 2-3 by functional activity. Also shown in Table 2-3 are the relationships between functional activity and each of five separate sales distribution methods.

As shown in Table 2-3, order preparation and order delivery costs are driven primarily by the number of sales outlets served. Direct mail and telephone order programs do not require bulk order preparations or deliveries since each order taken by mail or telephone is processed individually.

Direct sales costs at transit-operated outlets and at headquarters for direct mail and telephone order programs are a function of the number of sales transactions. The only sales costs recognized for public and private sales outlets (including employer programs) are the expenses incurred in sales commissions. This does not imply that there are no other costs involved in these activities, but simply that these costs are not borne by the transit company. Similarly, there is no cost for recording individual sales transactions at public and private outlets since this function is performed at the outlets at no extra cost to the transit company.

Finally, the costs of some functional activities (e.g., design, printing, and inventory) are incurred irrespective of the sales distribution method used. That is, these costs are independent of the alternative distribution systems. Overhead costs are computed separately for transit-operated outlets since the rent and supplies for this space are usually independent of the transit company's headquarter offices.

The analytical framework presented in Table 2-3 is expanded and described in detail in subsequent chapters. The transaction oriented costs are analyzed first in Chapter 3, followed by an analysis in Chapter 4 of all eight non-transaction oriented costs. In addition, separate parametric cost equations are developed for each of the functional activities that have been described in this chapter. Table 2-3, therefore, provides a "route map" of the analytical steps or "building blocks" taken in the next two chapters in this analysis of the full costs of operating fare prepayment programs.

Table 2-3

KEY VARIABLES AFFECTING COSTS BY FUNCTIONAL ACTIVITY AND SALES DISTRIBUTION METHOD

	Cost Category and Functional Activity		Cost Elements	SALES DISTRIBUTION METHODS				
				Transit-Operated Sales Outlets	Public/Private Sales Outlets	Direct Mail Programs	Telephone Order Programs	On-Board Pass Sales
TRANSACTION ORIENTED COSTS	ORDER PREPARATION	Sales Outlets	Labor Equipment	Per Outlet Served				
		On-Board Sales	Labor					Per Day Issued
	ORDER DELIVERY	Staff Delivery	Labor Vehicles	Per Outlet Served				
		Courier Delivery	Courier Service	Per Outlet Package				
		Certified Mail Delivery	Postal Service	Per Outlet Package				
	DIRECT SALES	Transit-Operated Outlets	Labor	Per Transaction				
		Public/Private Outlets	Commissions		Per Revenue Dollar			
		Direct Mail Programs	Labor Materials			Per Transaction		
		Telephone Order Programs	Labor Materials				Per Transaction	
	RECORDING AND ACCOUNTING	Recording Sales	Labor	Per Transaction		Per Transaction		
		Accounting Sales	Labor	Per Transaction				
		Accounting On-Board Sales	Labor					Per Day Issued
NON-TRANSACTION ORIENTED COSTS	DESIGN		Design Service	Per Design Change				
	PRINTING		Printing Service	Per Unit of Volume Printed				
	INVENTORY		Storage	Per Unit of Volume Stored				
	MISCELLANEOUS HANDLING		Labor Equipment	Per Instrument Handled				
	ADVERTISING		Labor Media	Per Instrument Advertised				
	ADMINISTRATION		Labor	Per Program Size Category				
	GENERAL OVERHEAD	Transit-Operated Outlets	Labor	Per Dollar of Labor				
		Headquarters	Labor	Per Dollar of Labor				
	COST OF FUNDS		Interest		Per Day of Delay			

3

TRANSACTION ORIENTED COSTS

3

TRANSACTION ORIENTED COSTS

INTRODUCTION

The most costly functions associated with the operation of transit fare prepayment programs are those that require direct labor involvement. Most of these labor intensive functions happen to be related directly to either the number (or volume) of fare prepayment sales or the number of sales outlets served. As the volume of prepayment sales transactions increases so do operating costs. Thus, these functions incur transaction oriented costs.

The most obvious transaction oriented function is the actual over-the-counter sales activity at transit-operated outlets. Since each sales transaction takes a certain period of time, the labor requirements (and thus the costs) for operating an outlet are directly related to the sales volume. As shown later, the average labor requirement for prepayment sales decreases as total sales volume increases. Thus, there are economies of scale in this transaction oriented function.

This chapter describes the cost behavior of four transaction oriented functions. The overall cost categories presented in this chapter include:

- order preparation costs, or the costs incurred when preparing orders for on-board sales and for sales at public, private, and employer outlets;
- order delivery costs, or the costs incurred when delivering orders from the transit authority's headquarters to each of the sales outlets;

- direct sales costs, or the costs incurred in selling fare prepayment plans directly to individuals; and

- recording and accounting costs, or the costs incurred when recording, accounting, and reconciling all fare prepayment sales.

Each overall cost category is analyzed by functional activity since several independent activities can be performed by a transit system within each cost category. The analysis of delivery costs, for example, includes discussions of the costs incurred if staff make the deliveries, if courier service is employed, and if the U.S. Postal Service is used. For each functional activity, therefore, labor and equipment requirements are analyzed and independent cost equations are developed. Table 3-1 presents a guide to this chapter identifying the four overall cost categories, each functional activity analyzed, and the cost elements of each activity. A parametric cost equation is developed for each cost element. The symbols and equation numbers for these cost formulas are also presented in Table 3-1.

Figure 3-1 illustrates the sequence followed in this chapter for analyzing transaction oriented costs, starting with order preparation costs and ending with accounting costs. This figure reappears in this chapter at the beginning of the analysis of each overall cost category to help the reader see each activity in its place as part of this comprehensive cost analysis. The particular cost category being discussed in each section of the chapter is highlighted on the figure.

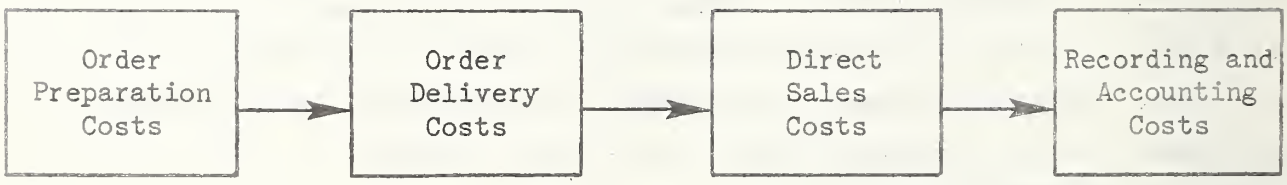


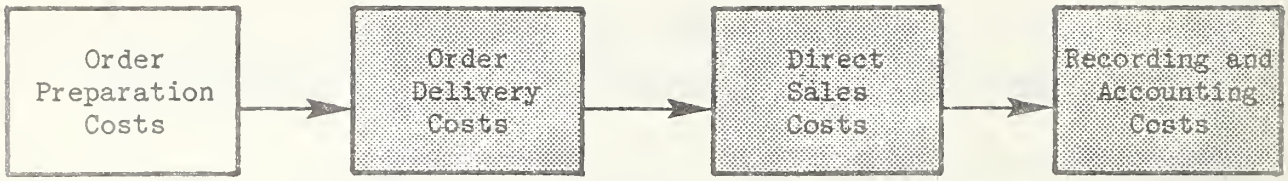
Figure 3-1: SEQUENCE FOLLOWED FOR ANALYZING TRANSACTION ORIENTED COSTS

Table 3-1

COST ELEMENT STRUCTURE FOR CHAPTER 3: TRANSACTION ORIENTED COSTS

Overall Cost Category	Functional Activity	Cost Elements	Parametric Equations	
			Symbol	Equation No.
Order Preparation Costs	sales at outlets	labor	L_{op}	(3.1)
		equipment	E_{op}	(3.2)
	on-board sales	labor	L_{pp}	(3.3)
Order Delivery Costs	staff delivery	labor	L_d	(3.5)
		vehicles	V_d	(3.6)
	courier delivery	courier service	C_{cs}	(3.7)
	postal service delivery	postal service	C_{cm}	(3.8)
Direct Sales Costs	sales at transit-operated outlets	labor	L_s	(3.11)
		percent commissions	SC_p	(3.12a)
	sales at public and private outlets	fixed rate commission	SC_r	(3.13a)
	direct mail sales	labor	L_{dm}	(3.14)
		materials	MC_{dm}	(3.15)
	telephone sales	labor	L_{tel}	(3.16)
		materials	MC_{tel}	(3.17)
Recording and Accounting Costs	recording sales at outlets and headquarters	labor	L_r	(3.21)
	accounting for sales at outlets and at headquarters	labor	L_a	(3.22)
	accounting for on-board sales	labor	L_{ap}	(3.23)

ORDER PREPARATION COSTS



Description of Activities

The first major operating task in any fare prepayment program is preparing a new supply of fare prepayment instruments for distribution to sales agents. The sales agent may be a bank teller at a public over-the-counter outlet or a bus driver selling day passes on board. In either case, the appropriate number of fare prepayment instruments must be assembled for distribution to the point of sale.

Order preparation costs can be divided into two categories:

- costs associated with over-the-counter and employer-distributed sales, and
- costs associated with on-board sales.

All of the case sites included in this cost study sell fare prepayment plans through transit-operated, public, private, and employer outlets. The preparation activity consists of preparing packages containing a new supply of instruments for distribution to the outlets where they will later be sold directly to the public. Although the activities involved in preparing orders for each outlet vary by site, the principal activities include:

- determining and assembling the appropriate number of each fare prepayment plan for each outlet,
- preparing invoices for each outlet, and
- packaging the plans for distribution to the outlets.

All of the above activities are usually performed by a fare clerk on a per outlet basis. When determining how many instruments of each fare type to package, most clerks rely on past sales data from the outlets. As a general rule,

each outlet is then provided with 20 to 30 percent more instruments than are expected to be sold. Occasionally, clerks will wait until an outlet requests additional instruments and prepare an order based on this request. Invoicing is generally straightforward since most transit systems provide plans to their outlets on a consignment basis.

In addition to over-the-counter sales of fare prepayment, three of the eleven sites have their drivers sell day passes on board the transit vehicle. Although the Sacramento day pass is sold every day of the week, passes in Tucson, St. Paul, and Seattle, are sold only on weekends.

Day passes in most systems are similar to transfers. They are thin strips of paper issued at the time of boarding. As many as 150 passes are contained in each pad. The pads are issued to the drivers at the beginning of each driver run by the dispatcher or a fare clerk. The preparation cost, therefore, depends on the amount of time it takes for a dispatcher to take the pads out of inventory and issue them to the drivers. The entire process takes between 10 and 30 minutes to perform each day passes are sold.

Order Preparation Costs For Sales at Outlets

Order preparation costs include both labor and some equipment costs. The labor requirements in preparing orders for delivery to sales outlets are discussed first.

Labor Requirements, Wages and Costs

The monthly labor requirements for each case site are presented in Table 3-2. In addition, this table presents data which attempt to explain the variation in the labor requirements by site. Unfortunately, the volume supplied per outlet preparation and the number of plan types included in each order do not explain all the variation. Although one would expect, for example, that large orders would require more time to prepare for distribution than small orders, this cannot be verified from the limited data base. Similarly, the number of plan types that can be included in an order (i.e., the complexity of the order) does not affect preparation time. As shown in Table 3-2, Tucson, Richmond, and Philadelphia provide evidence that it is difficult to make generalizations on the influence of volumes on costs.

Table 3-2

MONTHLY LABOR REQUIREMENTS FOR PREPARING ORDERS FOR DELIVERY TO PUBLIC AND PRIVATE OUTLETS

Transit Company	Total Man Hours Per Month	No. of Outlet Preparations Per Month	No. of Instruments Supplied Per Outlet Preparation[a]	No. of Plan Types	Man Hours Per Outlet
Seattle	207	151	485	8	1.37
Los Angeles	303	247	1,353	22	1.23
Tucson[b]	2	2	1,508	4	1.00
Cincinnati	23	39	71	1	0.59[c]
Portland	65	112	555	10	0.58
Sacramento	44	119	170	4	0.37
St. Paul	160	476	138	13	0.34
Tucson	16	58	89	4	0.28
Wilmington	5	25	979[d]	8	0.20
Richmond	29	173	216	5	0.17
Norfolk	21	177	52	13	0.12
Philadelphia	45	403	625	6	0.11

[a]Computed by multiplying the number of sales transactions by 1.26 (the average over-issue rate in Sacramento).

[b]For demonstration program only; data are per semester and not per month.

[c]Cincinnati's high labor requirement is due to the fact that tokens must be wrapped before distribution to outlets.

[d]Wilmington's very high volume per outlet is due to the fact that five of the outlets served are banks which in turn deliver to some 70 branches. Ninety-five percent of sales occur through these bank outlets.

The labor requirement for preparing orders for distribution to outlets, therefore, may have more to do with the procedures followed in preparing each order than on the size of the order. In Cincinnati, for example, loose tokens must be wrapped before they are placed in sacks. This activity alone accounts for 95 percent of order preparation time. Some transit companies require that the contents of each order be carefully accounted (i.e., noting serial numbers) before distribution to the outlet. Other systems provide bulk quantities to their outlets and allow them to do the accounting.

The labor requirements for order preparation can be standardized by the degree of labor involvement as shown in Table 3-3.

Table 3-3

STANDARDIZED LABOR REQUIREMENTS
PER OUTLET ORDER PREPARATION

Labor Requirements	MAN HOURS PER OUTLET ORDER PREPARATION	
	Normal Range	Standardized Value (MH_{op})
Exceptionally High	0.60 - 1.40	1.00
High	0.30 - 0.60	0.45
Normal	0.20 - 0.30	0.25
Low	0.10 - 0.20	0.15

Therefore, the monthly labor cost for preparing orders for delivery to sales outlets can be estimated from the following cost formula:

(3.1) $$L_{op} = (N_{op})(MH_{op})(W_{op})(1 + F_r)$$

where:

L_{op} = monthly labor cost (dollars) for preparing orders for delivery to sales outlets

N_{op} = number of outlet preparations per month

MH_{op} = {
- 1.00 hours per outlet preparation where the labor requirements are exceptionally high
- 0.45 hours per outlet preparation where the labor requirements are high
- 0.25 hours per outlet preparation where the labor requirements are normal
- 0.15 hours per outlet preparation where the labor requirements are low

W_{op} = average hourly wage rate for fare clerks

F_r = fringe benefit rate

Table 3-4 presents the actual 1981 monthly labor costs for this activity at each case site. The fringe benefit rates and average hourly wage rates for the personnel involved in order preparation are also presented in the table.

Equipment Requirements and Costs

Capital equipment is rarely used by transit operators when preparing orders for delivery to sales outlets. Only two of the eleven sites use machines in the order preparation process. The Sacramento Regional Transit employs a pass counter machine when preparing passes for distribution and Cincinnati's Queen City Metro uses three token wrapping machines in its prepayment program.[1] The full replacement and maintenance costs for these machines are summarized below in Table 3-5. Monthly equipment costs can then be given as:

$$(3.2) \qquad E_{op} = (E_c)(N_c) + (E_w)(N_w) = 105.53\ (N_c) + 100.44\ (N_w)$$

where:

E_{op} = monthly equipment cost (dollars) for order preparation

E_c = monthly equivalent cost per pass counter (1981 cost is $105.53 according to Table 3-5)

N_c = number of pass counter machines employed

E_w = monthly equivalent cost per token wrapping machine (1981 cost is $100.44 according to Table 3-5)

N_w = number of token wrapping machines employed

[1]Token wrapping machines are also employed in Philadelphia, St. Paul, and Sacramento, but cost data were not available.

Table 3-4

MONTHLY LABOR COSTS FOR PREPARING ORDERS
FOR DELIVERY TO PUBLIC AND PRIVATE OUTLETS - 1981

Transit Company	Number of Individuals Involved	Man Hours Per Month	Average Hourly Wage Rate	Fringe Benefit Rate[a] (Percent)	Monthly Labor Costs
Los Angeles	2	303	$10.00	46.7	$4,445
Philadelphia	2	45	8.88	36.1	544
St. Paul	3	160	8.77	33.2	1,869
Seattle	3	207	12.12	35.7	3,405
Cincinnati	1	23	7.21	38.7	230
Portland	2	65	11.30	33.0[b]	977
Norfolk	1	21	5.29	29.0	143
Sacramento	2	44	7.83	43.4	494
Richmond	1	29	5.05	31.1	192
Wilmington	1	5	6.73	40.6	47
Tucson	1	16	5.85	30.5	122
Tucson - Demo[c]	1	2	14.30	30.5	11

[a]Agency fringe benefit rates computed from: Transportation Systems Center, National Urban Mass Transportation Statistics First Annual Report, Section 15 Reporting System, prepared for the Urban Mass Transportation Administration, Washington, D.C., May 1981, pp. 2-46 through 2-57.

[b]Obtained from interviews with Tri-Met officials.

[c]Man hour requirements are per semester and not per month; costs, however, are monthly labor costs.

Table 3-5

ORDER PREPARATION EQUIPMENT COSTS - 1981

Transit Company	Equipment Type	Replacement Cost	Number Employed	Service Life	Monthly Capital Cost[a]	Monthly Maintenance Cost	Total Monthly Cost[b]
Sacramento	Pass Counter	$3,700	1	5 years	$85.53	$20.00	$106
Cincinnati	Token Wrapper	$3,000	3	20 years	$33.48	Negl.	$100

[a]One-time equipment acquisition costs are converted into equivalent annual (and subsequently monthly) costs using a capital recovery factor based on the service life and an interest rate of 12 percent.

[b]Computed as [(Unit Monthly Capital Cost)(Number of Units) + (Average Monthly Maintenance Cost)].

Order Preparation Costs for On-Board Pass Sales

Only labor costs are incurred in preparing orders for on-board pass sales. The labor required for preparing passes for driver pick-up varies between 10 and 30 minutes per day of pass sales. The labor requirements for three of the four companies that sell passes on board vehicles are presented below in Table 3-6.

Table 3-6

LABOR REQUIREMENTS FOR PREPARING ON-BOARD SALES

Transit Company	Type of Plan	No. of Days Per Month Passes Sold	Man Hours Per Month	Preparation Time Per Day (Hours)
St. Paul	Weekend Day Pass	8.66	4.33	0.500
Tucson	Weekend Day Pass	8.66	4.29	0.495
Sacramento	Day Pass	30.31	5.05	0.167

As shown in the above table, weekend day pass programs require more preparation time each day than a daily pass program. The only explanation for this difference is the sales frequency; that is, Sacramento's daily pass program may be more efficient because it is operated every day of the week instead of only on weekends. Nevertheless, the difference of twenty minutes per day is minor in comparison to other activities.

The labor cost equation can then be represented as:

$$(3.3) \qquad L_{pp} = (N_d)(MH_{pp})(W_{pp})(1 + F_r)$$

where:

L_{pp} = monthly labor cost (dollars) for preparing day passes for on-board sales

N_d = number of days per month day passes are sold

MH_{pp} = $\begin{cases} 0.50 \text{ hours per day where the labor requirements are } \underline{\text{high}} \\ 0.33 \text{ hours per day where the labor requirements are } \underline{\text{normal}} \\ 0.15 \text{ hours per day where the labor requirements are } \underline{\text{low}} \end{cases}$

W_{pp} = average hourly wage rate for fare clerk or dispatcher

F_r = fringe benefit rate (ratio of fringe benefits to wages)

The labor costs for the four companies selling day passes on board the bus are shown in Table 3-7 below. These companies do not use any equipment when preparing day passes for driver pick-up.

Table 3-7

MONTHLY LABOR COSTS FOR PREPARING ON-BOARD SALES - 1981

Transit Company	Number of Individuals Involved	Man Hours Per Month	Average Hourly Wage Rate	Fringe Benefit Rate (Percent)	Monthly Labor Cost
St. Paul	1	4.33	$ 8.77	33.2	$51
Seattle	1	4.33[a]	10.72	35.7	63
Sacramento	1	5.05	13.27	43.4	96
Tucson	1	4.29	6.92	30.5	39

[a]Actual labor requirement not known; value given based on standardized value for high labor requirement as given in equation (3.3).

Complete Order Preparation Cost Equation

The total monthly operating cost associated with the preparation of orders for eventual sales at public, private, and employer outlets, as well as for on-board sales, is given by the following equation:

(3.4) $$C_{op} = L_{op} + E_{op} + L_{pp}$$

where:

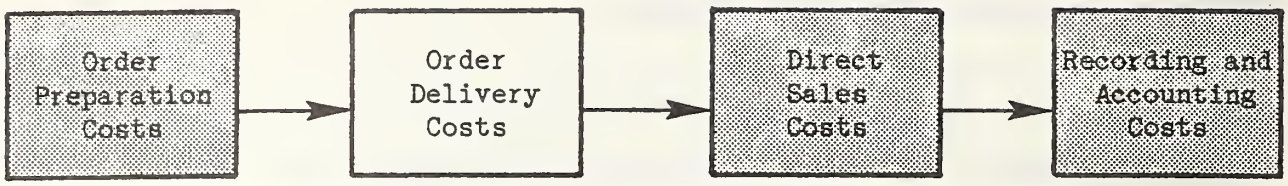
C_{op} = total monthly operating cost (dollars) associated with the preparation of orders for delivery to all sales outlets

L_{op} = monthly labor cost for order preparation for outlets as given in equation (3.1)

E_{op} = monthly capital cost for order preparation for outlets as given in equation (3.2)

L_{pp} = monthly labor cost for order preparation for on-board sales as given in equation (3.3)

If on-board sales of day passes are not part of the fare prepayment program, the total order preparation cost is simply the sum of L_{op} and E_{op}.



Description of Activities

All of the transit companies analyzed as part of this study sell fare prepayment plans through transit-operated, public, or private sales outlets. Transit-operated outlets are staffed by transit company personnel who sell directly to the general public. Public outlets also cater directly to the general public and include banks, department stores, and other retail businesses. Private sales outlets, however, sell fare prepayment plans only to their own clients or employees. Private outlets include social service agencies, schools, hospitals, and places of employment. Whichever outlets are used, it is necessary for the transit operator to arrange for the plans to be delivered. Three modes of delivering plans to outlets are used by the transit companies investigated in this study. These include:

- transit staff delivery
- courier delivery, and
- certified mail delivery

In addition, a transit company can choose to use a third-party contractor for the distribution, sales, and accounting of all fare prepayment sales to the public. Although none of the sites investigated used a third-party contractor at the time of the interviews, Portland's Tri-Met has subsequently contracted with the Seven-Eleven food store chain to provide this service. Cost data on this operation are not presented in this chapter but are included in the trade-off analysis in Chapter 5.

The first option available to a transit company for the delivery of fare prepayment plans to sales outlets is to have a staff member or members personally make the deliveries in a transit-owned vehicle. Nearly all of the transit companies investigated use this method, if not for all outlets, for at least

those outlets with the greatest sales volume. Several transit companies incorporate this function with other servicing tasks. For example, SEPTA in Philadelphia delivers fare prepayment plans in an armored truck to 17 of its outlets when cash fares are collected from bus depots for transfer to the bank. Other transit companies combine fare prepayment delivery with the delivery of schedules and other passenger information aids.

The most efficient operations utilize a single person per vehicle for the delivery of fare prepayment plans. As the volume of sales (and thus the retail sales value) increases, the greater the risk for theft. Consequently, larger transit companies will generally request that two fare agents be in each delivery vehicle.

When estimating the labor requirements for delivery to outlets, it is important to remember that most fare prepayment programs involve monthly pass plans which must be delivered to all outlets by the third week of each month. Staff and vehicle time, therefore, may not be spread out evenly over the month but rather concentrated during a one-to-two week period.

An alternative to staff delivery of fare prepayment plans is a professional courier delivery service. Use of courier service may be ideal for programs just beginning because it provides flexibility to handle unexpected changes in demand. In addition, courier service eliminates the need for staff and vehicle time spent on this activity. Transit personnel can thus be used more effectively for other tasks. This service provides same day pick-up and delivery.

The U.S. Postal Service can also be used for the delivery of fare prepayment plans to sales outlets. Several transit systems use the Postal Service for delivery to low-volume outlets where the cost to personally service these outlets would be prohibitive. All of the systems that use this service send their packages first class, certified mail.

A problem with both courier service and the U.S. Mail is the limited insurance available. The Postal Service, for example, provides a maximum insurance of $400 per parcel which is inadequate for most transit companies with high volume outlets. For adequate coverage when using a courier service, it may be necessary to obtain a separate insurance policy. SEPTA in Philadelphia, the only system included in this investigation that employs a courier service for the delivery of fare prepayment plans, does not have a separate insurance policy because passes are not validated (i.e., passes have no retail value at time of delivery) until the time of sale.

Transit Staff Delivery Costs

Both labor and capital equipment costs are incurred in delivery operations using transit company staff. The labor requirements and costs are discussed first.

Labor Requirements, Wages, and Costs

The labor requirements for delivering fare prepayment plans to sales outlets are presented in Table 3-8. Notice that staff delivery times per outlet decrease with city size and distance between outlets. Seattle is low on the scale because the 25 outlets serviced by staff are all located in the downtown area requiring only three hours of delivery time. Portland is high on the scale because staff deliver plans to all 109 outlets, some located 18 miles from downtown Portland. Thus, the further one must travel through the city, the longer it will take to service each outlet. In addition, the processing and servicing requirements at each outlet vary by site. For example, Tucson's labor requirement is high due to the recording requirements of the demonstration program. However, for estimating the labor (and vehicle) requirements for servicing sales outlets, the density and radius of the service area appear to be significant indicators. Categorizing the areas served into high- and low-density sites, the per outlet delivery time can be estimated from the standardized classification presented in Table 3-9.

Table 3-9

STANDARDIZED CLASSIFICATION OF STAFF DELIVERY LABOR REQUIREMENTS

Size of Service Area	Radius of Service Area (Miles)	DELIVERY TIME (MINUTES) PER OUTLET	
		Normal Range	Standardized Value (D_t)
HIGH DENSITY SITES			
Large	10 - 15	more than 35	40
Medium	7 - 10	25 - 35	30
Small	5 - 7	14 - 25	20
Very Small	less than 5	less than 14	0
LOW DENSITY SITES			
Very Large	18 - 25	more than 40	50
Large	15 - 18	30 - 40	35
Medium	10 - 15	20 - 30	25
Small	less than 10	5 - 20	10

TABLE 3-8

STAFF DELIVERY LABOR REQUIREMENTS

Transit Company	Number of Outlets Served By Staff	Number of Outlet Deliveries Per Month	Monthly Vehicle Hours	Monthly Vehicle Miles	Average Speed (Mi/Hr)	Esti. Radius Served (Miles)	Persons Per Vehicle	Delivery Time Per Outlet (Min/Outlet)
Tucson[a]	2	2	2	11	5.50	5	1	60.0
Portland	109	112	108	1,360	12.59	18	1	57.9[b]
Los Angeles	246	246	160	1,000	6.25	22	1	39.0
Philadelphia	17	74	43	129[c]	3.00[d]	11	3	34.9
St. Paul	17	32	17	68[c]	4.00[d]	8	1	31.9
Sacramento	106	106	53[d]	408[e]	7.70	11	1	30.0
Richmond	40	173	75	600[c]	8.00[d]	12	2	26.0
Norfolk	40	173	65	390[c]	6.00[d]	10	1	22.5
Cincinnati	9	39	9	26	2.89	5	2	13.8
Seattle	25	25	4	16[c]	4.00[d]	4	2	9.6
Wilmington	25	25	3	24[c]	8.00[d]	4	1	7.2

[a]Data for demonstration program are per semester (3.5 months) and not per month.

[b]Very high delivery cost due to size of area covered and as well as possible inefficiencies in operation.

[c]Monthly vehicle miles based on actual vehicle hours and estimated vehicle average speeds.

[d]Estimated average vehicle speeds based on density of area covered.

[e]Vehicle hour and mileage estimates include transportation of sales agents to schools (non-outlets) for selling student photographic identity cards.

The monthly labor costs associated with the delivery of fare prepayment plans to sales outlets can be estimated from the following equation:

$$(3.5) \qquad L_d = (1/60)(N_o)(D_t)(W_d)(1 + F_r)(N_e)$$

where:

L_d = monthly labor cost (dollars) of delivering fare prepayment plans to sales outlets

N_o = number of outlet deliveries per month

D_t =
- 40 minutes per outlet in high density sites where the radius of the area served is greater than 10 miles
- 30 minutes per outlet in high density sites where the radius of the area served is between 7 and 10 miles
- 20 minutes per outlet in high density sites where the radius of the area served is between 5 and 7 miles
- 10 minutes per outlet in high density sites where the radius of the area served is less than 5 miles

or

- 50 minutes per outlet in low density sites where the radius of the area served is greater than 18 miles
- 35 minutes per outlet in low density sites where the radius of the area served is between 15 and 18 miles
- 25 minutes per outlet in low density sites where the radius of the area served is between 10 and 15 miles
- 10 minutes per outlet in low density sites where the radius of the area served is less than 10 miles

W_d = average hourly wage rate for the delivery of fare prepayment plans to sales outlets

F_r = fringe benefit rate

N_e = number of employees per vehicle

Table 3-10 presents the actual 1981 hourly wage rates and monthly labor costs for each site using staff for the delivery of fare prepayment plans to sales outlets. The fringe benefit rates presented in this table and in all subsequent tables were obtained from the statistics presented in the first annual report of the Section 15 reporting system.[1]

[1]Transportation Systems Center, National Urban Mass Transportation Statistics First Annual Report, Section 15 Reporting System, prepared for the Urban Mass Transportation Administration, Washington, D.C., May 1981.

Table 3-10

MONTHLY LABOR COSTS FOR STAFF DELIVERY - 1981

Transit Company	Number of Individuals Involved	Man Hours Per Month	Average Hourly Wage Rate	Fringe Benefit Rate (Percent)	Monthly Labor Cost
Los Angeles	1	160	$10.00	46.7	$2,347
Philadelphia	3	129	8.37	36.1	1,470
St. Paul	1	17	8.92	33.2	202
Seattle	2	8	8.00	35.7	87
Cincinnati	2	18	7.21	38.7	180
Portland	1	108	11.30	33.0	1,623
Norfolk	1	65	5.29	29.0	444
Sacramento	1	53	7.41	43.4	563
Richmond	2	150	3.97	31.1	781
Wilmington	1	3	6.73	40.6	28
Tucson	1	2[a]	14.30	30.5	11

[a]Man hour requirements are per semester and not per month; costs, however, are monthly labor costs.

Vehicle Requirements and Costs

Half of the transit systems interviewed in this study use vans to transport fare prepayment plans to sales outlets; the other half use large or intermediate size automobiles. In Philadelphia, however, deliveries are made in an armor-plated truck as cash fares are being transferred from bus depots to the Authority's bank for deposit. Table 3-11 presents the vehicle category used at each site and the full costs attributable to the delivery of fare prepayment plans.

The cost estimates presented in this table are based on the vehicle's first year's ownership and operating costs. Thus, the costs correspond to those of new vehicles. Monthly fixed ownership costs and per mile operating cost for four vehicle categories are shown in Table 3-12.

Table 3-11

VEHICLE REQUIREMENTS AND COSTS - 1981

Transit Company	Vehicle Category[a]	No. of Vehicles Used	Proportion Used For Delivery (Percent)	Monthly Miles Driven	Monthly Ownership Cost[b]	Monthly Operating Cost[b]	Total Monthly Cost
Los Angeles	Standard	2	50	1,000	$305.63	$100.10	$406
Philadelphia	Van	1	25	129	136.20	16.38	153
St. Paul	Compact	1	10	68	19.29	6.08	25
Seattle	Van	1	2	16	10.90	2.03	13
Cincinnati	Van	1	2	26	10.90	3.30	14
Portland	Standard	2	100	1,360	611.26	136.00	747
Norfolk	Van	1	50	390	272.40	49.53	322
Sacramento	Van	1	25	408	136.20	51.82	188
Richmond	Van	1	14	600	76.27	76.20	152
Wilmington	Standard	1	2	24	6.11	2.40	9
Tucson	Standard	1	1	3	3.06	0.30	3

[a]Vehicles actually used have been categorized as follows:
Passenger Van - empty weight less than 5,000 lbs.
Standard - empty weight less than 4,000 lbs.
Compact - empty weight less than 3,000 lbs.
Subcompact - empty weight less than 2,500 lbs.

[b]See Table 3-12 for ownership and operating cost data.

Table 3-12

MONTHLY OWNERSHIP AND OPERATING COSTS - 1981[a]

Vehicle Category	Monthly Ownership Cost	Operating Cost Per Mile (Cents)
Van	$544.79	12.74
Standard	305.63	10.01
Compact	192.87	8.94
Subcompact	138.49	7.59

[a]Ownership and operating costs were inflated to 1981 pricing using the consumer price indices (CPI) for private transportation. The CPI series used include: 1967=100; 1979=212.3; July 1981 = 276.1. See "CPI Detailed Report" for appropriate years, U.S. Bureau of Labor Statistics, Department of Labor.

Source: Federal Highway Administration, "Cost of Owning and Operating Automobiles and Vans, 1979", U.S. Government Printing Office, 1980.

For simplicity, a parametric equation can be provided which will estimate monthly total ownership and operating costs based on a rate per mile. Ownership costs can be assigned on a per mile basis if the vehicle is assumed to have a fixed economic life and be driven a set distance per year. In the Federal Highway Administration (FHWA) report referred to above, a normal travel pattern has been set at 14,500 miles in the first year of operation with an assumed 10-year life. Based on these assumptions, the total monthly vehicle cost for the delivery of fare prepayment plans can be estimated from the following equation:

$$V_d = (M_d)(MR) \quad (3.6)$$

where:

V_d = monthly total vehicle cost (dollars) for delivery

M_d = average monthly mileage for delivery

MR = 57.82 cents per mile for a passenger van
35.31 cents per mile for a standard automobile
24.91 cents per mile for a compact automobile
19.05 cents per mile for a subcompact automobile

Courier Delivery Costs

An alternative to the high cost of order delivery by transit staff is to use courier service. SEPTA in Philadelphia is the only transit system interviewed that uses a messenger service. Seventy-five packages are delivered weekly, or a total of 325 deliveries per month. The cost for this service is $5.00 per package or delivery. The total monthly cost to SEPTA, therefore, is $1,625. In contrast, SEPTA's 74 outlet deliveries by staff cost just under $1,600 per month.

A study performed by an independent consultant for Tri-Met in Portland[1] provided information on the costs of courier delivery service in that city. The cost estimates from the Purolator Courier Corporation -- the same company servicing SEPTA in Philadelphia -- are shown below in Table 3-13.

Table 3-13

PROPOSED DELIVERY COSTS PER PACKAGE IN PORTLAND - 1981[a]

Number of Packages	Unit Cost
2 - 5	$5.50
6 - 10	$4.37
11 - 49	$3.23
over 50	$2.67

[a]Tom Godfrey's 1980 prices are inflated by a factor of 13.49 percent based on the CPI for transportation between May 1980 and July 1981. See "CPI Detailed Report," U.S. Department of Labor, Bureau of Labor Statistics for the month in question.

As discussed earlier, Purolator reportedly has extremely limited insurance coverage for its local messenger service. An independent insurance company said it would be willing to cover Tri-Mets' interest in this type of program, up to a limit of $20,000 with a $1,000 deductible, for a $350 annual premium (or $29.17 per month).[2] Using this information, the courier service cost equation is:

[1]Tom Godfrey. "Fare Sales Outlet Feasibility Study." An independent marketing study prepared for Tri-Met, May 5, 1980.

[2]Tom Godfrey (1980), p. 55.

(3.7) $C_{cs} = (N_{cd})(N_s)(CR) + (CI)$

where:

C_{cs} = monthly cost (dollars) for courier service

N_{cd} = number of carrier deliveries per month

N_s = number of outlet stops per delivery

$CR = \begin{cases} \$5.50 \text{ each for 2-5 outlet stops} \\ \$4.37 \text{ each for 6-10 outlet stops} \\ \$3.23 \text{ each for 11-49 outlet stops} \\ \$2.67 \text{ each for over 50 outlet stops} \end{cases}$

CI = monthly equivalent insurance premium for courier service. The 1981 monthly equivalent premium in Portland is \$33.46[1]

Postal Service Delivery Costs

A final alternative to staff delivery of fare prepayment plans to sales outlets is the U.S. Postal Service. Specifically, the U.S. Postal Service can provide economical service for the delivery of pass plans to low volume outlets. Ticket books are generally too heavy to make this distribution mode economically attractive and tokens are much too heavy to be sent through the mail.

Four of the eleven transit companies reviewed here use the U.S. Postal Service for the delivery of fare prepayment plans to sales outlets. All four send only monthly passes through the mail and all packages are sent certified mail. None of the companies pay an additional fee for insuring the packages.

The U.S. Postal Service rates for certified mail are as follows:

\$0.75 - fee in addition to postage
0.60 - additional for return receipt
\$1.35 - certified mail with return receipt

Additional fees for insuring mail are shown below in Table 3-14. Note that the Postal Service liability for insured mail is limited to \$400.

[1]1980 monthly equivalent premium is inflated by a factor of 14.71 percent based on the CPI for all services between May 1980 and July 1981. See "CPI Detailed Report," U.S. Department of Labor, Bureau of Labor Statistics for the month in question.

Table 3-14

INSURED MAIL FEE SCHEDULE - 1981

Liability	Fee
$ 0.01 - $ 20.00	$0.45
20.01 - 50.00	0.85
50.01 - 100.00	1.25
100.01 - 150.00	1.70
150.01 - 200.00	2.05
200.01 - 300.00	3.45
300.01 - 400.00	4.70

Estimates of the weights of packages containing various quantities of passes (monthly or weekly) and 10-trip ticket books are presented in Table 3-15. Total package weights are based on 100 passes weighing 5 ounces, 10 books of 10-trip tickets weighing 1.5 ounces, and envelope and invoice weights varying by envelope size from 1.5 to 8.5 ounces. This weight schedule should be accurate for most fare prepayment programs. Passes with special coatings or with photographs, and tickets of a heavier stock obviously weigh more and this schedule should be adjusted accordingly.

The cost to mail passes and tickets of the quantities shown in Table 3-15 are presented in Table 3-16. One cost item missing from this table is the cost of insurance. Since the maximum liability of insured mail is only $400, only 20 monthly passes valued at $20 each could be sent per mail package. As with courier service, a transit manager may opt for separate liability coverage if more than $400 worth of passes are sent to any one outlet.

Another item missing from Table 3-16 is the cost of each mailing envelope. Depending on size, these envelopes can cost between 18 and 56 cents each. The monthly cost for delivering packages to sales outlets by the U.S. Postal Service is a function of the number of outlets, the number of fare prepayment instruments delivered to each outlet, and the type of fare prepayment plan (i.e., pass or ticket book as shown here).

Table 3-15

ESTIMATED PACKAGE WEIGHTS BY PACKAGE SIZE AND TYPE OF FARE PREPAYMENT PLAN

Quantity Per Package	Weight of Contents (ounces)	Weight of Envelope & Invoice (ounces)	Total Weight of Package (ounces)
Passes			
less than 10	0 - 0.5	2.5	2.5 - 3.0
10 - 50	0.5 - 2.5	2.5	3.0 - 5.0
51 - 100	2.5 - 5.0	2.5	5.0 - 7.5
101 - 200	5.0 - 10.0	4.5	9.5 - 14.5
201 - 500	10.0 - 25.0	4.5	14.5 - 29.5
501 - 1000	25.0 - 50.0	8.5	33.5 - 58.5
Ticket Books			
less than 10	0 - 1.5	2.5	2.5 - 4.0
10 - 50	1.5 - 7.5	2.5	4.0 - 10.0
51 - 100	7.5 - 15.0	4.5	12.0 - 19.5
101 - 200	15.0 - 30.0	4.5	19.5 - 34.5
201 - 500	30.0 - 75.0	8.5	38.5 - 83.5

Table 3-16

ESTIMATED POSTAGE COST PER PACKAGE SENT CERTIFIED MAIL - 1981

Quantity Per Package	1st Class Postage (Mean Value)	Certified Mail	Subtotal Cost	Return Receipt	Total Cost
Passes					
less than 10	$0.52	$0.75	$1.27	$0.60	$1.87
10 - 50	0.86	0.75	1.61	0.60	2.21
51 - 100	1.20	0.75	1.95	0.60	2.55
101 - 200	2.22	0.75	2.97	0.60	3.57
201 - 500	2.22	0.75	2.97	0.60	3.57
501 - 1000	2.89	0.75	3.64	0.60	4.24
Ticket Books					
less than 10	0.69	0.75	1.44	0.60	2.04
10 - 50	1.37	0.75	2.12	0.60	2.72
51 - 100	2.22	0.75	2.97	0.60	3.57
101 - 200	2.40	0.75	3.15	0.60	3.75
201 - 500	3.38	0.75	4.13	0.60	4.73

The monthly cost can be represented, therefore, by the following expression:

$$(3.8) \qquad C_{cm} = \sum_{i=1}^{N_{cm}} (C_{ei} + C_{pi} + C_c + C_r)$$

where:

C_{cm} = monthly cost (dollars) to send fare prepayment instruments to sales outlets by U.S. Postal Service

N_{cm} = total number of packages mailed each month

C_{ei} = cost of envelope used in mailing to outlet i

C_{pi} = cost of first class postage to mail package to outlet i

C_c = certified mail rate

C_r = return receipt rate

With C_c = \$0.75 and C_r = \$0.60 for each package independent of weight, equation (3.8) thus becomes:

$$(3.9) \qquad C_{cm} = (\$1.35)(N_{cm}) + \sum_{i=1}^{N_{cm}} (C_{ei} + C_{pi})$$

Where the cost of each envelope (C_e) and the first class postage rate (C_p) are based on the schedule presented below in Table 3-17.

Table 3-17

ENVELOPE AND FIRST CLASS MAIL FEE SCHEDULE - 1981

No. of Passes in Package	C_e	C_p	No. of Ticket Books in Package	C_e	C_p
less than 10	\$0.18	\$0.52	less than 10	\$0.18	\$0.69
10 - 50	0.18	0.86	10 - 50	0.18	1.37
51 - 100	0.18	1.20	51 - 100	0.34	2.22
101 - 200	0.34	2.22	101 - 200	0.34	2.40
201 - 500	0.34	2.22	201 - 500	0.56	3.38
501 - 1000	0.56	2.89			

Equation (3.9) appears to provide reasonable estimates of the cost per package as evident by the responses from the case site interviews. Data from the four case sites using certified mail are presented in Table 3-18. Two estimates of the average package cost are presented: one from an official involved in the distribution of fare prepayment at each case site, and the other estimate from equation (3.9). In addition, the total monthly mailing cost for each transit company is presented.

Table 3-18

CERTIFIED MAILING COST BY TRANSIT COMPANY - 1981

Transit Company	Number of Outlets Served Per Month	Number of Instruments Per Package		Estimated Cost Per Package		Total Monthly Cost
		Range	Average	Agency	Equation (3.9)	
St. Paul	435	10-300	68	NA	$2.73	$1,188
Seattle	125	10-500	75[a]	$3.00	2.73	341
Sacramento	12	NA	6	1.75	2.05	25
Tucson	58	NA	86	2.35	2.73	158

[a]Average not known but estimated to be 75.

Complete Order Delivery Cost Equations

The three order delivery modes discussed in this section (i.e., staff delivery, courier delivery, and postal service delivery) can be used together or independently depending on the number of outlets and their locations, and on the types of fare prepayment programs offered. Several sites employ two of the three delivery modes; none, however, employs all three.

In summary, total monthly costs for delivering fare prepayment plans to sales outlets can be estimated from one, or any combination of the following three equations as appropriate.

a) For transit staff delivery to sales outlets:

$$C_{sd} = L_d + V_d \tag{3.10}$$

where:

C_{sd} = total monthly cost (dollars) to distribute fare prepayment plans by staff to sales outlets

L_d = monthly labor cost of staff delivery to sales outlets as given in equation (3.5)

V_d = monthly vehicle cost for staff delivery to sales outlets as given in equation (3.6)

b) For courier delivery to sales outlets:

$$C_{cs} = (N_{cd})(N_s)(CR) + (CI) \tag{3.7}$$

where the parameters have been defined in equation (3.7)

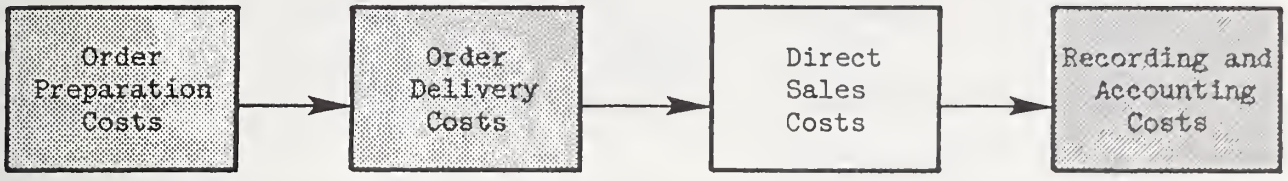
c) For postal service delivery to sales outlets:

$$C_{cm} = \sum_{i=1}^{N_{cm}} (C_{ei} + C_{pi} + C_c + C_r) \tag{3.8}$$

where the parameters have been defined in equation (3.8)

Later in Chapter 5 some guidelines are presented for choosing among these alternative delivery methods.

DIRECT SALES COSTS



Description of Activities

An objective of most fare prepayment programs is to sell as many prepayment instruments as possible. One way of guaranteeing maximum sales is to put in place a network of sales outlets throughout the transit service area so that all transit riders have the opportunity to conveniently purchase fare prepayment plans. These sales outlets can be complemented by the direct sales of prepayment by either mail or telephone order. Unlike order preparation and delivery costs, which are based primarily on the number of outlets served, sales costs are a function of the number of sales transactions. The total costs to the transit company associated with these sales activities are presented in this section.

Fare prepayment sales can occur through sales outlets, on board the transit vehicle, or by telephone and direct mail.[1] Sales outlets can be owned and operated by the transit company or they can be public or private outlets such as banks, department stores, hospitals, social service agencies, schools, and places of employment. Although the sales activity may not be markedly different to the consumer, the costs to the transit company differ significantly. For example, sales outlets owned and operated by the transit company incur labor, rent, material, and overhead costs.[2] Public and private sales outlets,

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[1]Other methods are obviously possible (e.g., from vending machines), but these methods are rare and cost data are not available. An on-going demonstration of alternative distribution methods in Sacramento designed by Ecosometrics, Inc. will test the costs and effectiveness of these methods. See Ecosometrics, Inc. A Comprehensive Demonstration of Distribution Systems for Transit Fare Prepayment: The Sacramento Regional Transit Project. Prepared for the Office of Service and Methods Demonstrations, Urban Mass Transportation Administration, Washington, D.C., February 1981.

[2]Overhead costs for rent, supplies, and miscellaneous expenses are described in Chapter 4.

on the other hand, either donate labor and rent as an added service to their customers and clients, or charge the transit company a commission on sales. At one case site, public outlets use equipment for fare prepayment sales which are paid for by the transit company.

Day and weekend passes are always sold on board the transit vehicle, by the driver. After the exact fare is paid (generally two times the one-way fare), the bus driver will issue the passenger a transfer-like pass which is usually valid for unlimited rides throughout the day. The purchase of day passes, like the acquisition of transfer slips, may decrease the rate at which passengers enter the bus when the fare is deposited, thus decreasing average running speed and increasing vehicle hours and costs. Subsequent use of the pass during the day, however, can reduce boarding times since no cash payments are made. Since these two effects tend to cancel out, there may be no net changes in boarding times and thus operating costs. Consequently, the potential change in operating costs due to on-board pass sales is not reviewed in this study.

Telephone and direct mail sales generally occur at the transit company headquarters or passenger service facility. Direct mail service allows customers to purchase a fare prepayment instrument through the mail. Payment can be by check, money order, or credit card. Following receipt of mail orders and verification of all credit card purchasers, the fare clerk can then mail the item(s) purchased directly to the individual.

Telephone payment allows customers to order and purchase a fare prepayment instrument over the telephone using a major credit card. The customer provides the fare clerk with his/her credit card number, date of expiration, name, address, and telephone number. After verification of the customer's credit card account and once an authorization number is obtained, the fare prepayment instrument is mailed directly to the individual.

Similar to the costs associated with sales at transit-operated outlets, telephone and direct mail programs incur labor and material costs. The costs of materials for telephone and direct mail programs include envelopes, postage, telephone, and bank service charges for credit card use. The types of operating costs incurred in each of the four sales categories are summarized in Table 3-19.

Table 3-19

TYPES OF DIRECT SALES COSTS INCURRED BY SALES CATEGORY

	Transit-Operated Outlets	Public and Private Outlets	Direct Mail Sales	Telephone Order Sales
Labor	X		X	X
Equipment	X	X	X	X
Commissions		X		

Direct Sales Costs: Transit-Operated Outlets

As shown in Table 3-19, transit-operated sales outlets incur labor and some equipment costs. General supplies, rent, overhead, and administrative expenses are discussed in Chapter 4: Non-Transaction Oriented Costs.

Labor Requirements, Wages, and Costs

The labor requirements at transit-operated sales outlets in eight companies are presented in Table 3-20. Although the data do not show a clear transition, the average time required to make a transaction generally decreases as the average number of monthly sales transactions increases. The fact that a clear trend is not evident is due to differences in the types of fare prepayment plans offered as well as differences in each system's recording requirements and labor utilization. Nevertheless, the time required for most transactions varies between 1.5 and 2.5 minutes. In an attempt to develop some reasonable estimates of labor requirements, the data presented in Table 3-20 can be standardized as shown in Table 3-21.

Table 3-21

STANDARDIZED TIME REQUIRED PER TRANSACTION

Number of Monthly Transactions at Outlet i (N_{si})	MINUTES REQUIRED PER TRANSACTION	
	Normal Range	Standardized Value (R_{si})
less than 5,000	3.0 - 4.0	3.50
5,000 - 10,000	2.3 - 3.0	2.50
10,000 - 20,000	1.8 - 2.3	2.00
more than 20,000	1.5 - 1.8	1.75
Outlets where many photographs are taken	4.0 - 7.0	5.00

Table 3-20

LABOR REQUIREMENTS AT TRANSIT-OPERATED SALES OUTLETS

Transit Company Outlet	Man Hours Per Month	Number of Monthly Transactions	Minutes per Transaction
Seattle - Headquarters	260	2,323	6.72[a]
Los Angeles - Headquarters	603	5,501[b]	6.58
Philadelphia - Red Arrow Division	693	9,437	4.41
Philadelphia - 8 Depots	364[c]	5,161[c]	4.23
Los Angeles - El Monte	409	6,973	3.52
Los Angeles - Greyhound Terminal	1003	21,731	2.77
St. Paul - MTC Office	9	201[d]	2.69
Cincinnati - Headquarters	3	68	2.65
Los Angeles - Arco Plaza	298	8,470	2.11
Philadelphia - 6 Cashier Offices	156[c]	4,590[c]	2.04
St. Paul - St. Paul Booth	69	2,200[d]	1.88
St. Paul - Minneapolis Booth	158	5,456[d]	1.74
Los Angeles - Hollywood	298	10,722	1.67
Norfolk - Headquarters	72	2,663	1.62
Portland - Customer Assistance Office	554	21,314	1.56
Sacramento - Passenger Service Center	73	4,018	1.09
Philadelphia - 13th Street	173	9,529	1.09
Philadelphia - 15th Street	693	38,449	1.08
Philadelphia - Treasury	5	541	0.55

[a]Includes sales of plans involving photographs

[b]Excludes direct mail sales of passes

[c]Average value for 8 depots and 6 cashier offices respectively

[d]Estimated number of monthly transactions

For estimation purposes, therefore, the labor costs for sales of fare prepayment can be given by the following equation:

$$(3.11) \qquad L_s = (1/60)(W_s)(1 + F_r) \sum_{i=1}^{N_{to}} (N_{si})(R_{si})$$

where:

L_s = monthly labor cost (dollars) for selling fare prepayment plans at transit-operated sales outlets

W_s = average hourly wage rate for sales activities at transit-operated outlets

F_r = fringe benefit rate

N_{to} = number of transit-operated sales outlets

N_{si} = number of monthly transactions at outlet i

R_{si} = average time required (minutes) to make each transaction at outlet i following the schedule presented in Table 3-21

Table 3-22 presents the monthly labor costs for each transit-operated outlet, as well as those from Sacramento's student photographic identification card sales outlets. Because of the lack of data on labor requirements at five additional outlets operated by SCRTD in Los Angeles, the labor hours and costs for these outlets were computed from equation (3.11). The fringe benefit rates and average hourly wage rates for personnel involved in fare prepayment sales at each site are also presented in this table.

Equipment Costs

Few transit companies keep detailed records of the costs of operating a sales outlet. Consequently, general operating expenses -- such as those incurred for utilities, maintenance, telephone, and office supplies -- are presented in Chapter 5 as overhead expenses.

Three transit companies incur expenses on equipment for fare prepayment sales. The first transit company, SEPTA in Philadelphia, requires all passes to be validated at the time of sale. Thus, all sales outlets must have validator

Table 3-22

MONTHLY LABOR COSTS AT TRANSIT-OPERATED SALES OUTLETS - 1981

Transit Company Outlet	Number of Individuals Involved	Man Hours Per Month	Average Hourly Wage Rate	Fringe Benefit Rate (Percent)	Monthly Labor Cost
Los Angeles					
Greyhound	N.A.	1003	$10.00	46.7	14,714
Headquarters	N.A.	603	10.00	46.7	8,846
El Monte	N.A.	409	10.00	46.7	6,000
Arco Plaza	N.A.	298	10.00	46.7	4,372
Hollywood	N.A.	298	10.00	46.7	4,372
Long Beach	N.A.	41[a]	10.00	46.7	601[a]
Van Nuys	N.A.	273[a]	10.00	46.7	4,005[a]
South Central	N.A.	75[a]	10.00	46.7	1,100[a]
South Bay	N.A.	57[a]	10.00	46.7	836[a]
Wilshire Office	N.A.	214[a]	10.00	46.7	3,139[a]
Philadelphia					
8 depots (each)	N.A.	364	11.00	36.1	5,446
(combined)		(2910)[b]	11.00	36.1	(43,566)[b]
6 cashier offices (each)	N.A.	156	12.00	36.1	2,545
(combined)		(935)[b]	12.00	36.1	(15,270)[b]
13th Street	1	173	11.00	36.1	2,590
15th Street	5	693	4.80	36.1	4,527
Treasury	1	5	12.00	36.1	82
Red Arrow Division	4	693	8.50	36.1	8,017
St. Paul					
MTC Office	1	9	8.92	33.2	107
Minneapolis Booth	2	158	8.92	33.2	1,877
St. Paul Booth	1	69	8.92	33.2	820
Seattle					
Headquarters	4	260	8.00	35.7	2,823
Cincinnati					
Headquarters	1	3	3.85	38.7	16
Portland					
Customer Assistance Office	4	554	14.08	33.0	10,374
Norfolk					
Headquarters	3	72	4.33	29.0	$402
Sacramento					
Passenger Service Center	1	73	7.41	43.4	776
Headquarters	N.A.	28	7.41	43.4	298
Photo ID's - Headquarters	1	173	7.41	43.4	1,838
Photo ID's - School Outlets	2	79	6.50	43.4	736

[a]Monthly labor hours and costs computed from equation (3.11).

[b]The larger numbers in parentheses indicate the total labor requirement and monthly labor cost at the conbined outlets

stamps and a supply of ink. On the average, each outlet has ten validators at $7.50 each. Ink for the validators cost SEPTA $2,500 per year, or $26.88 annually per outlet. Thus, total monthly cost per outlet is:

	Monthly Cost Per Outlet
Validators	$6.25
Ink	2.25
Total	$8.50

Total monthly material cost to all sales outlets is $790.

Sacramento and Seattle both issue photographic identity cards (ID cards) to special pass purchasers or riders.[1] The principal cost element for issuing photo ID cards is, of course, the camera. The Polaroid cameras used in Sacramento and Seattle retail for $3,200 each in 1981 dollars. In addition, film, ID cards, and plastic coating material are required to produce these passes. The costs per photograph for these items, except ID cards, are shown in Table 3-23. The costs of printing ID cards are presented in Chapter 4.

Table 3-23

COSTS FOR ISSUING PHOTOGRAPHIC IDENTITY CARDS - 1981

Polaroid Camera:	$3,200 each	
Film:	$325/case 25 rolls/case 12 photographs/roll	-- $1.08/photograph
Plastic Coating:	$99/box 1,000 photographs/box	-- $0.10/photograph

Table 3-24 presents the monthly equipment and material costs for issuing photographic identity cards. Note that with the exception of the camera, the costs incurred are based on the number of passes sold.

[1]Other transit systems, such as Los Angeles, issue photographic identity cards but accurate data on the number of cards issued per month was not available.

Table 3-24

MONTHLY EQUIPMENT AND MATERIAL COSTS FOR PHOTOGRAPHIC IDENTITY CARDS - 1981

Transit Company	Number of Monthly Transactions	Film Cost	Plastic Cost	Camera Cost[a]	Total Monthly Cost
Seattle	503	$543.24	$50.30	$ 73.97	$ 668
Sacramento					
Headquarters	774	835.92	77.40	147.94[b]	1,061
School Outlets	328[c]	354.24	32.80	147.94[b]	535

[a]Monthly equivalent capital costs computed using a capital recovery factor with 12% discount rate and five year useful life ($73.97 /month).

[b]Sacramento uses four cameras during the beginning of the school season.

[c]Three month totals averaged over 12-month period.

Sales Costs: Public and Private Outlets

All of the transit companies included in this study use public and private sales outlets to supplement their own fare prepayment outlets. Banks, savings and loan institutions, department stores, hospitals, schools, and places of employment are all used for this purpose. Although many institutions, agencies, and companies will sell fare prepayment plans as a benefit or convenience to their clients and employees, a significant number charge a commission on sales. The fact that many transit companies are paying commissions suggests that a broad distribution system is in the interest of the transit company.

Sales commissions can either be based on a percentage of prepayment sales revenues or on a fixed rate per instrument sold. In addition, some transit systems will pay a commission on sales over a specified amount (e.g., 1% on sales over $1,000). The sales commission rates in all 11 case sites are presented in Table 3-25. Each transit company's average monthly commission fee is also presented.

Table 3-25

SALES COMMISSION RATES BY TRANSIT COMPANY

Transit Company	Commission Rates	Number of Commissioned Sales Outlets	Avg. Monthly Commission Paid
Los Angeles			
Greyhound Terminal	5% pass revenues 8% ticket revenues	1	$17,875
Public/Private Outlets	3% pass revenues	207	$92,152
Philadelphia	$0.25 per weekly pass (3% of value) $0.50 per monthly pass (1.6% of value)	75	$20,615
St. Paul	1% revenues over $1,000 per month	450	$57,143
Seattle	$0.40 per monthly pass or ticket book (1.4-2% of value) $0.10 per E&H sticker (5% of value)	400	$19,092
Wilmington	2% revenues at WSFS institutions only	N.A.	$208

Other than those systems that do not pay a commission, commission rates vary from one percent in St. Paul to eight percent at the Greyhound Terminal in Los Angeles. The fixed charges per transaction range from $0.10 per monthly elderly and handicapped sticker in Seattle (5% of value), to $0.50 per monthly pass in Philadelphia (1.6% of value). Table 3-26 presents a categorization of sales commission rates.

Table 3-26

LEVELS OF SALES COMMISSION RATES - 1981

	Percentage of Sales Value	Rate Per Instrument[a]
Low Rate	0	0
Medium Rate	1 - 3	$0.25 - $0.50 (1.6% - 3%)
High Rate	3 - 8	$0.10 (5%)

[a]Figures in parentheses denote sales commission expenses as percentages of the sales value of the prepayment instrument.

The following two parametric equations are provided to estimate the total monthly sales commission of a fare prepayment program. For commissions based on a percentage of sales revenues:

$$(3.12a) \qquad SC_p = \sum_{i=1}^{N_{co}} \sum_{j=1}^{N_t} (CMP_j)(P_j)(N_{ij})$$

where:

SC_p = total monthly sales commission (dollars) for percentage rate commissions

N_{co} = number of commissioned sales outlets

N_t = number of different types of fare prepayment plans

CMP_j = commission rate (decimal) for fare prepayment plan j

P_j = price (dollars) of fare prepayment plan j

N_{ij} = number of monthly transactions at outlet i for fare prepayment plan j

If total sales are known and commissions are based on only one fare prepayment type, then equation (3.12a) becomes:

$$(3.12b) \qquad SC_p = (CMP)(P)(N)$$

where:

$(P)(N)$ = total sales revenue

For commissions based on a fixed rate per instrument:

$$(3.13a) \qquad SC_r = \sum_{i=1}^{N_{co}} \sum_{j=1}^{N_t} (CMR_j)(N_{ij})$$

where:

SC_r = total monthly sales commission (dollars) for fixed value commissions

N_{co} = number of commissioned sales outlets

N_t = number of different types of fare prepayment plans

CMR_j = commission rate (dollars) per fare prepayment plan j sold

N_{ij} = number of monthly transactions at outlet i for fare prepayment plan j

When total sales are known and where commissions are based on one fare prepayment type, the equation for total monthly sales commissions becomes:

(3.13b) $SC_r = (CMR)(N)$

where:

N = total number of fare prepayment instruments sold

Sales Costs: Direct Mail Order and Distribution

Both labor and material costs are incurred in direct mail order and distribution. The labor requirements and costs are discussed first.

Labor Requirements, Wages, and Costs

Five of the eleven transit systems interviewed allow transit users to purchase fare prepayment plans through the mail. As shown in Table 3-27, the time required for each mail order transaction can vary from one to six minutes. For the five transit companies shown, there appears to be no relationship between sales time per transaction and the number of monthly transactions. For mail order sales, therefore, an increase in the number of transactions will not necessarily lead to a reduction in the average transaction time. Obviously other factors, such as reporting and credit card verification requirements, as well as follow-ups on bad checks, affect the transaction time.

Table 3-27

LABOR REQUIREMENTS FOR DIRECT MAIL SALES

Transit Company	Number of Monthly Transactions	Man Hours Per Month	Minutes Per Transaction
Norfolk	433	40	5.54
Los Angeles	1200	87	4.35
Wilmington	10	0.5	3.00
Portland	550	16	1.75
St. Paul	195	4	1.23

As a guideline for determining the labor requirement for mail order sales, the standardized values presented below in Table 3-28 can be used. The values are ranked according to the labor requirement.

Table 3-28

STANDARDIZED LABOR REQUIREMENT AND TRANSACTION TIMES FOR DIRECT MAIL SALES

Labor Requirement	MINUTES PER TRANSACTION	
	Normal Range	Standardized Value (MM_{dm})
Large	4 - 6	5.0
Normal	2 - 4	3.0
Small	1 - 2	1.5

The equation for estimating the monthly labor cost for direct mail sales is given as:

$$(3.14) \qquad L_{dm} = (1/60)(W_{dm})(1 + F_r)(MM_{dm})(N_{dm})$$

where:

L_{dm} = monthly labor cost (dollars) for direct mail sales

W_{dm} = average hourly wage rate for direct mail sales

F_r = fringe benefit rate

MM_{dm} = { 5.0 minutes per transaction for systems with high labor requirements
3.0 minutes per transaction for systems with normal labor requirements
1.5 minutes per transaction for systems with low labor requirements

N_{dm} = number of monthly direct mail transactions

Table 3-29 presents the actual monthly labor costs at each of the five case sites operating direct mail programs.

Table 3-29

LABOR COSTS FOR DIRECT MAIL SALES - 1981

Transit Company Outlet	Man Hours Per Month	Average Hourly Wage Rate	Fringe Benefit Rate (Percent)	Monthly Labor Cost
Los Angeles	87	$12.12	46.7	$1,547
Portland	16	14.08	33.0	300
Norfolk	40	3.85	29.0	199
St. Paul	4	8.77	33.2	47
Wilmington	0.5	6.73	40.6	5

Material Costs

The material costs associated with mail order programs in five case sites are shown in Table 3-30. In addition to these costs, a transit company can expect to pay a fixed annual fee and marginal rate for business reply mail (BRM). This service, provided by the U.S. Postal Service, allows an individual to send an order form (commonly referred to as mailers) to the transit company free of charge. The transit company will then pay the postage plus a five cent surcharge. The annual fee for this service is $40.

Table 3-30

ACTUAL MATERIAL COSTS FOR DIRECT MAIL PROGRAMS AT FIVE CASE SITES - 1981

Transit Company	Cost Per Order Form	Cost Per Envelope	Postage Cost Per Transaction
Los Angeles	$0.0250	$0.0650[a]	$0.10
St. Paul	0.0500[b]	0[c]	0[c]
Portland	0.0352	0.0223	0.18
Norfolk	0.0372	0.0410	0.18
Wilmington	N.A.	0.0650[a]	0.18

[a]Standard transit company envelopes are used. Printed envelopes cost approximately $65 per thousand.

[b]Order forms are photocopied in-house (estimated at five cents per copy).

[c]St. Paul has no envelope and postage costs because they require a self-addressed stamped envelope with every mail order.

Special Cost: Service Charges for Credit Card Payment - Another service a transit company can provide in its direct mail program is to allow the payment of fare prepayment plans by credit card. In order to be able to process these transactions, it is necessary for the transit company to enter into an agreement with the company's financial institution. The financial institution will then verify all credit card purchases and process these transactions. A discount rate (service charge) ranging from three to five percent is normal for transactions "without plastic" (i.e., without credit card imprint). The discount rate could be as low as two percent if a credit card imprint is made. A realistic bank card discount rate schedule for drafts without plastic is presented below in Table 3-31.

Table 3-31

APPROXIMATE BANK CARD DISCOUNT RATE SCHEDULE
FOR DRAFTS WITHOUT PLASTIC - 1981[a]

MONTHLY VOLUME	SALES DRAFT AVERAGE					
	Under $20	$20.01 to $35	$35.01 to $50	$50.01 to $75	$75.01 to $100	$101 and over
$ 1 - $ 2,500	5.75%	5.50%	5.25%	5.00%	4.25%	4.25%
2,501 - 5,000	5.50	5.25	5.00	4.50	4.25	4.00
5,001 - 7,500	5.25	5.25	4.75	4.25	3.75	3.75
7,501 - 12,500	5.25	5.00	4.75	4.25	3.75	3.50
12,501 - 20,000	5.25	5.00	4.50	3.75	3.50	3.50
20,001 - 25,000[b]	5.25	4.75	4.50	3.75	3.50	3.50

[a]Without plastic refers to those transactions where credit card imprints are not taken. Two percent is added to original rate schedule for drafts with plastic quoted by the Bank of America for the Sacramento Regional Transit.

[b]Monthly volume above this figure is subject to individual contract negotiation.

Source: Ecosometrics, Inc. A Comprehensive Demonstration of Distribution Systems For Transit Fare Prepayment: The Sacramento Regional Transit Project. Prepared for the Office of Service and Methods Demonstrations, Urban Mass Transportation Administration, February 1981.

Credit card verification at the transit company can occur in three ways:

i) checking the credit card number in the interbank listing: Card Recover Bulletin;

ii) calling the transit company's financial institution by telephone to obtain an authorization number; or

iii) using a credit card verification machine.

The first option, while simple, does not fully protect the transit company against all situations in which a credit card cannot be used for payment. The second option is the most common approach for credit card verification. Moreover, the transit company's financial institution will usually include the cost of this service in the discount rate (service charge). Use of a credit card verification machine, while the most efficient approach, is also very expensive. Most transit companies will not find this option cost-effective unless extremely high sales volumes and sale values exist.

The total monthly material cost for a direct mail program can be estimated from the following equation:

Total Material Cost = (Cost of Order Forms) + (Cost of Business Reply Mail Fee (BRM)) + (Cost of Envelope and Postage) + (Cost of Credit Card Service)

or

$$(3.15) \qquad MC_{dm} = (N_{dm})(C_{dm}) + [BRM + (C_p + C_{ps})(N_{dm})] + (C_e)(N_{dm}) + (C_p)(N_{dm}) + (N_{dm})(\overline{P})(DR)$$

where:

MC_{dm} = monthly material cost (dollars) for direct mail program

N_{dm} = number of monthly direct mail transactions

C_{dm} = cost per order form (dollars)

BRM = business reply mail monthly fee, currently at \$40 ÷ 12 = \$3.33

C_p = first class postage cost per mailing

C_{ps} = cost of postage surcharge for business reply mail service currently at \$0.05

C_e = cost per envelope

$\overline{P}$ = weighted average cost of a fare prepayment instrument sold through the direct mail program

DR = financial institution bank card discount rate (service charge) according to the schedule presented in Table 3-31

The total monthly material cost for each of the five case sites is presented in Table 3-32. Total costs are presented using actual case site data and assuming a business reply mail charge (except for St. Paul). The last four columns present total and average material costs for two situations: first, assuming no credit card usage (columns six and seven) and second, assuming 50 percent of all transactions are credit card sales (last two columns).

The average material cost for a direct mail program should cost approximately 50 cents per transaction regardless of the quantity sold through the mail. Notice that insurance fees are not included in this figure. If credit cards are acceptable methods of payment, the non-labor costs of the program can be expected to double.

Sales Costs: Telephone Order and Mail Distribution

Telephone order is similar to direct mail order in that the transactions take place at the transit company headquarters. Unlike a direct mail program where several methods of payment are possible, telephone orders of fare prepayment must be charged to the customer's major credit card. The costs for this service are equivalent to the discount rates charged by financial institutions for direct mail sales presented in Table 3-31.

Labor Requirements, Wages, and Costs

Only one of the eleven case sites operates a telephone order service (Wilmington), and that program had just begun at the time of the interview. Since only 35 monthly passes were ordered by telephone during the month of the interview, it is impossible to provide accurate data on the labor requirements and costs of this program. Nevertheless, evidence from Wilmington and other transit companies suggests that the labor requirements are not significantly different from those of a direct mail program. Thus:

$$(3.16) \qquad L_{tel} = (1/60)(W_{tel})(1 + F_r)(MM_{tel})(N_{tel})$$

where:

L_{tel} = monthly labor cost (dollars) for telephone sales
W_{tel} = average hourly wage rate for telephone sales
F_r = fringe benefit rate

Table 3-32

TOTAL MONTHLY MATERIAL COST FOR DIRECT MAIL PROGRAM - 1981

Transit Company	Number of Monthly Transactions	Cost of Order Forms	Business Reply Mail	Cost of Envelopes	Cost of Postage	WITHOUT CREDIT CARD		WITH CREDIT CARD	
						Total Monthly Cost	Cost Per Transaction	Total Monthly Cost	Cost Per Transaction
Los Angeles	1200	$30.00	$279.33	$78.00	$216.00	$603	$0.50	$1,273	$1.06
St. Paul	195	9.75	0	0	0	10	0.05	125	0.64
Portland	550	19.36	129.83	12.27	99.00	260	0.47	578	1.05
Norfolk	433	16.11	102.92	17.75	77.94	215	0.50	493	1.14
Wilmington	10	0.33[b]	5.63	0.65	1.80	8	0.84	14	1.39

[a]Assumes 50 percent of transactions are by credit card. Average pass prices are: LA = $20.28, St. Paul = $21.42, Portland = $21.00, Norfolk = $23.31, Wilmington = $20.10. A discount rate of 5.5 percent is used and based on data presented in Table 3-31.

[b]Based on a unit order form cost of $0.0325.

$$MM_{tel} = \begin{cases} 5.0 \text{ minutes per transaction for systems with } \underline{\text{high}} \text{ labor requirements} \\ 3.0 \text{ minutes per transaction for systems with } \underline{\text{normal}} \text{ labor requirements} \\ 1.5 \text{ minutes per transaction for systems with } \underline{\text{low}} \text{ labor requirements} \end{cases}$$

N_{tel} = number of monthly telephone transactions

Based on an average usage rate of $6.73, fringe benefit rate of 40.6 percent, and three minute per transaction labor requirement, Wilmington's monthly labor cost is $16.56 for its telephone order program.

Equipment and Material Costs

The non-labor costs that are incurred in a telephone order and mail distribution program include telephone installation and monthly service charges, bank card service charges, window envelopes, and first class postage. Telephone installation and monthly service charges vary by region and type of telephone system used. As part of its on-going demonstration, Sacramento Regional Transit obtained quotes from Pacific Telephone for the telephone order program scheduled to begin in early 1982. These figures are presented below in Table 3-33.

Table 3-33

TELEPHONE INSTALLATION AND MONTHLY SERVICE COSTS - 1981

Type of Telephone System	Installation Charge		Monthly Service Charge	Total Monthly Telephone Cost
	Total Charge	Monthly Equiv. Charge[a]		
3 Pushbutton Phones With Two Rotary Lines	$370.97	$8.58	$28.55	$37
3 Pushbutton Phones With Three Rotary Lines	458.45	10.60	39.32	50

[a]One-time charge converted to monthly equivalent cost using a capital recovery factor based on an interest rate of 12 percent and normal life of five years.

Source: Communication with Ms. Beth F. Beach, Fare Prepayment Manager, Sacramento Regional Transit.

From this data and from the material costs reviewed for direct mail programs, the non-labor costs incurred in a telephone order program can be standardized as follows:

- telephone service (including installation and monthly charges): $30 - 50 per month
- bank card service charges: 4 - 6% of sales
- window envelopes: $0.0317 each
- postage: $0.18 each

The equation for estimating total material costs for a telephone order program can thus be given as:

$$(3.17) \qquad MC_{tel} = (TC) + (N_{tel})(\overline{P}_t)(DR) + (C_e)(N_{tel}) + (C_p)(N_{tel})$$

where:

MC_{tel} = monthly material cost (dollars) for telephone order program

TC = monthly equivalent telephone installation and service charge

N_{tel} = number of monthly telephone orders

$\overline{P}_t$ = weighted average cost of a fare prepayment instrument sold by telephone

DR = financial institution bank card discount rate based on schedule presented in Table 3-31

C_e = cost per envelope

C_p = first class postage cost per mailing

Since Wilmington does not have a separate telephone line for fare prepayment sales, its monthly non-labor costs is only $42.59.[1] With labor costs, the telephone order program costs $59.15 per month. Thirty-five passes were sold by telephone during the month of this interview resulting in a unit cost of $1.69 per transaction. As sales increase, average costs will not necessarily drop since all charges, including labor, are transaction dependent.

[1]Based on average sales volume of 35 passes, average pass price of $20.10, 5 percent discount rate, and envelope and postage charges shown above.

Complete Direct Sales Cost Equations

Although none of the 11 transit systems reviewed in this study employs all four sales activities analyzed in this section, it is possible for a transit company to operate its own sales outlets, pay commissions on sales at public and private outlets, and operate both direct mail and telephone order programs. The complete cost equations for each of these four activities are summarized below.

a) For sales at transit-operated outlets, total monthly costs are the sum of labor, rental, and material costs. Thus:

(3.18) $$C_{to} = L_s + MC_s$$

where:

C_{to} = total monthly cost (dollars) of operating a sales outlet

L_s = monthly labor costs for selling fare prepayment plans at sales outlets as given in equation (3.11)

MC_s = monthly material cost required for sales at outlets as reviewed in the text

b) For sales at public/private outlets, the total monthly cost is simply the commission paid to all outlets. Where commissions are based on a percentage of sales revenue, total monthly costs are:

(3.12a) $$SC_p = \sum_{i=1}^{N_{co}} \sum_{j=1}^{N_t} (CMP_j)(P_j)(N_{ij})$$

where the parameters have been defined in equation (3.12a)

Where commissions are based on a fixed rate per instrument, total monthly costs are:

(3.13a) $$SC_r = \sum_{i=1}^{N_{co}} \sum_{j=1}^{N_t} (CMR_j)(N_{ij})$$

where the parameters have been defined in equation (3.13a)

c) For direct mail sales of fare prepayment plans, the total monthly operating cost is equal to the labor cost plus the material or non-labor cost. Thus:

(3.19) $C_{dm} = L_{dm} + MC_{dm}$

where:

C_{dm} = total monthly cost (dollars) of operating a direct mail program

L_{dm} = monthly labor cost for direct mail sales as given by equation (3.14)

MC_{dm} = monthly material cost for direct mail program as given by equation (3.15)

d) For telephone order and mail distribution of fare prepayment plans, the total monthly cost is equal to the sum of the monthly labor and material cost. Thus:

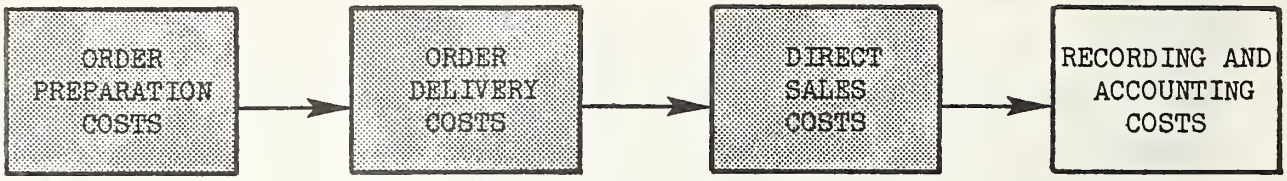
(3.20) $C_{tel} = L_{tel} + MC_{tel}$

where:

C_{tel} = total monthly cost (dollars) of operating a telephone order program

L_{tel} = monthly labor cost for telephone sales as given by equation (3.16)

MC_{tel} = monthly material cost for telephone order program as given by equation (3.17)



Description of Activities

The final recurrent tasks of any fare prepayment program are recording all sales and accounting for all revenue income. These two tasks are usually performed at separate times and by different personnel. Recording fare prepayment sales, for example, is done at the time the sale is transacted (or shortly thereafter) by a fare agent. The cost incurred for this activity is simply the labor cost at transit-operated sales outlets or at a transit company headquarters if direct mail and telephone order programs are used. The total labor cost for recording sales, therefore, is a function of the procedures used and the number of monthly prepayment sales.

Accounting procedures vary from one transit company to the next depending on the arrangements made with public sales outlets. Most companies, however, have consignment accounts with their outlets. While sales on a consignment basis has its advantages, there are those who argue that such a system is labor intensive. For this reason, some transit companies sell tickets or passes to their public and private outlets, either for cash or on a charge basis. Whichever system is used, it is up to the accountant to post the accounts receivable or entries to consignment accounts on a periodic basis as sales outlets are serviced. Like the recording activity, accounting fare prepayment sales is a transaction oriented task. The larger the sales volume at a particular outlet, the more time is required to verify and account for sales and revenues. This section presents the labor requirements and costs for sales recording and accounting. As will be shown, both activities exhibit economies of scale; that is, as the number of monthly transactions increases, the average labor required (i.e., labor per transaction) decreases.

Recording Costs

The labor requirements for recording sales at transit-operated sales outlets and for sales programs at transit company headquarters are presented in Table 3-34. No recording costs are incurred by the transit company for sales from public, private, and employer outlets, and from the transit vehicle for day passes. In Figure 3-2, the average transaction time is plotted against the number of monthly transactions to graphically show this relationship. Notice that economies occur throughout the normal range of monthly prepayment sales.[1]

Table 3-34

MONTHLY LABOR REQUIREMENTS FOR RECORDING SALES

(transit-operated outlets, direct mail and telephone programs only)

Transit Company and Type of Sales Program	Man Hours Per Month	Number of Monthly Transactions	Minutes Per Transaction
St. Paul - MTC Office	13.97	201	4.17
Tucson - 20-Ride Pass[a]	33.60	560	3.60
Tucson - Semester Pass[a]	42.00[b]	1,055[b]	2.39
St. Paul - St. Paul Booth	35.57	2,200	0.97
Philadelphia - Treasury	8.66	541	0.96
Norfolk - Direct Mail Order	5.41	433	0.75
Sacramento - Passenger Service Center	31.20	4,018	0.47
St. Paul - Minneapolis Booth	25.46	5,456	0.28
Norfolk - Headquarters	10.00	2,663	0.23
Portland - Customer Assistance Office	69.28	21,314	0.20

[a]These plans are from a special fare prepayment demonstration program and not part of the regular monthly pass program. The recording costs are borne by the University of Arizona and Pima College and not the transit company.

[b]Total hours and number of transactions per semester (3.5 months).

[1]This implies that average recording costs will decrease as sales volume increases.

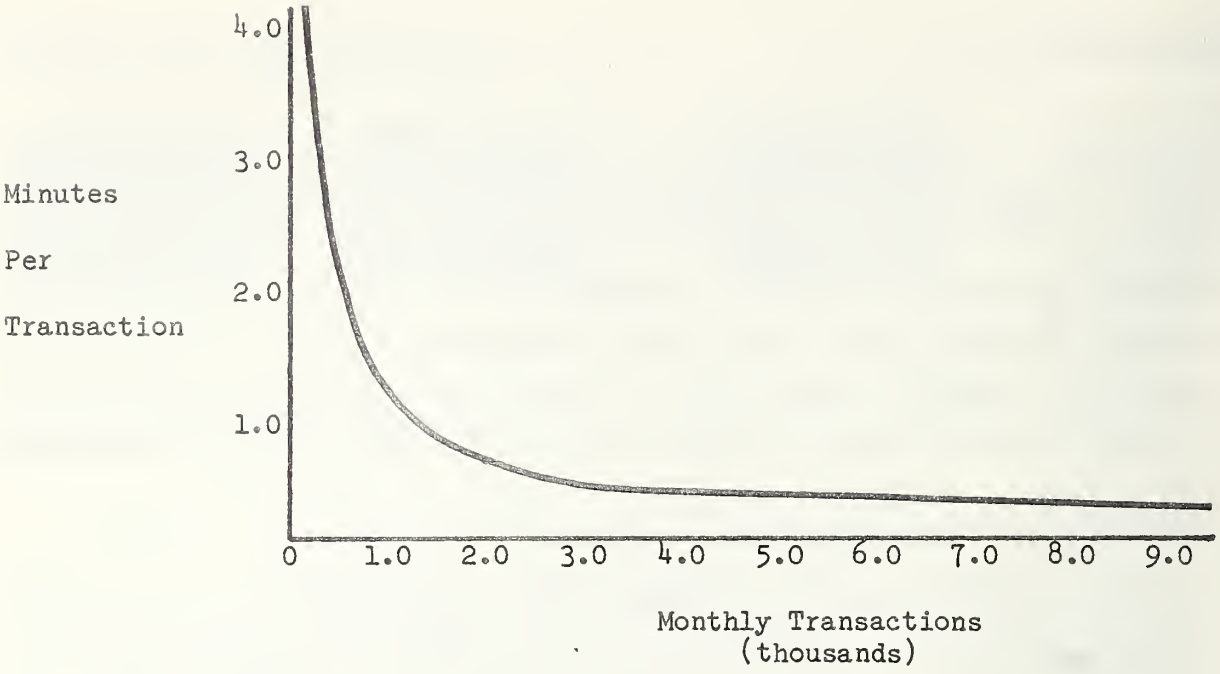


Figure 3-2: AVERAGE RECORDING TIME BY SALES VOLUME FOR TRANSIT-OPERATED OUTLETS, DIRECT MAIL, AND TELEPHONE PROGRAMS

The labor requirements for sales recording can be standardized by sales volume from Figure 3-2 as shown in Table 3-35.

Table 3-35

STANDARDIZED RECORDING LABOR REQUIREMENTS PER TRANSACTION

(transit-operated outlets, direct mail, and telephone programs only)

Monthly Sales Volume	MINUTES PER TRANSACTION	
	Normal Range	Standardized Value (MM_r)
Less than 500	2.20 - 4.20	3.10
500 - 1,000	1.20 - 2.20	1.70
1,000 - 2,000	0.60 - 1.20	0.90
2,000 - 5,000	0.35 - 0.60	0.50
5,000 - 10,000	0.30 - 0.35	0.33
More than 10,000	0.20 - 0.30	0.25

Based on the relationship presented in Table 3-35, the monthly labor cost for recording fare prepayment sales can be estimated from the following equation:

$$L_r = L_{rh} + L_{rt} \tag{3.21}$$

where:

$$L_{rh} = (1/60)(W_{rh})(1 + F_r)(MM_r)[N_{dm} + N_{tel}] \tag{3.21a}$$

$$L_{rt} = (1/60)(W_{rt})(1 + F_r) \sum_{i=1}^{N_{to}} (N_i)(MM_{ri}) \tag{3.21b}$$

where:

L_r = total monthly labor cost (dollars) for recording fare prepayment sales at transit-operated outlets and at headquarters

L_{rh} = monthly labor cost (dollars) for recording fare prepayment sales at headquarters

L_{rt} = monthly labor cost (dollars) for recording fare prepayment sales at transit-operated outlets

W_{rh} = average hourly wage rate for recording fare prepayment sales at headquarters

W_{rt} = average hourly wage rate for recording fare prepayment sales at transit-operated outlets

F_r = fringe benefit rate

N_{dm} = number of monthly direct mail transactions

N_{tel} = number of monthly telephone transactions

N_{to} = number of transit-operated sales outlets

N_i = number of monthly transactions at outlet i

$MM_{r(i)}$ =
- 3.10 minutes per transaction when there are less than 500 monthly transactions at headquarters (or at outlet i)
- 1.70 minutes per transaction when there are 500-1,000 monthly transactions at headquarters (or at outlet i)
- 0.90 minutes per transaction when there are 1,000-2,000 monthly transactions at headquarters (or at outlet i)
- 0.50 minutes per transaction when there are 2,000-5,000 monthly transactions at headquarters (or at outlet i)
- 0.33 minutes per transaction when there are 5,000-10,000 monthly transactions at headquarters (or at outlet i)
- 0.25 minutes per transaction when there are more than 10,000 monthly transactions at headquarters (or at outlet i)

The labor costs for recording fare prepayment sales at each case site are presented in Table 3-36. The transit companies in Tucson and Richmond are not represented because they do not incur any recording costs. Neither site operates its own sales outlets nor sales programs at its headquarters. The actual labor requirements at each site are used to compute labor costs when this information is available. When it is not available, the standardized values presented in Table 3-35 are used to estimate monthly labor costs.

In addition to the labor cost for recording fare prepayment sales, Tidewater Transit in Norfolk photocopies each monthly pass ordered through the mail for its own records. None of the other three transit companies with direct mail programs incurs this extra record-keeping cost. For Norfolk, the cost each month for photocopying 433 passes is approximately $21.65.

Accounting and Reconciling Costs

Accounting costs are incurred by all transit companies and for all sales methods. Except for on-board sales, accounting costs are incurred on a per transaction basis. The accounting costs incurred from sales at outlets and at headquarters are discussed first.

Accounting Costs From Conventional Sales Outlets and Headquarters

The labor requirements for accounting and reconciling fare prepayment sales at nine transit companies are presented in Table 3-37. Like the labor requirements for recording sales, the average time required for accounting sales drops as the the number of transactions increases. The average transaction time is plotted against number of monthly transactions in Figure 3-3, showing this inverse relationship. As with recording time, economies of scale occur throughout the normal range of monthly prepayment sales.

Table 3-36

MONTHLY LABOR COSTS FOR RECORDING FARE PREPAYMENT SALES - 1981

(transit-operated outlets, direct mail, and telephone programs)

Transit Company and Type of Sales Program	Number of Monthly Transactions	Minutes per Transactions[a]	Average Hourly Wage Rate	Fringe Benefit Rate (Percent)	Monthly Labor Cost
Los Angeles					
10 outlets	64,716	0.15	$10.00	46.7	$2,373
Direct mail	1,200	0.90	12.12	46.7	320
Philadelphia					
18 outlets	126,787	0.15	10.91	36.1	4,707
St. Paul					
3 outlets	7,857	0.46	8.92	33.2	716
Direct mail	195	3.10	8.77	33.2	118
Seattle					
1 outlet	2,323	0.50	8.00	35.7	210
Cincinnati					
1 outlet	255	3.10	3.85	38.7	70
Portland					
1 outlet	21,314	0.20	14.08	33.0	1,331
Direct mail	550	3.10	14.08	33.0	532
Norfolk					
1 outlet	2,663	0.23	4.33	29.0	57
Direct mail	433	0.75	3.85	29.0	27
Sacramento					
Headquarters	1,568	0.90	7.41	43.4	250
Passenger service center	4,018	0.47	7.41	43.4	334
Photo ID services	2,087	0.90	6.84	43.4	307
Wilmington					
Direct mail	10	3.10	6.73	40.6	5
Telephone	35	3.10	6.73	40.6	17

[a]Actual labor requirements are used whenever possible as presented in Table 3-34. When data from a site are not available, the standardized values shown in Table 3-35 are used to compute estimates of monthly labor costs.

Table 3-37

MONTHLY LABOR REQUIREMENTS FOR ACCOUNTING
AND RECONCILING FARE PREPAYMENT SALES

Transit Company	Man Hours Per Month	Number of Monthly Transactions	Minutes Per Transaction
Tucson (monthly pass)	33	3,767	0.526
Tucson (demonstration plans)	13	1,615[a]	0.483
Norfolk	46	7,281	0.379
Wilmington	88	19,420	0.272
Seattle	143	58,073	0.148
Portland	146	62,687	0.140
Sacramento	50	22,504	0.133
Philadelphia	325	220,938	0.088
Los Angeles	346	266,506	0.078
St. Paul	87	71,489	0.073

[a]Semester passes sold during one month period only.

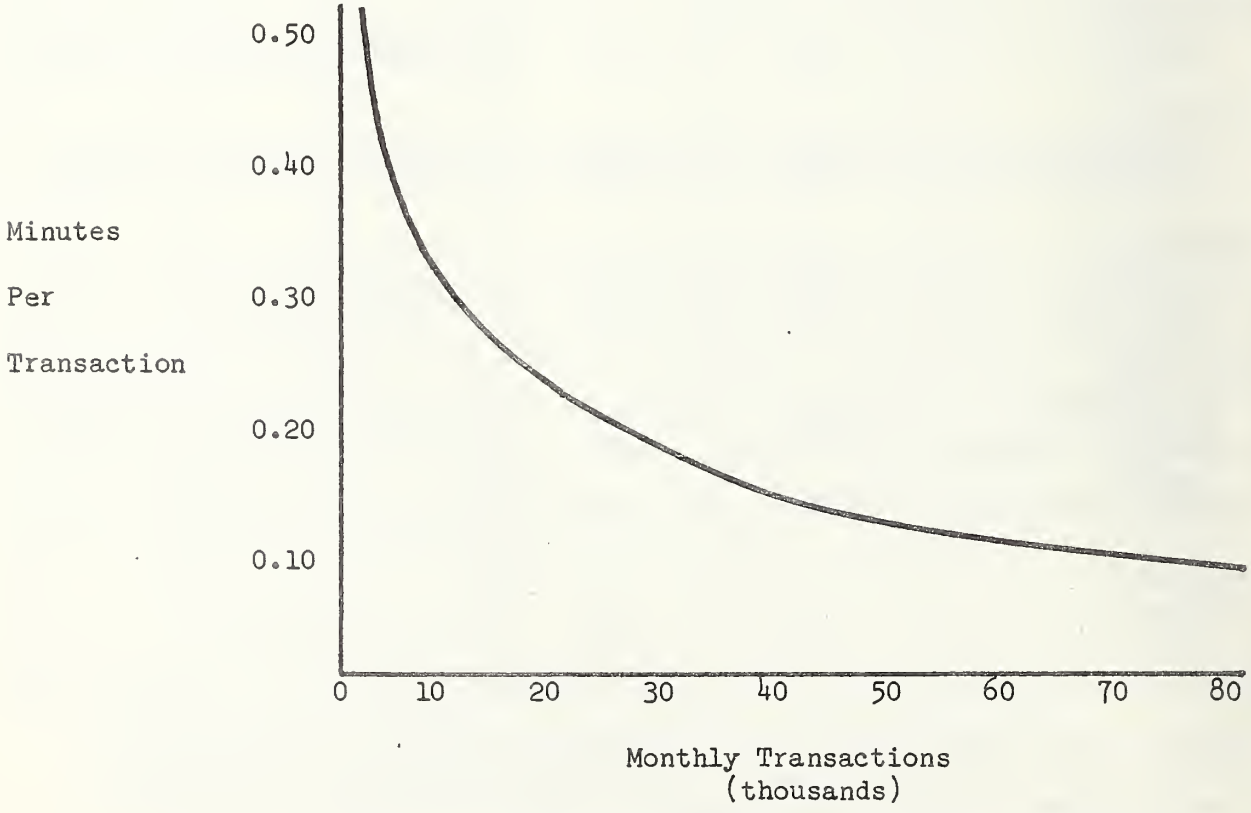


Figure 3-3: AVERAGE ACCOUNTING TIME AND SALES VOLUME

The labor requirements for accounting and reconciling fare prepayment sales are standardized by sales volume in Table 3-38. These figures are based on the data presented in Table 3-37.

Table 3-38

STANDARDIZED ACCOUNTING LABOR REQUIREMENTS PER TRANSACTION

Monthly Sales Volume	MINUTES PER TRANSACTION	
	Normal Range	Standardized Value (MM_a)
Less than 5,000	0.40 - 0.55	0.45
5,000 - 10,000	0.31 - 0.40	0.35
10,000 - 20,000	0.23 - 0.31	0.26
20,000 - 50,000	0.12 - 0.23	0.15
50,000 - 100,000	0.10 - 0.12	0.11
100,000 - 200,000	0.08 - 0.10	0.09
More than 200,000	0.06 - 0.08	0.07

Based on this relationship, the monthly labor cost for accounting and reconciling fare prepayment sales can be estimated from the following equation:

$$L_a = (1/60)(W_a)(1 + F_r)(NT - N_{ob})(MM_a) \quad (3.22)$$

where:

L_a = monthly labor cost (dollars) for accounting and reconciling fare prepayment sales

W_a = average hourly wage rate for accounting and reconciling fare prepayment sales

F_r = fringe benefit rate

NT = total number of monthly transactions

N_{ob} = number of monthly on-board transactions

MM_a =
- 0.45 minutes per transaction when there are less than 5,000 monthly transactions
- 0.35 minutes per transaction when there are 5,000-10,000 monthly transactions
- 0.26 minutes per transaction when there are 10,000-20,000 monthly transactions
- 0.15 minutes per transaction when there are 20,000-50,000 monthly transactions
- 0.11 minutes per transaction when there are 50,000-100,000 monthly transactions
- 0.09 minutes per transaction when there are 100,000-200,000 monthly transactions
- 0.09 minutes per transaction when there are more than 200,000 monthly transactions

The monthly labor costs for accounting fare prepayment sales at each case site are presented in Table 3-39. Cincinnati is the only transit company that does not handle the accounting of its token sales. The financial institution that collects and deposits Queen City Metro's revenues accounts for all daily cash, including revenues from token sales. The transit authority is not charged for this service as long as it maintains an average balance of $60,000 in its account. The opportunity cost for these funds at an annual interest rate of 10 percent is $500 per month.

Accounting Costs From On-Board Sales

In addition to the costs incurred for accounting fare prepayment sales from conventional sales outlets, three case sites incur costs in the accounting of on-board sales of weekend passes.[1] Data on two of the three programs where cost information is available are presented in Table 3-40.

With data from only two programs, it is difficult to arrive at conclusions concerning the specific factors that drive the costs in this accounting activity. At first glance, however, it appears that once again there are economies of scale; that is, average labor requirements decrease as sales volumes increase. This relationship is suggested by the difference in the number of minutes per transaction between the two sites.

Table 3-40

LABOR REQUIREMENTS FOR ACCOUNTING ON-BOARD SALES OF WEEKEND PASSES

Transit Company	Man Hours Per Month	Number of Monthly Transactions	Minutes Per Transactions	Days Issued Per Month	Man Hours Per Day Issued
St. Paul	30.31	34,927	0.052	8.66	3.50
Tucson	8.70	2,000	0.261	8.66	1.00

[1]Sacramento Regional Transit sells day passes on-board its vehicles but does not account for those sold.

Table 3-39

MONTHLY LABOR COSTS FOR ACCOUNTING
AND RECONCILING FARE PREPAYMENT SALES - 1981

Transit Company	Number of Monthly Transactions[a]	Minutes per Transaction	Average Hourly Wage Rate	Fringe Benefit Rate (Percent)	Monthly Labor Cost
Los Angeles	266,506	0.078	$12.12	46.7	$6,160
Philadelphia	220,938	0.088	16.27	36.1	7,175
St. Paul	71,489	0.073	8.77	33.2	1,016
Seattle	58,073	0.148	7.05	35.7	1,370
Cincinnati	4,373	N.A.[b]	N.A.[b]	N.A.[b]	500
Portland	62,687	0.140	12.98	33.0	2,525
Norfolk	7,281	0.379	8.32	29.0	494
Sacramento	22,504	0.133	9.65	43.4	690
Richmond	29,600	0.150[c]	8.32[d]	31.1	877
Wilmington	19,420	0.272	6.73	40.6	833
Tucson	4,628	0.518[e]	6.08	30.5	317

[a]This column does not include on-board sales of day passes.

[b]Accounting activities are performed by the transit company's financial institution when collecting fare box and token revenues. Costs presented are opportunity costs. See text for explanation.

[c]Accurate data not available. The figure presented is obtained from standardized values given in Table 3-38 and based on Richmond's sales volume.

[d]Data not available, wage rate based on Norfolk data.

[d]Weight average transaction time from Table 3-35.

The labor requirements for preparing day passes for sales on-board transit vehicles were discussed earlier in this chapter and found to be related more to the number of days the passes were issued than to the number of passes sold. The same relationship, however, does not hold true for the accounting activity since the daily time requirement increases with sales.

The monthly labor cost for accounting on-board weekend pass sales can be estimated from the following equation:

$$(3.23) \qquad L_{ap} = (W_{ap})(1 + F_r)(N_d)(MH_{ap})$$

where:

L_{ap} = monthly labor cost (dollars) for accounting and reconciling on-board sales of weekend day passes

W_{ap} = average hourly wage rate for accounting and reconciling on-board pass sales

F_r = fringe benefit rate

N_d = number of days per month passes are sold on-board transit vehicles

$$MH_{ap} = \begin{cases} 1.00 \text{ hours per day when there are less than 5,000 passes sold per month} \\ 2.25 \text{ hours per day when there are 5,000-24,000 passes sold per month} \\ 3.50 \text{ hours per day when there are more than 24,000 passes sold per month} \end{cases}$$

The monthly labor costs for accounting on-board pass sales at the three case sites offering weekend passes are presented in Table 3-41. The Sacramento Regional Transit also sells day passes on board buses but no accounting or reconciliation is done in Sacramento to determine exactly how many day passes are actually sold.

Complete Recording and Accounting Cost Equations

Recording and sales accounting costs were reviewed in this last section of Chapter 3. To summarize, a complete set of the cost equations needed for analyzing the labor costs associated with recording and accounting activities is presented here.

Table 3-41

MONTHLY LABOR COSTS FOR ACCOUNTING ON-BOARD SALES OF WEEKEND PASSES - 1981

Transit Company	Number of Monthly Transactions	Days Issued Per Month	Man Hours Per Day Issued	Average Hourly Wage Rate[a]	Fringe Benefit Rate (Percent)	Monthly Labor Cost
St. Paul	34,927	8.66	3.50	8.77	33.2	$354
Seattle	24,827	8.66	3.50[b]	7.05	35.7	290
Tucson	2,000	8.66	1.00	6.08	30.5	69

[a]From Table 3-39.

[b]Based on man-hour estimates presented in equation (3.23).

a) For recording fare prepayment sales at transit-operated outlets and at headquarters, the following cost equations is used:

(3.21) $L_r = L_{rh} + L_{rt}$

where:

L_r = total monthly labor cost (dollars) for recording fare prepayment sales at transit-operated outlets and at headquarters

L_{rh} = monthly labor cost (dollars) for recording fare prepayment sales at headquarters as given in equation (3.21a)

L_{rt} = monthly labor cost (dollars) for recording fare prepayment sales at transit-operated outlets as given in equation (3.21b)

b) For accounting fare prepayment sales from all sales outlets excluding on-board sales, the following cost equation is used:

(3.22) $L_a = (1/60)(W_a)(1 + F_r)(NT - N_{ob})(MM_a)$

where the parameters have been defined in equation (3.22)

c) For accounting on-board fare prepayment sales, the following equation is used:

(3.23) $L_{ap} = (W_{ap})(1 + F_r)(N_d)(MH_{ap})$

where the parameters have been defined in equation (3.23).

4

NON-TRANSACTION ORIENTED COSTS

4

NON-TRANSACTION ORIENTED COSTS

INTRODUCTION

The costs directly attributable to the sales of transit fare prepayment plans were discussed in detail in the last chapter. There are, however, many fare prepayment program costs that are not directly driven by the number of prepayment instruments sold. The cost of designing a fare prepayment plan, for example, is based on the complexity of the individual design and the frequency of the design change. This cost will not change if sales increase or decrease. In this chapter the cost of designing fare prepayment plans, as well as other non-transaction oriented costs are described in detail.

Some of the functional activities discussed in this chapter, while categorized under the rubric of non-transaction oriented costs, are loosely related to sales volume. Expenditures on advertising, for example, will generally be greater in transit companies with high sales volumes. This relationship, however, is not due to the size of the program as much as it is due to a management decision on the importance of the prepayment program and the relative merits of advertising. Similarly, printing costs, which increase as sales escalate, are reviewed in this chapter because printing fare prepayment plans is not directly related to a fare prepayment transaction.

The cost behavior of non-transaction oriented activities are discussed in this chapter. The specific activity costs include:

- design costs, or the costs incurred for the design and art work of a fare prepayment plan;
- printing costs, or the costs incurred to print and deliver new fare prepayment instruments to the transit company;
- inventory costs, or the costs incurred for storing fare prepayment instruments at the transit company headquarters or garage;
- miscellaneous handling costs, or the costs incurred in counting new passes, separating tickets from cash revenues, and destroying unsold passes;
- advertising costs, or the costs incurred to advertise a fare prepayment program;
- administrative costs, or the costs incurred in supervising, administering, and promoting a fare prepayment program;
- general overhead costs, or the costs incurred for space, utilities, telephones, and general supplies, but not labor; and
- cost of funds, or the costs resulting from lost interest on fare revenues due to delays in crediting a transit company's account.

Detailed cost and planning information are presented in this chapter for each of the above cost categories. Unlike in the previous chapter where each cost category is divided into independent functional activities with cost elements identified for each activity, such a division is not possible here. This is so because each cost category in this chapter results in a unique cost equation that translates labor and equipment into standardized unit costs.

Figure 4-1 illustrates the sequence followed in this chapter for analyzing non-transaction oriented costs, starting with design costs and ending with the cost of funds. This figure reappears at the beginning of the analysis of each cost category to help the reader see each activity in its place as part of this cost analysis. The particular cost category being discussed in each section of the chapter is highlighted on the figure.

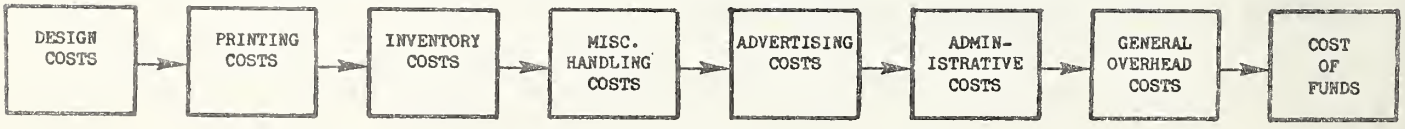
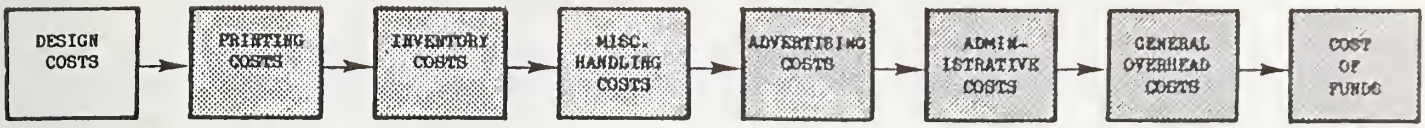


Figure 4-1: SEQUENCE FOLLOWED FOR ANALYZING NON-TRANSACTION ORIENTED COSTS

DESIGN COSTS



Description of Activities

Designing fare prepayment plans includes choosing the dimensions of the instrument, the type of paper stock to use, and the artwork on both sides of the instrument. Tickets, tokens, and punch cards usually have simple designs and, consequently, most transit companies use standard designs provided by the printing company. These designs are changed slightly to incorporate the transit company's logo and information on the use of the prepayment instrument.

Since most fare prepayment plans do not require special designs, transit companies do not spend a significant amount of money to design tickets, tokens, and punch cards. A set-up charge at the time of printing will usually cover the artwork. Passes, however, are usually preceded by relatively ambitious advertising campaigns to inform the public of the pass and its benefits. In these instances, more attention is placed on design and artwork to make the pass attractive, functional, and -- to the extent possible -- counterfeit free.

As shown in Table 4-1, eight of the eleven case sites report significant design costs for ten prepayment plans. Nine of the ten plans are passes; the remaining plan is a 20-ride punch card. The design costs for these plans range from $57 to $3,500 per design, with design changes occurring every six months to three years. Fifty percent of the transit companies analyzed make design changes annually.

In addition to the plans' total design costs, Table 4-1 presents average design costs (i.e., the cost per instrument printed). Although this cost varies widely from $0.10 to $4.79 per thousand instruments printed, there is a clear inverse relationship between unit cost and volume printed. As a transit company sells more pass plans,[1] the amount of funds spent on pass design will increase but at a decreasing rate. Artwork and design will, therefore, contribute less to the cost of selling each fare prepayment instrument as sales increase.

[1]The volume printed is generally indicative of the sales volume.

Table 4-1

FARE PREPAYMENT DESIGN COSTS - 1981

Transit Company	Fare Prepayment Plan	In-House or Outside Design[a]	Design Cost	Design Frequency	Average Monthly Volume Printed	Cost per Thousand Instruments Printed
Norfolk	Monthly Pass	0	$ 125.00	6 months	4,350	$4.79
Sacramento	Monthly Pass	0	680.26	annually	16,000	$3.54
Tucson	Semester Pass	I	57.20	3 years	500	$3.18
Portland	Monthly Pass	0	600.00	6 months	43,250	$2.31
Tucson	20-Ride Punch	I	57.20	3 years	715	$2.22
Los Angeles	Base Pass	0	500.00	annually	41,667	$1.00
St. Paul	Monthly Pass	I	735.42	annually	70,000	$0.88
Philadelphia	All Passes	0	3,500.00	2 years	309,800	$0.47
Los Angeles	Monthly Pass	0	500.00	annually	160,000	$0.26
Seattle	Monthly Pass	I	100.00	annually	80,000	$0.10

[a]In-house designs are indicated by I and outside designs are indicated by 0.

Another aspect of the cost of designing pass plans is that in-house designs are less expensive than the designs produced by contractors or advertising agencies. This is probably true because in-house design cost estimates generally do not include overhead and material costs. A contractor, however, is obviously interested in covering his total cost plus a fee as reflected in his invoice. Based on the cost data presented in Table 4-1, standardized design costs at different average printing volumes are presented in Table 4-2 for in-house and outside designs.

Table 4-2

STANDARDIZED DESIGN COSTS PER THOUSAND PRINTED FOR IN-HOUSE AND OUTSIDE DESIGNS - 1981

IN-HOUSE DESIGNS		OUTSIDE DESIGNS	
Average Monthly Volume Printed	Standardized Cost (DC_i)	Average Monthly Volume Printed	Standardized Cost (DC_i)
Less than 10,000	$2.70	Less than 10,000	$4.60
10,000 - 30,000	1.90	10,000 - 30,000	2.90
30,000 - 60,000	1.10	30,000 - 60,000	1.80
60,000 - 100,000	0.60	60,000 - 100,000	1.10
100,000 - 200,000	0.20	100,000 - 200,000	0.60
More than 200,000	0.10	More than 200,000	0.40

Based on this analysis, a transit manager can estimate the average monthly cost for designing pass plans as follows:

$$(4.1) \qquad D = (1/1000) \sum_{i=1}^{N_{pd}} (NP_i)(DC_i)$$

where:

D = average monthly cost (dollars) for designing pass plans

N_{pd} = number of prepayment plans that incur significant design costs

NP_i = average monthly volume printed of prepayment plan i

DC_i = standardized design cost per thousand instruments printed of prepayment i following the schedule presented in Table 4-2

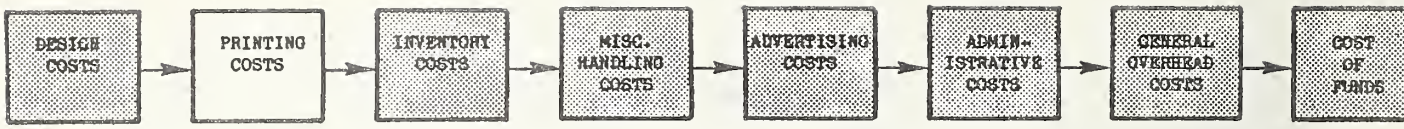
The average monthly design costs for all eight transit systems reporting significant design activities are presented below in Table 4-3. Unlike many other cost elements of fare prepayment program, the costs incurred in designing pass plans are not large.

Table 4-3

AVERAGE MONTHLY DESIGN COSTS -1981

Transit Company	Average Monthly Volume Printed	Average Monthly Design Cost
Los Angeles	201,667	$ 83
Philadelphia	309,800	146
St. Paul	70,000	61
Seattle	80,000	8
Portland	43,250	100
Norfolk	4,350	21
Sacramento	16,000	57
Tucson	1,215	3

PRINTING COSTS



Description of Activities

Printing fare prepayment plans is generally done by professional printing companies and not by the transit agency itself since there are significant economies of scale in printing or minting fare prepayment plans. Most of these economies can not be realized by a transit company because of their relatively low printing requirements and the high capital costs of printing equipment. Of the eleven case sites, SunTran in Tucson is the only system that does not contract out for its printing needs. This is because SunTran -- a city-owned transit system -- uses the printing facilities of the City of Tucson. The result of this policy is that, for its demonstration plans, SunTran has been able to reduce its unit printing cost below the level that could be provided in the marketplace given SunTran's minor requirements of student semester passes and 20-ride punch cards.

The printing costs presented in this section generally incorporate the cost of engraving, set-up, printing, and delivery to the transit company, as well as all sales taxes. SCRTD in Los Angeles is the only transit company included in this investigation that picks up its own fare prepayment plans from the printer. The cost to SCRTD for making its own monthly pick-ups is included in the total monthly printing cost for Los Angeles as presented in Table 4-18 at the end of this section.

As a general rule, printing costs are affected by the following four factors:

- type of fare prepayment plan,
- quality of materials and printing,
- annual volume printed, and
- printing frequency.[1]

[1]The minting cost of tokens is affected by the first three factors only.

The type of fare prepayment plan is an important factor affecting costs since most plans require a different printing process. Ticket books, for example, are more expensive than strip tickets or tickets in rolls because the printer must cut, collate, and staple tickets to make ticket books.

The printing costs for a particular fare prepayment plan can differ depending on the quality of the paper and ink or the printing process used. St. Paul prints more monthly passes than Philadelphia and at a third the price because St. Paul chose a much simpler design. Philadelphia's pass, however, cannot be color photocopied or easily counterfeited because each pass is laminated with an irradescent coating.

There are definite economies of scale in printing fare prepayment plans as shown in Figures 4-2a and 4-2b. Figure 4-2a shows that large volume printing orders will result in lower unit printing costs, all other factors being equal. For example, for two transit companies ordering ticket books at six-month intervals, the company ordering 100,000 books will pay a lower unit cost than the company ordering only 10,000. This relationship is true over the normal range of printing orders.

Similarly, as shown in Figure 4-2b, a transit company can reduce its unit printing cost by ordering plans less frequently, given a fixed annual printing requirement. 1981 cost estimates prepared for the Sacramento Regional Transit (RT) for printing RT's monthly pass indicate that RT can save 21 percent by ordering one 12-month supply instead of two, 6-month supplies. Greater savings are obtained when comparing a 12-month order to orders placed every month, as shown in Table 4-4. A higher unit price is charged for smaller orders primarily because of the large fixed cost for engraving and set-up. Order size, therefore, is the major factor affecting the unit cost of printing. This factor is used throughout this analysis in developing standardized costs for printing.

Table 4-4

PRINTING COSTS BY ORDER SIZE FOR A MONTHLY PASS IN SACRAMENTO - 1981

	Printed Monthly	Printed Semi-Annually	Printed Annually
Order Size	16,000	96,000	192,000
Printing Cost Per Order	$1,332	$2,206	$3,506
Annual Printing Cost	$15,984	$4,412	$3,506
Unit Printing Cost (cost per thousand)	$83.25	$22.98	$18.26

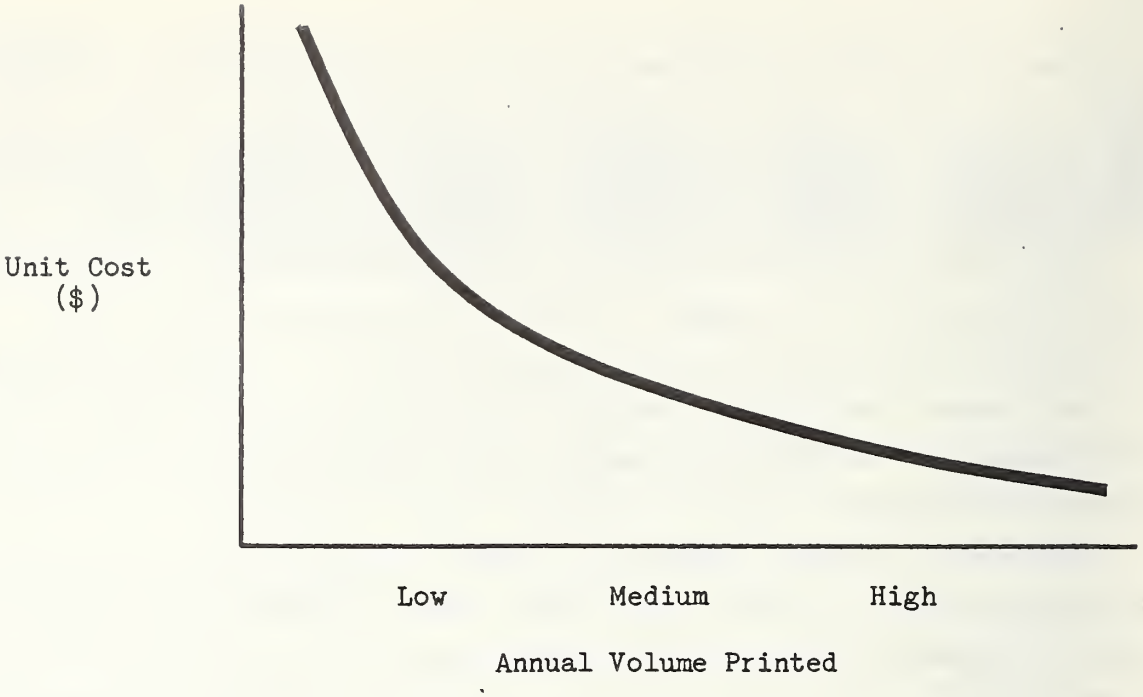


Figure 4-2a: UNIT PRINTING COST BY ANNUAL VOLUME PRINTED ASSUMING CONSTANT PRINTING FREQUENCY

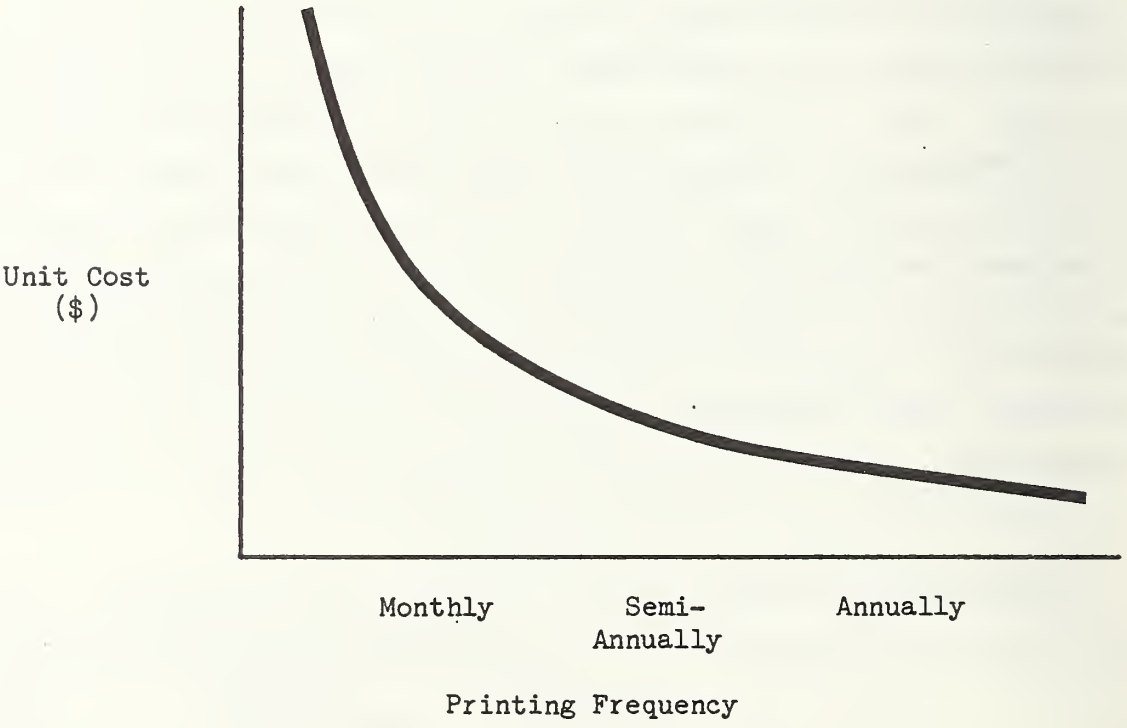


Figure 4-2b: UNIT PRINTING COST BY PRINTING FREQUENCY ASSUMING CONSTANT ANNUAL VOLUME PRINTED

Since weekly and monthly passes can only be used during the period of time for which they were printed, it is important that transit managers carefully decide how many passes to print. If too few passes are ordered, demand will exceed supply. On the other hand if too many are ordered, the transit company may be spending more on printing than necessary. Obviously, overprinting is required to cover fluctuations in demand. Thus, the issue facing many transit managers is determining how many more passes to order.

Nearly all of the transit companies interviewed for this study print many more instruments than are required. Anywhere from 20 to 200 percent more passes are being printed than actually sold. Although seasonal and annual fluctuations are occurring, such excess printing orders are unnecessary. The authors believe that for mature fare prepayment programs, an average overprinting rate of between 20 and 35 percent is reasonable. The actual rate chosen will depend on fluctuations in demand, volumes printed, and unit printing cost.

The printing costs discussed in this section are presented by type of fare prepayment plan. Specifically, the costs are presented in six categories.

1. monthly, weekly, and semester passes;
2. day passes, including weekend day passes;
3. tickets and punch cards, including ticket books, ticket strips, and tickets sold individually;
4. tokens;
5. stickers and stamps; and
6. special passes and permits, including annual passes, photo permits, and tourist passes.

Actual printing costs at each site are presented under each of the six categories, and standardized costs are developed from this information. Parametric cost equations that will generate printing cost estimates are presented at the end of this section along with the average monthly printing cost for each transit system.

Monthly, Weekly, and Semester Passes

Monthly, weekly, and semester pass printing costs for ten transit companies are presented in Table 4-5. These costs are presented along with the size of each order and printing frequency. With few exceptions, unit printing costs tend

to decrease as the size of the printing order increases. This relationship is shown graphically in Figure 4-3 for most of the monthly pass plans. Notice that significant economies of scale occur for order sizes below 50,000 instruments. Beyond that value, unit costs will continue to decrease but at a much slower rate.

Table 4-5

PRINTING COSTS FOR MONTHLY, WEEKLY, AND SEMESTER PASSES - 1981

Fare Prepayment Plan and Transit Company	Size of Order	Printing Frequency	Cost Per Thousand Printed
Monthly Pass			
Philadelphia	40,000	monthly	$108
Wilmington	14,250	3 months	71
Norfolk	26,100	6 months	58
Portland	259,500	6 months	43
St. Paul	70,000	monthly	33
Tucson	95,320	annually	32
Sacramento	96,000	6 months	23
Seattle	960,000	annually	21
Los Angeles	160,000	monthly	10
Weekly Pass			
Philadelphia	259,800	monthly	108
Richmond	65,000	6 months	20
Semester Pass			
Tucson	1,750	6 months	69

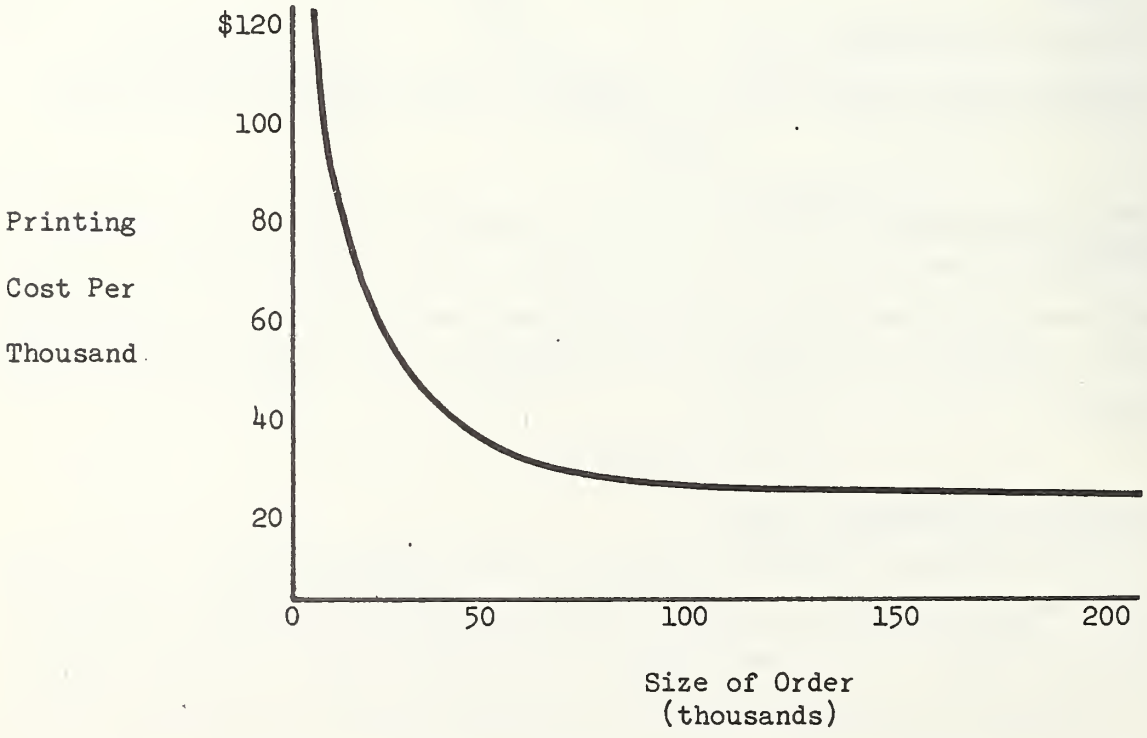


Figure 4-3: MONTHLY PASS PRINTING COSTS BY SIZE OF ORDERS - 1981

The differences in printing costs at comparable volumes are probably due to differences in printing quality and annual printing requirements. Philadelphia's monthly and weekly passes are considerably more expensive than other plans because of the high cost technology used in the printing process to make the passes counterfeit-proof. The ten dollar cost difference between Tucson and Sacramento may also be due to printing quality. Another explanation, however, is that Sacramento prints twice as many plans each year and thus gets a better price.

The weekly and semester pass prices presented in Table 4-5 do not differ substantially from monthly pass prices. Tucson's relatively low price for printing only 1,750 semester passes is probably due to the fact that they are printed by the City of Tucson. Based on the data presented in Table 4-5 and Figure 4-2, printing costs can be standardized by order size for estimating purposes. These values are presented in Table 4-6.

Table 4-6

STANDARDIZED PRINTING COSTS FOR MONTHLY, WEEKLY, AND SEMESTER PASSES BY SIZE OF ORDER - 1981

Size of Order	COST PER THOUSAND PRINTED	
	Normal Range	Standardized Cost
Less than 10,000	More than $90	$120
10,000 - 30,000	$47 - $90	60
30,000 - 50,000	$37 - $47	40
50,000 - 100,000	$30 - $37	32
More than 100,000	Less than $30	25

Day and Weekend Passes

Day passes, including day passes valid only on weekends, are relatively inexpensive plans because of the volumes printed and the quality of the paper stock used. Most transit companies that do offer day passes use a paper stock similar to that used for bus transfers. In Sacramento, for example, 150 passes are bound in pads. The passes are torn from the pad when issued to the passenger.

Printing costs for the four transit companies that sell day and weekend passes are presented in Table 4-7 along with the volumes printed and printing frequency. Notice that the printing costs drop quickly at high order sizes. The inverse relationship between unit cost and size of order is presented in Figure 4-4.

Table 4-7

PRINTING COSTS FOR DAY AND WEEKEND PASSES - 1981

Fare Prepayment Plan and Transit Company	Size of Order	Printing Frequency	Cost Per Thousand Printed
Weekend Pass			
Tucson	3,500	weekly	$92
St. Paul	286,000	6 months	13
Seattle	1,200,000	annually	6
Day Pass			
Sacramento	2,205,500	3 months	2

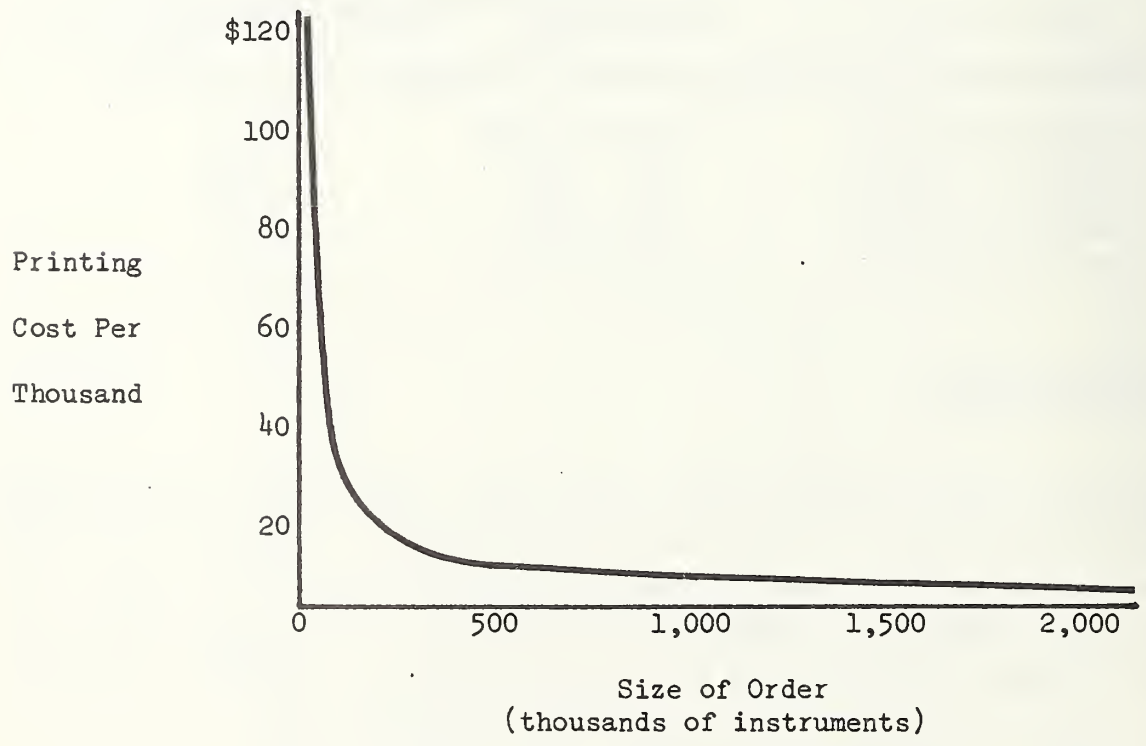


Figure 4-4: DAY PASS PRINTING COST BY SIZE OF ORDER - 1981

Based on the curve shown in Figure 4-4 and the data from Table 4-7, a series of standardized printing costs by size of order is presented below in Table 4-8.

Table 4-8

STANDARDIZED PRINTING COSTS FOR DAY PASSES BY SIZE OF ORDER - 1981

Size of Order	COST PER THOUSAND PRINTED	
	Normal Range	Standardized Cost
Less than 50,000	More than $50	$90
50,000 - 100,000	30 - 50	40
100,000 - 200,000	18 - 30	24
200,000 - 500,000	11 - 18	14
500,000 - 1,000,000	7 - 11	9
1,000,000 - 2,000,000	3 - 7	5
More than 2,000,000	Less than $3	2

Tickets and Punch Cards

In addition to pass plans, most of the transit companies investigated in this study offer trip-limited plans to their customers. Although most of these are in the form of ticket books, strip tickets and punch cards are also provided. The printing costs for these fare prepayment plans are shown in Table 4-9.

Four quantities of ticket books are included in the data base: 10-trip, 20-trip, 40-trip, and 45-trip ticket books. Although one might expect the average cost of a 45-trip book to be greater than the cost of printing a 10-trip book, the data presented in Table 4-9 suggest that there is no cost difference. Richmond, for example, orders 100,000 books, one to two times each year. At this volume, the printer charges $29.43 per thousand, regardless of the type of books requested. The cost difference in Seattle between its 20-trip and 40-trip ticket books is probably due to the volume ordered since one would expect a 40-trip ticket book to be at least as expensive as a 20-trip book.

Average printing costs, therefore, can be approximated by the volume printed and not the quantity of tickets enclosed in each book. The costs and volumes presented in Table 4-9 are plotted in Figure 4-5 to show the inverse relationship between order size and cost. From this curve, one can estimate what costs to expect when ordering ticket books of different quantities. These costs are presented in Table 4-10.

Table 4-9

PRINTING COSTS FOR TICKETS AND PUNCH CARDS - 1981

Fare Prepayment Plan and Transit Company	Size of Order	Printing Frequency	Cost Per Thousand Printed
Ticket Books			
Seattle: 20-trip	6,000	Monthly	$348
Los Angeles (BEEP): 10-trip	21,000	2 Months	291
Los Angeles (School 3's): 10-trip	7,200	2 Months	196
Norfolk: 10-trip	45,000	6 Months	92
Seattle: 40-trip	30,000	Monthly	87
Los Angeles (School): 10-trip	15,000	2 Months	85
St. Paul: 10-trip	15,000	6 Months	58
Los Angeles (Regular) 10-trip	24,600	2 Months	58
Richmond: 10-, 20-, 45-trip	100,000	9 Months	29
Portland: 10-trip	200,000	6 Months	25
Strip Tickets			
Wilmington: 10-trip	30,000	3 Months	25
Tickets in Rolls			
Los Angeles: any quantity	600,000	3 Months	3
Punch Cards			
Tucson: 20-trip	2,500	6 Months	69
St. Paul (Commuter): 10-trip	20,000	3 Months	38
St. Paul (School): 10-trip	84,000	Annually	10

[a]With the exception of tickets sold in rolls, all quantities presented are for ticket books or individual cards and not individual tickets.

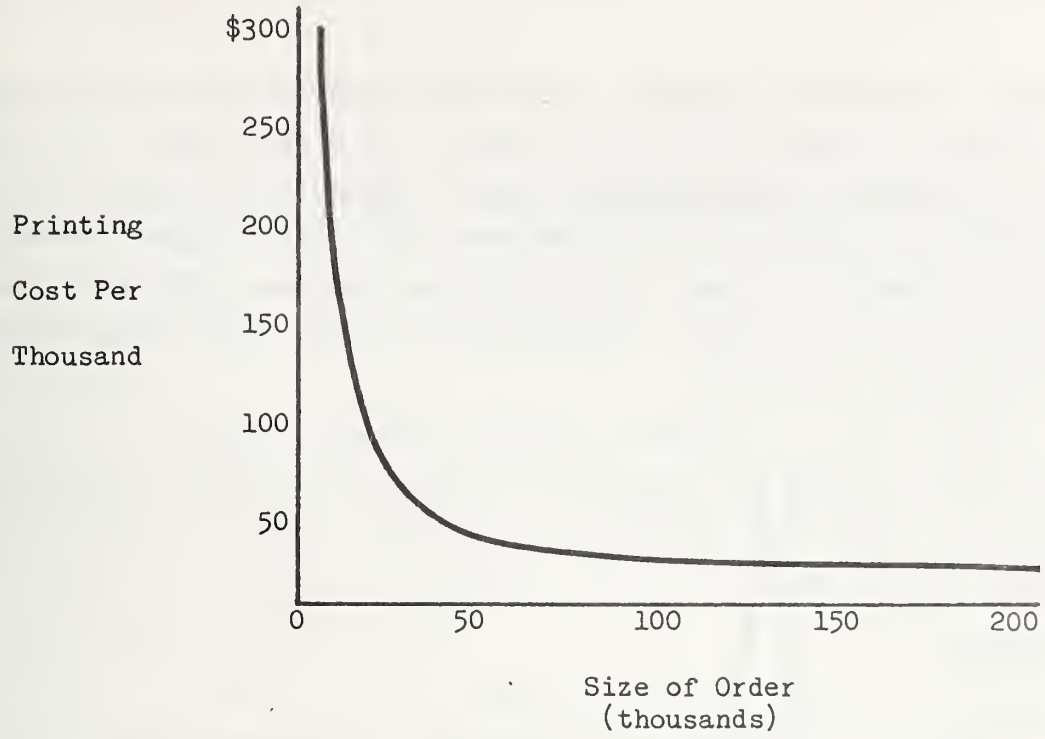


Figure 4-5: TICKET BOOK PRINTING COST BY SIZE OF ORDER - 1981

Table 4-10

STANDARDIZED PRINTING COSTS FOR TICKET BOOKS BY SIZE OF ORDER - 1981

Size of Order	COST PER THOUSAND PRINTED	
	Normal Range	Standardized Cost
Less than 10,000	More than $180	$250
10,000 - 30,000	60 - 180	87
30,000 - 50,000	40 - 60	50
50,000 - 100,000	25 - 40	30
More than 100,000	Less than $25	20

Wilmington is the only case site that offers customers strip tickets. Because they are not bound and stapled, strip tickets are significantly less expensive than ticket books. For example, 30,000 10-trip strip tickets cost $25.33 per thousand in Wilmington, while Seattles' 30,000 40-trip ticket books cost $86.67 per thousand. Wilmington's unit costs, moreover, are less than those in Portland, and Portland is printing 200,000 books.

Another way to minimize the cost of printing tickets is to order them in rolls as Los Angeles does for its school program. Their cost per thousand tickets is $3.24. Selling tickets from rolls, however, will not meet most passenger needs.

Finally, the costs of printing punch cards, which are presented in Table 4-9, are plotted in Figure 4-6 by size of order. Once again there are economies of scale. In addition, punch cards are less expensive to print than ticket books. For example, 84,000 punch cards cost St. Paul $9.82 per thousand while 200,000 ticket books in Portland cost $25.40 per thousand. The major disadvantage of punch cards is that the bus driver must take time to punch each card when the passenger is boarding.

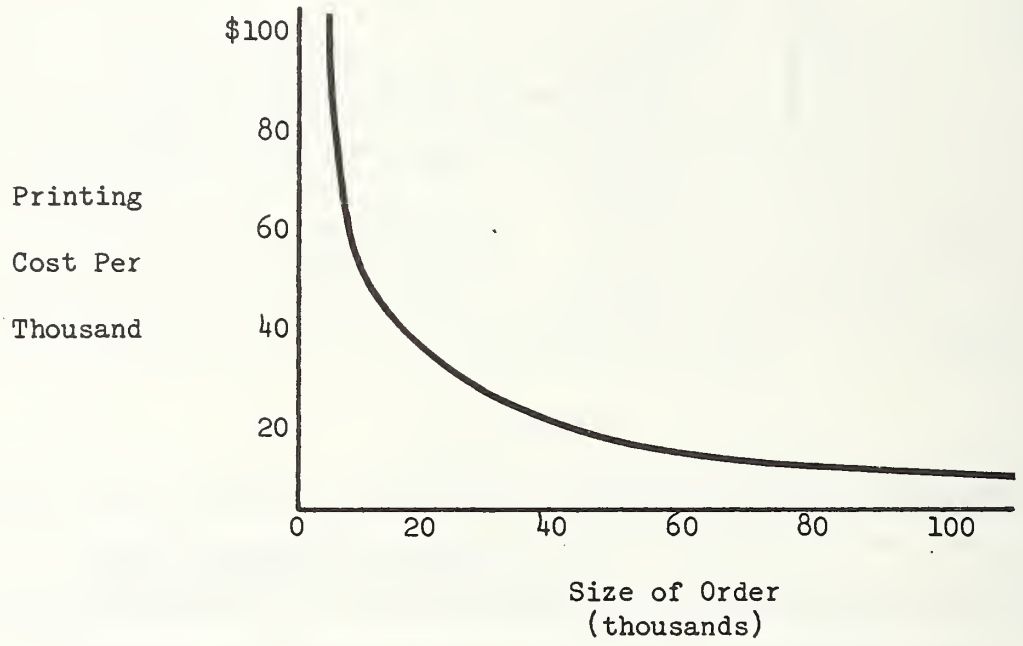


Figure 4-6: PUNCH CARD PRINTING COSTS BY SIZE OF ORDER - 1981

For estimation purposes, a set of standardized costs is presented in Table 4-11. These values should provide reasonable estimates of punch card printing costs at different printing volumes.

Table 4-11

STANDARDIZED PRINTING COSTS FOR PUNCH CARDS BY SIZE OF ORDER - 1981

Size of Order	COST PER THOUSAND PRINTED	
	Normal Range	Standardized Cost
Less than 10,000	More than $52	$62
10,000 - 30,000	28 - 52	38
30,000 - 50,000	17 - 28	22
50,000 - 100,000	8 - 17	12
More than 100,000	5 - 8	7

Tokens

Tokens are the only form of fare prepayment that must be minted instead of printed. In addition, tokens are reusable and can last for an indefinite period of time. To avoid hoarding of tokens prior to a fare change, many transit companies have an extra quantity of tokens of a different type to replace those in circulation.

Four of the eleven transit companies included in this study use tokens: Philadelphia, St. Paul, Cincinnati, and Sacramento. It has been more than six years since any of these companies has purchased new tokens. The quantities minted, year of purchase, and minting costs for three of the companies are presented in Table 4-12.

Table 4-12

MOST RECENT TOKEN PURCHASES IN THREE TRANSIT COMPANIES[a]

Transit Company	Volume Minted	Year Purchased	Minting Cost Per Thousand
Philadelphia	1,500,000	1974	$55
Cincinnati	500,000	1969	N.A.
Sacramento	50,000	1971	$46

[a]Data on St. Paul not available.

The prices shown in Table 4-12 are several years old and, therefore, should not be used for estimating new token prices. The 1981 prices quoted by several minting companies indicate that price can be affected in three ways. First, costs will drop as volume increases. Because of the high cost of the alloys used, the drop in unit price is not as significant as the drop shown for ticket or pass plans. Secondly, as the size (diameter) of the token increases, so will its cost. Token diameters can range from 0.65 inches to as much as 1.51 inches. Token prices increase very fast at sizes above 1.2 inches in diameter. Finally, token prices depend on the alloy used. Brass, for example, is significantly more expensive than aluminum.

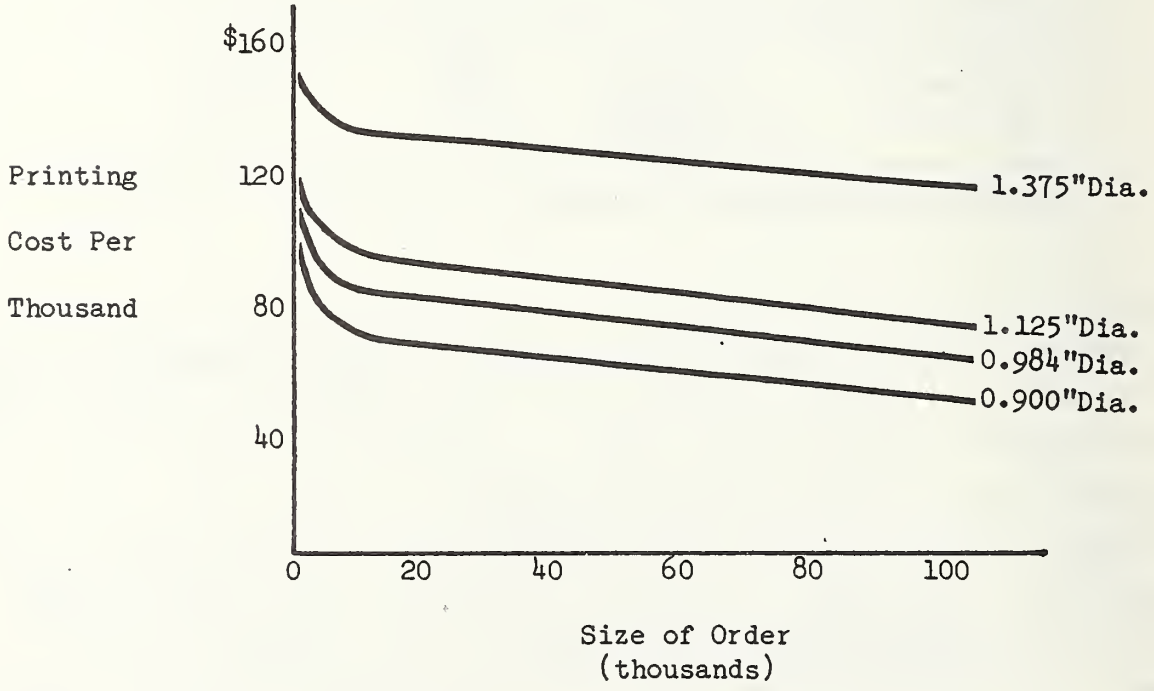
The 1981 costs for brass tokens are presented in Table 4-13 and graphically represented in Figure 4-7. Each curve in the figure represents a unique token size and shows how the unit costs drop as the size of the order increases. For comparison purposes, a U.S. quarter is 0.955 inches in diameter.

Table 4-13

TYPICAL MINTING COSTS FOR BRASS TOKENS - 1981

Size of Order	COSTS PER THOUSAND MINTED BY TOKEN DIAMETER			
	0.900"	0.984"	1.125"	1.375"
1,000 tokens	$96	$109	$119	$160
5,000 tokens	73	85	96	137
10,000 tokens	70	83	94	134
25,000 tokens	68	81	92	132
50,000 tokens	64	77	88	128
100,000 tokens	53	65	75	117

Source: 1981 Price List for Golden Brass Tokens from the Roger Williams Mint.



Source: 1981 Price List for Golden Brass Tokens from the Roger Williams Mint.

Figure 4-7: TOKEN COSTS BY SIZE OF ORDER AND TOKEN SIZE - 1981

Stickers and Stamps

Special stamps or stickers are used by several transit companies to minimize their printing cost and still offer the convenience of a pass to different customers. This is possible because stickers allow the transit company to differentiate the pricing and restrictions of a pass, while keeping the same base pass. Stamps in Sacramento, for example, can be placed on a regular monthly pass to create a pass good for services outside the city of Sacramento. The same stamp can also be placed on the photo identity cards (ID's) for senior citizens and the handicapped, allowing them to use the card as a reduced fare monthly pass.

The printing costs for stamps and stickers in four transit companies are presented in Table 4-14. Note the significant difference in prices between the high-cost stamps printed in Seattle and Sacramento, and those printed in Los Angeles and Portland. Costs are much higher in Seattle and Sacramento because of the quality of the stamp. The stamp used in Seattle may also be expensive because of the low volume printed.

Table 4-14

PRINTING COSTS FOR STAMPS AND STICKERS - 1981

Transit Company	Purpose	Size of Order	Printing Frequency	Cost Per Thousand Printed
Seattle	Elderly and Handicapped	10,000	Monthly	$40
Sacramento	Elderly and Handicapped, Zone	72,000	Annually	28
Portland	Zone	90,000	6 Months	6
Los Angeles	Student	70,000	Monthly	7
	College	50,000	Monthly	6
	Senior Citizen	95,000	Monthly	6
	Express	70,000	Monthly	6

The information presented in Table 4-14 suggests that printing costs do not vary by order size. Although this is probably not the case, a firm relationship between unit cost and printing volume cannot be developed from these data. Consequently, for standardized cost purposes, stamp and sticker printing costs are stratified into high, medium, and low cost categories as shown in Table 4-15.

Table 4-15

STANDARDIZED PRINTING COST FOR
STAMPS AND STICKERS - 1981

	Cost Per Thousand Printed
High Cost	$34
Medium Cost	20
Low Cost	6

Special Passes

In addition to the fare prepayment plans already presented in this section, transit companies can sell special passes and permits to subgroups of the transit riding population. Two types of special passes offered by the case sites include:

- photographic identity cards (base passes) and annual passes; and
- tourist passes.

Although all of the transit companies reviewed in this study offer permits or identify cards to special user groups, only Los Angeles and Sacramento were able to provide data on the costs of printing identity cards for use by special clients. When used with stamps or stickers, identity cards become reduced-fare monthly passes. In Seattle, photographic equipment is used to prepare annual passes, as well as other reduced-fare passes.

Los Angeles is the only case site to offer tourists unlimited travel for fixed periods of time. Five different tourist passes are offered: 3-, 5-, 7-, 10-, and 15-day passes. Passes are priced at $1.00 per day.

The costs of issuing a photographic identity card or annual pass were reviewed in Chapter 3 as a sales cost at transit-operated sales outlets. Of all the materials used in each photographic pass, the base card is the only item printed. The printing costs for these cards in Los Angeles and Sacramento are shown in Table 4-16.

Table 4-16

PRINTING COSTS FOR IDENTITY CARDS (EXCLUDING PHOTOGRAPHS) - 1981

Transit Company	Purpose	Size of Order	Printing Frequency	Cost Per Thousand Printed
Los Angeles	Base Pase	100,000	2 Months	$21
Sacramento	Elderly and Handicapped	30,000	Annually	17

Based on the Los Angeles and Sacramento data, identity cards for base passes and annual passes can be purchased for approximately $20.00 per thousand printed. Identity cards are less expensive than monthly passes because fewer colors and a simpler design are used.

The tourist passes used in Los Angeles are printed monthly for $10.20 per thousand. Approximately 8,000 passes are printed each month. The low cost is due to the relatively simple design and low cost materials used.

Parametric Cost Equation For Printing Fare Prepayment Plans

The average monthly cost for printing all of the plans included in a transit company's fare prepayment program can be estimated using the standardized costs developed in this chapter. The values developed for all fare prepayment plans are summarized in Table 4-17.

Total monthly printing costs can be estimated from the following parametric equation.[1]

$$(4.2) \qquad PC = (1/1000) \sum_{i=1}^{N_t} (S_i)(PR_{ij})/(PF_i)$$

where:

PC = total average monthly cost (dollars) for printing all fare prepayment plans

N_t = number of different fare prepayment plans

S_i = size of printing order for fare prepayment plan i

PR_{ij} = standardized printing cost per thousand instruments of fare prepayment plan i at printing volume j as given in Table 4-18.

PF_i = number of months between printing orders for fare prepayment plan i.

The average monthly costs for printing each fare prepayment plan offered by all 11 transit companies are presented in Table 4-18. Most of the costs presented are based on the actual costs obtained during the interviews. In some cases -- as noted in the table -- monthly cost estimates are based on the standardized costs presented in Table 4-17. The minting costs for the four transit companies that sell tokens are converted into monthly equivalent costs by first amortizing the total minting cost over a ten year useful life.[2] A discount rate of 12 percent is used to obtain annualized costs. Monthly equivalent costs are simply the annualized costs divided by twelve.

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[1]Delivery costs, such as those incurred in Los Angeles, are not estimated separately in this equation since the standardized costs (PR_{ij}) already incorporate delivery charges.

[2]A ten year useful life is a resonable estimate for tokens in contemporary transit companies.

Table 4-17

STANDARDIZED COSTS FOR PRINTING DIFFERENT FARE PREPAYMENT PLANS - 1981

STANDARDIZED COSTS BASED ON ORDER SIZE (PR_{ij})
(cost per thousand printed)

Size of Order	Monthly, Weekly, Semester Passes	Day and Weekend Passes	Ticket Books	Punch Cards	Tokens[a]
Less than 10,000	$120	$90	$250	$62	$96
10,000 - 30,000	60	90	87	38	92
30,000 - 50,000	40	90	50	22	90
50,000 - 100,000	32	40	30	12	82
100,000 - 200,000	25	24	20	7	75
200,000 - 500,000	25	14	20	7	75
500,000 - 1,000,000	25	9	20	7	75
1,000,000 - 2,000,000	25	5	20	7	75
More than 2,000,000	25	2	20	7	75

STANDARDIZED COSTS NOT BASED ON ORDER SIZE (PR_i)

Printed Item	Cost Per Thousand Printed
Multiple-Trip Strip Tickets	$25
Tickets Sold in Rolls	3
Sticker & Stamps: High Cost	34
Medium Cost	20
Low Cost	6
Identity Cards	20
Tourist Passes	10

[a]Costs are for 0.984 inch diameter brass tokens only. See Table 4-13 for costs for other token sizes.

Table 4-18: AVERAGE MONTHLY PRINTING COSTS BY FARE PREPAYMENT PLAN AND TRANSIT COMPANY - 1981

Transit System	PASSES AND PERMITS							Stamps and Stickers	Ticket Books	Ticket Strips & Rolls	Punch Cards	Tokens[b]	Total Average Monthly Printing Cost
	Annual[a]	Semester	Monthly	Weekly	Day/ Weekend	Tourist	Base[a]/ Permit						
Los Angeles[c]	--	--	$1,654	--	--	$85	$1,073	$1,749	$5,267	$669	--	--	$10,497
Philadelphia	--	--	4,320	$28,058	--	--	NA[d]	--	--	--	--	$1,438	33,816
St. Paul	--	--	2,300	--	$629	--	NA	--	145	--	$324	479	3,877
Seattle	$10	--	1,710	--	614	--	NA	399	4,687	--	--	--	7,420
Cincinnati	--	--	--	--	--	--	NA	--	--	--	--	479	479
Portland	--	--	1,838	--	--	--	NA	87	847	--	--	--	2,772
Norfolk	--	--	253	--	--	--	NA	--	689	--	--	--	942
Sacramento	--	--	368	--	1,676	--	35	167	--	--	--	57	2,303
Richmond	--	--	--	219	--	--	NA	--	327	--	--	--	546
Wilmington	--	--	335	--	--	--	NA	--	--	253	--	--	588
Tucson	--	$20	255	--	1,399	--	NA	--	--	--	--	29	1,703

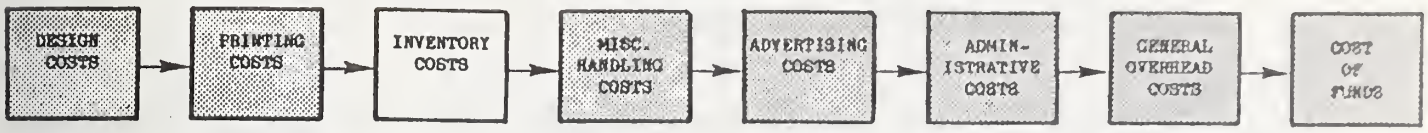
[a]Includes only the cost of the identity card for annual and base passes and not the cost of the photograph or the plastic coating. For Seattle, 6,039 annual passes were in effect in April, or approximately 503 passes were sold per month.

[b]One-time minting costs were converted to monthly equivalent costs assuming ten-year life, 12% discount rate, and 1981 costs for brass 0.984 inch tokens as presented in Table 4-13. St. Paul data on minting volume is not available. It is estimated that 500,000 tokens are minted every 10 years.

[c]Delivery costs of $350 per month were added to the printing costs in Los Angeles, and distributed in proportion to the printing costs of the individual plans.

[d]N A refers to data not available. All of the transit systems included in this study offer special clients identity cards to take advantage of reduced-fare programs. Most systems, however, do not have accurate data on the volumes of cards sold and the costs per card.

INVENTORY COSTS



Description of Activities

Finding adequate storage space for fare prepayment plans is not a problem for transit managers in most companies since passes and tickets do not occupy a large volume of space. They do, however, require secure space since most plans are not dated and can be very valuable. Walk-in vaults and small safes are used at all of the case sites. This space is generally shared with other valuable documents and printed material. Cash, however, is nearly always taken to the bank for deposit on a daily basis.

Two factors affect the space requirements for fare prepayment storage: the type of fare prepayment plans stored and the size of each printing order. Printing frequency plays a role only in that it affects the size of each printing order; that is, as the number of printing orders increases, the volume of each printing decreases. Storage space, therefore, can be minimized by printing less fare prepayment instruments more frequently. In the previous section on printing costs, however, it was shown that increasing the printing frequency increases costs. Thus, there is a cost trade-off between printing frequency and inventory space.

The space requirement will also be affected by the type of fare prepayment plans stored since plans are often of different dimensions. Four or five zone stamps, for example, occupy the same amount of space as one monthly pass.

Although the two factors described above affect the amount of inventory space required to store fare prepayment plans, most storage facilities require access space and space for additional capacity. This additional space has the effect of reducing the total number of instruments that can be stored in a cubic foot of space.

Inventory Requirements and Costs

The space requirements for the 11 transit companies analyzed in this study are divided into three categories:

- storage requirements for pasess and tickets;
- storage requirements for day passes, and
- storage requirements for tokens.

Day passes are separated from conventional passes and tickets because they occupy much less space and are often placed in separate storage facilities. For the four companies using tokens, actual inventories of tokens were available only from Cincinnati. Restocking generally does not occur since tokens are minted very infrequently. In addition, tokens returning through the farebox are wrapped and distributed to outlets for resale and are generally not restocked.

The inventory requirements of nine transit companies are presented in Table 4-19. Inventory stock, or the maximum number of instruments stored at any time, is based on the printing order size of each fare prepayment plan. Stamps and rolls of tickets were multiplied by a factor of 0.25 to normalize the space requirements on a per instrument basis since they occupy approximately 25 percent of the space of a pass or ticket book. The token inventory stock is based on the actual number of tokens not in circulation.

As shown in Table 4-19, inventory requirements -- defined in terms of numbers of instruments per cubic foot -- are not related to inventory stock or restocking frequency. The space requirements for conventional pass and ticket programs are constant across five of the eight sites. Day pass and token programs require much less space.

To compute inventory costs, it is necessary to assign a value for storage space. A 1981 value of $0.77 per cubic foot per year (or $0.06 per cubic foot per month) is used in this study. This value was obtained from a 1976 freight management study.[1]

The equation for estimating monthly storage costs is given by the following expression:

$$(4.3) \qquad IC = (SV) \sum_{i=1}^{N_t} (IS_i)/(IR_i)$$

[1]The McDonnell Douglas Air Freight Decision Tool, McDonnell Douglas Corporation, Long Beach, California, March 1976. The value of $0.57/cu. ft./year used in the McDonnell Douglas study was inflated to 1981 dollars using the GNP Implicit Price Deflator indices.

Table 4-19

INVENTORY REQUIREMENTS FOR SELECT TRANSIT FARE PREPAYMENT PROGRAMS

Fare Prepayment Plan and Transit Company	Inventory Stock[a] (Number of Instruments)	Restocking Frequency[b] (months)	Inventory Space (cu.ft.)	Inventory Requirements (inst/cu.ft.)
Pass and Ticket Programs[c]				
Sacramento	114,000[d]	6.79	400	285
Tucson[e]	4,250	6.00	18	236
Norfolk	71,100	6.00	320	222
Seattle	280,000	10.50	1,312	213
Portland	482,000	6.00	2,400	201
St. Paul	189,000	6.50	960	197
Wilmington	44,250	3.00	400	111
Los Angeles	556,850	1.84	10,000	56
Day Pass Programs				
Sacramento	2,205,500	3.00	320	6,892
Token Programs				
Cincinnati	2,400,000	NA	174	13,793

[a]Based on printing order size except for token programs; stamps and ticket rolls times 0.25.

[b]Weighted average frequency of printing orders.

[c]Includes programs except day passes and tokens.

[d]Does not include photographic identity cards.

[e]Demonstration program only.

where:

IC = monthly inventory cost (dollars) for storing fare prepayment plans

SV = value of storing fare prepayment (dollars per cubic foot per month). In this study, SV = $0.06/cu ft./month

N_t = total number of different fare prepayment plans

IS_i = inventory stock defined as the maximum number of fare prepayment instruments on hand at any one time, where:

$$IS_i = \begin{cases} SI_i, \text{ or the size of the printing order of fare prepayment plan i for conventional plans excluding tokens, tickets in rolls, and stamps;} \\ 0.25\ S_i, \text{ or a quarter of the size of the printing order of fare prepayment i for tickets in rolls and stamps} \\ N_{ts}, \text{ or the actual number of tokens in stock} \end{cases}$$

IR_i = inventory space requirement computed in instruments per cubic foot using the standardized values presented below in Table 4-20.

Table 4-20

STANDARDIZED INVENTORY REQUIREMENTS

Fare Prepayment Plan and Efficiency of Space Utilization	NUMBER OF INSTRUMENTS PER CUBIC FOOT	
	Normal Range	Standardized Value (IR_i)
CONVENTIONAL PLANS		
High Efficiency	240 - 290	265
Normal Efficiency	200 - 240	220
Low Efficiency	100 - 200	150
DAY PASSES	NA	7,000
TOKENS	NA	14,000

Actual and estimated monthly inventory costs for all 11 transit companies are presented in Table 4-21. Actual costs based on the inventory space reported during the case study interviews are presented for most of the transit companies. For those companies where inventory space was not reported, monthly storage costs are computed from equation (4.3) using the standardized values presented in Table 4-20.

Table 4-21

MONTHLY INVENTORY COSTS - 1981

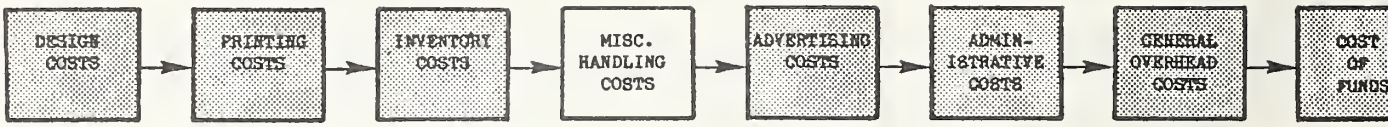
Transit Company and Fare Prepayment Program	Inventory Stock (No. of instruments)	Inventory Space (cu. ft.)	Monthly Inventory Cost[a]
Los Angeles			
Conventional Plans	556,850	10,000	$600
Philadelphia			
Pass Plans	299,800	1,363[b]	82
Tokens	5,782,568[c]	413[b]	25
St. Paul			
Conventional Plans	189,000	960	58
Weekend Pass	286,000	41[b]	2
Tokens	2,400,000[c]	174	10
Seattle			
Conventional Plans	280,000	1,312	79
Weekend Pass	1,200,000	171[b]	10
Cincinnati			
Tokens	2,400,000	174	10
Portland			
Conventional Plans	482,000	2,400	144
Norfolk			
Conventional Plans	71,100	320	19
Sacramento			
Conventional Plans	114,000	400	24
Day Pass	2,205,000	320	19
Tokens	1,191,170[c]	85[b]	5
Richmond			
Conventional Plans	165,000	750[b]	45
Wilmington			
Conventional Plans	44,250	400	24
Tucson			
Monthly Pass	95,320	433[b]	26
Demonstration Plans	4,250	18	1
Weekend Pass	3,500	1[b]	negligible

[a]Costs based on $0.06 per cubic foot per month.

[b]Actual inventory space not known; space calculated from standardized values presented in Table 4-20.

[c]Inventory stock of tokens estimated from storage rate in Cincinnati.

MISCELLANEOUS HANDLING COSTS



Description of Activities

Three of the eleven transit companies perform special functions in the operation of their ticket and pass programs. Norfolk, for example, counts all new passes arriving from the printer and destroys unsold passes during the month the passes are valid. Wilmington and Portland both separate tickets from the farebox, weigh them, and destroy the tickets with a shredding machine.

Labor and Equipment Costs

The monthly labor and equipment costs for three transit companies are itemized in Table 4-22. These are the only transit companies included in this study that acknowledged significant labor and equipment costs for destroying fare prepayment plans. Although these costs are real, the authors believe that these costs can be minimized or even eliminated if other methods of disposing of passes and tickets are considered. In Sacramento, for example, unsold passes are delivered to the Weyerhaeuser Company for paper recycling. This service is provided free of charge and a certificate of destruction is issued for each recycling operation. Vacuum-operated fare collection equipment automatically separates paper material from cash revenues, eliminating the need to manually separate tickets from cash fares.

Table 4-22

MONTHLY LABOR AND EQUIPMENT COSTS FOR
PASS AND TICKET COUNTING AND SHREDDING - 1981

NORFOLK

Activity:	Counting new passes and destroying unsold passes.	
Labor:	24 hours/month @ $4.81/hour	
Monthly Costs:	Labor and Fringe	$148.92
	Other	0
	Total Monthly Cost	$149.92

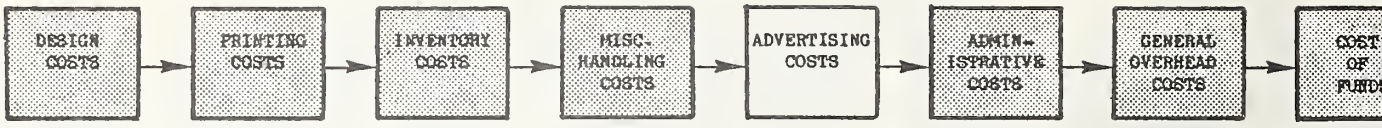
WILMINGTON

Activity:	Separating tickets from farebox and shredding tickets	
Labor:	9 hours/month @ $10.10/hour	
Equipment:	One shredding machine @ $3,700, 3-year service life	
Monthly Costs:	Labor and Fringe	$127.81
	Equipment	128.36[a]
	Total Monthly Cost	$256.17

PORTLAND

Activity:	Separating tickets from farebox, weighing tickets, and shredding tickets	
Labor:	21 hours/month @ $16.27/hour	
Equipment:	One shredding machine @ $3,700, 3-year service life	
Monthly Costs:	Labor and Fringe	$480.39
	Equipment	128.36[a]
	Total Monthly Cost	$608.75

[a]One-time equipment acquisition costs are converted into equivalent annual (and subsequently monthly) costs using a capital recovery factor based on the service life and a discount rate of 12 percent.



Description of Activities

Few of the transit companies interviewed operate on-going advertising campaigns to promote and inform the public of existing fare prepayment programs. Most transit managers feel their programs have been around for a long enough period of time that further publicity would be unproductive. Three transit companies however, do incur monthly advertising and publicity costs and these expenses are described here.

In addition to these monthly costs, three transit companies provided information on the costs of advertising campaigns that were run to promote the introduction of new pass programs or the introduction of new sales outlets. These one-time costs were spent over a fairly short period of time just prior to and after the change in the program. While most forms of advertising have a very short-term effect on sales[1], the literature on the economics of advertising recognizes that some advertising practices -- such as the large scale introductory campaigns that introduce new products or major changes in products -- may have a lagged effect on sales longer than one year. For example, Peles[2] found annual depreciation rates of 40 to 50 percent for non-durable goods, but for durable goods, such as car purchases, he found 100 percent annual depreciation rates. Faced with this information, the following procedure was used to estimate advertising costs: i) all recurrent advertising was assumed to have a short-term effect and 100 percent depreciable within the year in question, and ii) large scale introductory campaigns -- such as the ones that accompany the introduction of a new fare prepayment plan -- were assumed to have an effect over an 18 month period, which is at the midpoint between the durable and non-durable amortization rates.

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[1]See James M. Ferguson. Advertising and Competition. Ballinger Publishing Company, Cambridge, Massachusetts, 1974.

[2]Peles, Yoram. "Rates of Amortization of Advertising Expenditures". Journal of Political Economy. Vol. 79. September 1977.

Labor and Media Costs For Continuous Advertising Campaigns

Continuous advertising campaigns are run in Los Angeles, Seattle, and Tucson. The labor and media costs for these programs are presented in Table 4-23. This table also presents fare prepayment sales and the total advertising cost per instrument sold.

Table 4-23

MONTHLY LABOR AND MEDIA ADVERTISING COSTS FOR FOUR FARE PREPAYMENT PLANS - 1981

Transit Company and Fare Prepayment Plan	Monthly Sales	Man Hours Per Month	Labor & Fringe Costs	Media Costs	Total Advertising Costs	Advertising Cost Per Instrument Sold
Los Angeles Monthly Pass	217,139	126	$2,142	$24,500	$26,642	$0.1227
Seattle Monthly Pass	46,409	5	75	15,000	15,075	0.3248
Tucson Demonstration[a]	3,016	Negl.	Negl.	2,000	2,000	0.6631
Los Angeles Tourist Pass	5,323	21	360	4,000	4,360	0.8191

[a]Demonstration program sales and cost data for 6-month period.

As shown in Table 4-23, the unit costs spent on advertising drop as the size of the program increases. This inverse relationship is presented graphically in Figure 4-8. Note that although unit advertising costs decrease as sales expand, total advertising costs grow with sales. Los Angeles, for example, spends 77 percent more money each month in advertising its monthly pass program than Seattle does on its program, and Los Angeles sells 368 percent more passes.

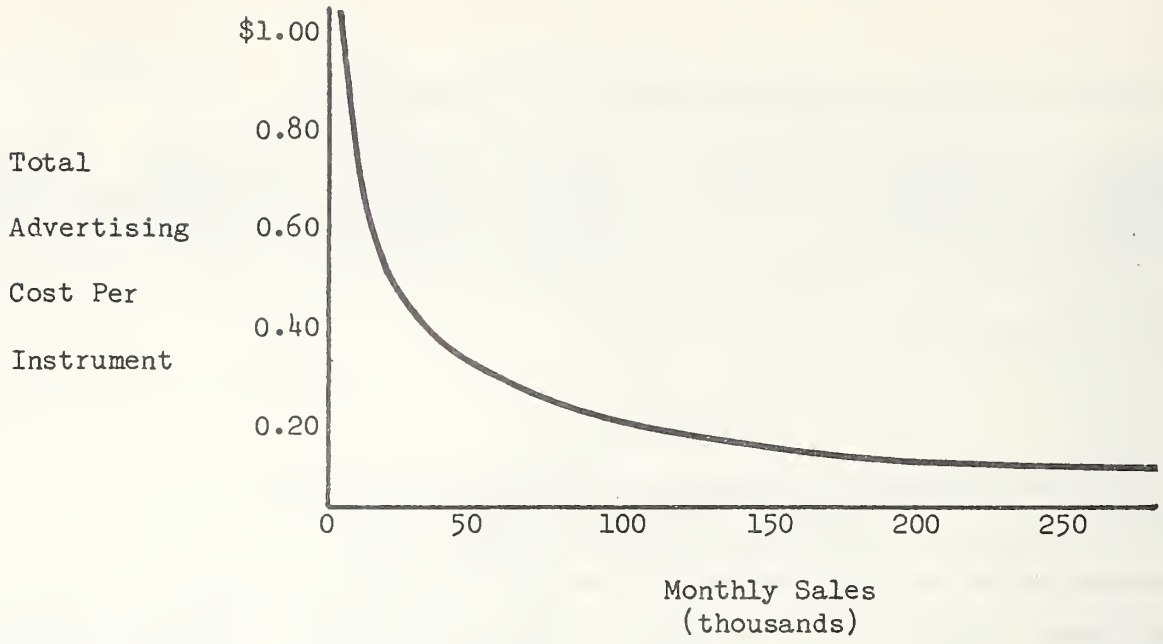


Figure 4-8: UNIT ADVERTISING COSTS BY SALES VOLUME

Although there is a direct relationship between expenditures on advertising and monthly sales in the transit companies with advertising programs, advertising is not a transaction-oriented function. Los Angeles, for example, could easily choose to advertise at a rate far below what it is currently spending. Most transit companies, in fact, have no advertising budget for their fare prepayment programs. Advertising expenditures, therefore, are based on management decisions and not fare prepayment sales.

Following the relationship presented in Figure 4-8, it is possible to provide a series of standardized costs for continuous advertising campaigns based on the size of the pass or ticket program. These values, presented below in Table 4-24, can be used to estimate what a "normal" level of expenditure might be for a program of a particular size. The following equation is provided for computing average monthly advertising costs:

$$(4.4) \qquad AC = \sum_{i=1}^{N_a} (N_i)(AR_i)$$

where:

AC = total monthly advertising cost (dollars)

N_a = number of different fare prepayment plans being advertised each month

N_i = number of monthly sales of fare prepayment plan i

AR_i = standardized advertising cost as given in Table 4-24

Table 4-24

STANDARDIZED COSTS FOR ADVERTISING FARE PREPAYMENT PROGRAMS - 1981

Monthly Sales Volume	MONTHLY COST PER INSTRUMENT SOLD	
	Normal Range	Standardized Cost (AR_i)
Less than 10,000	More than $0.60	$0.80
10,000 - 30,000	0.40 - 0.60	0.50
30,000 - 50,000	0.33 - 0.40	0.37
50,000 - 100,000	0.20 - 0.33	0.24
100,000 - 200,000	0.12 - 0.20	0.15
More than 200,000	Less than 0.12	0.10

Costs for One-Time Advertising Campaigns

Single "blitz" advertising campaigns, while not a continuing operating cost of fare prepayment programs, are the most common form of fare prepayment advertising. In 1979 when Philadelphia introduced its monthly and weekly pass program, $150,000 was spent to promote the new program. An additional $80,000 was spent in the fall of 1979 to further promote the program.

As part of an UMTA demonstration grant, Sacramento Regional Transit spent approximately $26,000 in 1978 to promote the introduction of its employer-distributed pass program. These funds were spent over a 12-month period at the beginning of the program.

This year, Tri-Met in Portland entered into a contract with the Seven-Eleven retail chain allowing Seven-Eleven to distribute and sell Tri-Met's passes and tickets at its retail outlets. This new sales program was introduced with a 60-day advertising campaign involving bus advertising and media coverage. Between $20,000 and $25,000 was spent during this 60-day period.

The advertising expenditures on these campaigns are presented in Table 4-25. These costs are amortized over an 18-month period and then compared to each company's average monthly prepayment sales. The amortized unit advertising costs are also presented in Table 4-25.

Table 4-25

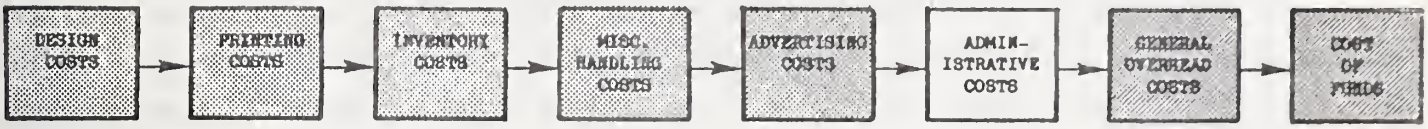
ONE-TIME ADVERTISING COSTS - 1981

Transit Company and Fare Prepayment Plan	Year of Campaign	Campaign Advertising Expenditure	Amortized Monthly Expenditure[a]	Average Monthly Sales	Amortized Advertising Cost Per Instrument
Sacramento Demonstration	1978	$ 25,967	$1,661	$ 13,473	$0.12
Philadelphia All Passes	1979 (Jan.)	150,000	9,595	178,791	0.05
Philadelphia All Passes	1979 (fall)	80,000	5,117	178,791	0.03
Portland All Plans	1981	25,000	1,599	62,687	0.03

[a]One-time advertising costs are converted into equivalent monthly costs using a capital recovery factor based on a sales effect period of 18 months and a discount rate of 12 percent.

The cost figures presented in Table 4-25 indicate that, outside of a demonstration setting, individual advertising campaigns can have an effect over an 18-month period and can be budgeted at amortized costs of $0.03 to $0.05 per instrument sold each month. These figures, however, are presented only as indications of what some transit companies are spending on one-time advertising campaigns. Obviously, many other factors are brought into focus when determining specific funding levels.

ADMINISTRATIVE COSTS



Description of Activities

As with advertising costs, few transit companies report significant costs in the overall administration of their fare prepayment programs. Six of the eleven transit companies report supervisory, administrative, and promotional activities. The remaining sites are either uncertain of actual time spent on these activities or report that these costs constitute a negligible part of the programs overall cost.

Four administrative functions were identified during the interviews at the case sites:

- staff supervision and administration;
- transit-operated outlet administration;
- support and maintenance of existing public, private, and employer outlets; and
- outlet expansion and promotion.

The first two functions are administrative in nature, while the latter two support outlet expansion. Most companies do not expend resources on servicing and promoting public sales outlets since existing operations are considered satisfactory. A negligible amount of time is spent in staff supervision since most programs are not new and, consequently, are self-administering.

Labor Requirements and Costs

The labor requirements for fare prepayment programs in six transit systems are presented in Table 4-26. The differences in reported man-hours are significant and cannot be easily explained. Los Angeles has a very large fare prepayment program which could explain the level of effort spent on administration

at that site. St. Paul, Seattle, and Sacramento put a lot of effort in outlet promotion and expansion. Philadelphia and Norfolk, however, are perhaps typical in terms of the level of man-hours spent on administration and the size of the fare prepayment program. If these values are taken as accurate, then standardized values of the man-hours required to manage a fare prepayment program can be given as shown in Table 4-27. The values presented are divided into those systems with large expansion and promotional efforts and those just maintaining a basic fare prepayment system.

Table 4-26

LABOR REQUIREMENTS FOR FARE PREPAYMENT PROGRAM ADMINISTRATION

Transit Company	MONTHLY MAN HOURS				
	Staff Supervision	Outlet Administration	Outlet Support	Outlet Promotion	Total Program Administration
Los Angeles	N.A.[a]	N.A.	N.A.	N.A.	346
St. Paul	N.A.	N.A.	N.A.	N.A.	173
Sacramento	43	N.A.	43	87	173
Seattle	2	8	N.A.	87	97
Philadelphia	N.A.	N.A.	N.A.	N.A.	52
Norfolk	1	N.A.	N.A.	N.A.	1

[a]N.A. refers to category where data are not available.

Table 4-27

STANDARDIZED VALUES OF LABOR REQUIRED FOR FARE PREPAYMENT PROGRAM ADMINISTRATION

Fare Prepayment Program Size and Characteristics	MONTHLY MAN HOURS	
	Normal Range	Standardized Value (ADR)
Companies With Program Expansion		
Large Programs	200 - 300	250
Medium Programs	100 - 200	150
Small Programs	50 - 100	75
Companies Without Program Expansion		
Large Programs	40 - 60	50
Medium Programs	20 - 40	30
Small Programs	1 - 20	10

The monthly costs for the administration of the fare prepayment programs in all 11 systems are presented in Table 4-28. Since most case sites report that their costs are either unknown or negligible, the labor requirements for these companies are based on the standardized values presented in Table 4-27. Although some of these transit companies are expanding their fare prepayment programs, the administrative labor for all the case sites not reporting costs are taken from the category of companies without program expansion.

The monthly costs given in Table 4-28 can be computed from the following equation:

$$L_{ad} = (W_{ad})(1 + F_r)(ADR) \quad (4.5)$$

where:

L_{ad} = monthly labor cost (dollars) for administering a fare prepayment program

W_{ad} = average hourly wage rate for program administration

F_r = fringe benefit rate

ADR = monthly labor requirement in man-hours based on standardized values presented in Table 4-27

Administrative Costs for Employer Distribution and Payroll Deduction

Due to the time required to develop and maintain an employer-distributed fare prepayment program, a transit manager should expect that an equal amount of time will be spent on general program administration and the administration of an employer-distributed program. Thus, total administration costs could double with such a program. For this reason, transit managers interested in adopting an employer-promoted fare prepayment program should use the labor requirements presented in Table 4-27 under the category of companies with program expansion.

In addition to the administrative costs incurred by a transit company, employer-distributed fare prepayment will increase an employer's costs slightly. In a detailed study of the employer-promoted monthly pass demonstration program in Sacramento, California,[1] Systan, Inc. found that the average monthly cost

[1]Systan, Inc. Sacramento Transit Fare Prepayment Demonstration. Final Report Prepared for the Transportation Systems Center, U.S. Department of Transportation, Cambridge, Massachusetts, May 1981.

Table 4-28

MONTHLY LABOR COST FOR FARE PREPAYMENT ADMINISTRATION - 1981

Transit Company	Man Hours Per Month[a]	Average Hourly Wage Rate	Fringe Benefit Rate (Percent)	Monthly Administrative Cost
Los Angeles	346[b]	$13.27	46.7	$6,736
Philadelphia	52[b]	15.00	36.1	1,062
St. Paul	173[b]	10.58	33.2	2,438
Seattle	97[b]	12.65	35.7	1,665
Cincinnati	10	7.21	38.7	100
Portland	30	11.30	33.0	451
Norfolk	1[b]	12.02	29.0	16
Sacramento	173[b]	13.87	43.4	3,441[c]
Richmond	10	8.65	31.1	113
Wilmington	10	6.73	40.6	95
Tucson				
monthly pass	10	5.85	30.5	76
demonstration passes	10	14.30	30.5	187

[a]Based on standardized values shown in Table 4-27 except as noted.

[b]Based on actual data as shown in Table 4-26.

[c]Very large monthly administrative cost is partially due to the administrative requirements of the demonstration program.

to the employer was $30.80, including $18.12 for pass sales and distribution, $5.81 for surveys and interviews (a demonstration-specific activity), $4.54 for payroll deduction, and $2.34 for miscellaneous costs, such as mailing. Among the 48 participating employers, average monthly costs ranged from $0 to $168; the median monthly cost, however, was only $11.25.

The monthly costs reported in this study were found to be positively correlated with number of passes sold. For an employer, consequently, administration (and sales) is a transaction-oriented function. Excluding costs for payroll deduction and surveys, Systan Inc. ran a simple regression between cost and sales. The equation, with an R-squared of 0.49, is:

(4.6) Employer Monthly Costs = $6.72 + $0.34 x (number of passes sold)

This equation, however, is overly influenced by a few extreme data points. The use of a marginal cost of $0.50 with no fixed cost was suggested by Systan, Inc. to be more appropriate. The total cost reported by employers divided by the number of passes sold results in a cost per pass of $0.504. The total monthly costs, therefore, incurred by employers can be estimated from the following equation:

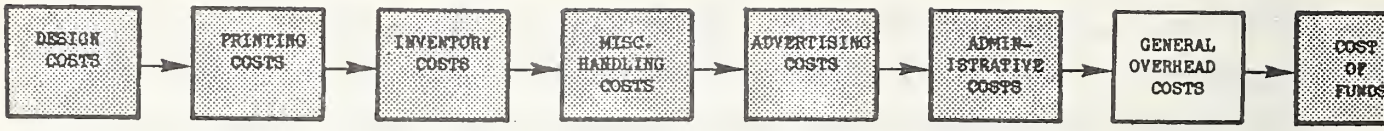
$$(4.7) \qquad EC = (0.504) \sum_{i=1}^{F_m} EM_i$$

where:

EC = monthly cost (dollars) incurred by employers for the administration of the employer-distributed program

F_m = number of firms participating in the employer distributed program

EM_i = number of fare prepayment plans sold monthly by employer i.



Description of Activities

In addition to direct labor, fringe benefits, and special equipment costs, all fare prepayment programs incur general supply and operating costs. As a general rule, program overhead costs (i.e., the cost of general supplies, telephones, utilities, maintenance, and rent) can be estimated as a percentage of direct labor costs when actual overhead costs are not known. This is done because most overhead expenses are labor-specific. Space, for example, must increase along with the number of workers employed. The overhead costs included in this section exclude any charges for overhead labor above the supervisor's time noted in the previous section in view of the authors' desire to approximate truly incremental costs.

This section presents the overhead costs incurred at transit-operated sales outlets and at transit company headquarters. Because overhead expenses differ considerably between sales outlets and headquarters, these costs are analyzed separately. In both cases, overhead costs are computed as a percentage of labor costs.

Overhead Costs at Transit-Operated Sales Outlets

Few fare prepayment managers were able to provide accurate cost information on the operation and maintenance of company-operated sales outlets. A few years ago, however, the Marketing Department of SCRTD in Los Angeles did a series analyses of the revenue performance of their outlets. At issue was whether the outlets should remain operational if sales dropped below a certain level. One departmental memorandum reviewed the operating costs of five SCRTD sales outlets. These costs are presented in Table 4-29.

The overhead rates presented in Table 4-29 -- defined as the ratio of overhead cost to labor cost -- are not aligned with either number of monthly transactions or total labor cost. The extremely high rate observed at the Greyhound Terminal is due to the fact that a commission is charged on pass and ticket revenues in lieu of a rental fee. Thus, normal overhead rates appear to range from 0.10 to 0.40. The mean overhead rate for the last four sales outlets is 0.20.

Table 4-29

OVERHEAD RATES AT FIVE LOS ANGELES SALES OUTLETS

Sales Outlets	Number of Monthly Transactions	Monthly Labor Costs 1978	Overhead Costs - 1978			Overhead Rate (Overhead/ Labor
			Rent Maintenance Utilities	General and Admin.	Total Over-Head	
Greyhound Terminal	21,731	$11,268	$21,901[a]	$1,891	$22,792	2.11
Arco Plaza	8,470	3,347	1,017[b]	249	1,266	0.38
Hollywood	10,722	3,347	441	216	657	0.20
Headquarters	5,501	8,259	604	505	1,109	0.13
El Monte	6,973	4,598	185[b]	273	458	0.10

[a]Extremely high commission is paid at the Greyhound Terminal which covers the rental fee.

[b]Does not include rent (space is donated).

Source: Cost data provided in: Ron Johnson, "ARCO Plaza Ticket Office," Appendix B, Departmental Memorandum, March 23, 1978.

If a standard overhead rate is applied to all transit-operated sales outlets, monthly overhead costs can be computed as follows:

$$(4.8) \qquad OC_t = (OR_t)(L_s + L_{rt})$$

where:

OC_t = monthly overhead cost (dollars) for operating all transit-operated sales outlets

OR_t = overhead rate for transit-operated sales outlets defined as the ratio of overhead costs to labor costs, (a standardized value of 0.20 is applied in this study)

L_s = monthly labor cost (dollars) for selling fare prepayment plans at transit-operated sales outlets as defined in equation (3.11)

L_{rt} = monthly labor cost (dollars) for recording fare prepayment sales at transit-operated sales outlets as defined in equation (3.21b)

The monthly overhead costs at all transit-operated sales outlets are presented in Table 4-30. A standardized overhead rate of 0.20 was applied uniformly to all sales outlets.

Overhead Costs at Transit Company Headquarters

Overhead expenses at transit company headquarters are computed as a percentage of the labor costs (i.e., salary plus fringe benefit) incurred in operating a fare prepayment program. These overhead expenses do not include any overhead labor in view of the authors' desire to approximate incremental costs. In contrast to sales outlets where a standardized overhead rate was computed from a very limited data base, actual administrative overhead rates (as opposed to the overhead rates that include bus operations) for transit company headquarters are available from a recent UMTA report of annual operating statistics based on the Section 15 reporting system.[1] These overhead rates were computed as a percentage of labor costs for use in this study. These values and the monthly overhead costs for fare prepayment programs at each transit company headquarters are presented in Table 4-31. Notice that company overhead rates drop as transit company size increases.

To compute the monthly overhead cost that can be attributed to the operations of a fare prepayment program at headquarters, the following equation should be applied:

$$(4.9) \qquad OC_h = (OR_h)(L_h)$$

where:

OC_h = monthly overhead cost (dollars) for operating a fare prepayment program at transit company headquarters

OR_h = overhead rate for transit company headquarters defined as the ratio of total administrative materials, supplies, and other expenses, to total non-operating administrative labor

L_h = monthly labor cost (dollars) for operating a fare prepayment program at transit company headquarters, including the labor cost of order preparation for public outlets and on-board sales, staff delivery, direct mail and telephone programs, recording and accounting, plan design, advertising, administration, and other miscellaneous labor activities

The monthly labor costs presented in Table 4-31 (L_h) are the sum of all the labor costs incurred in operating a fare prepayment program at transit company headquarters. Thus these costs are the sum of all labor costs presented in this report, less the costs incurred for operating sales outlets ($L_s + L_{rt}$). Labor costs at headquarters include the labor cost of order preparation, staff delivery, direct mail and telephone programs, recording and accounting, plan design, advertising, administration, and other miscellaneous activities.

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[1] U.S. Transportation Systems Center, National Urban Mass Transportation Statistics: First Annual Report, Section 15 Reporting System. Prepared for the Urban Mass Transportation Administration, Washington, D.C., May 1981, pp. 2-57 through 2-79.

Table 4-30

MONTHLY OVERHEAD COSTS FOR TRANSIT-OPERATED SALES OUTLETS - 1981

Transit Company and Sales Outlets	Labor Costs			Monthly Overhead Costs[a]
	Sales Costs	Recording Costs	Total Monthly Costs	
Los Angeles[b]				
Greyhound	$14,714	$ 796	$15,510	$3,102
Headquarters	8,846	202	9,048	1,810
El Monte	6,000	256	6,256	1,251
Arco Plaza	4,372	311	4,683	937
Hollywood	4,372	393	4,765	953
Long Beach	601	26	627	125
Van Nuys	4,005	172	4,177	835
South Central	1,100	47	1,147	229
South Bay	836	36	872	174
Wilshire Office	3,139	134	3,273	655
Philadelphia				
8 depots (each)	5,446	192	5,638	1,128
(combined)	(43,566)[c]	(1,536)[c]	(45,102)[c]	(9,024)[c]
6 cashier offices (each)	2,545	170	2,715	543
(combined)	(15,270)[c]	(1,020)[c]	(16,290)[c]	(3,258)[c]
13th Street	2,590	354	2,944	589
15th Street	4,527	1,427	5,954	1,191
Treasury	82	20	102	20
Red Arrow Division	8,017	350	8,367	1,673
St. Paul				
MTC Office	107	18	125	25
Minneapolis Booth	1,877	498	2,375	475
St. Paul Booth	820	200	1,020	204
Seattle				
Headquarters	2,823	210	3,033	607
Cincinnati				
Headquarters	16	70	86	17
Portland				
Customer Assistance Office	10,374	1,331	11,705	2,341
Norfolk				
Headquarters	402	57	459	92
Sacramento				
Passenger Service Center	776	334	1,110	222
Headquarters	298	250	548	110
Photo ID's at Headquarters[d]	1,838	307	2,145	429

[a]Computed as 0.20 x (total monthly labor cost).

[b]Actual overhead costs for five outlets previously mentioned were not available for 1981. Consequently, standardized costs are presented.

[c]The larger numbers in parentheses indicate the total labor and overhead costs at the combined outlets.

[d]Photo ID services at schools are estimated to incur zero overhead cost.

Table 4-31

MONTHLY OVERHEAD RATES AND COSTS AT TRANSIT SYSTEM HEADQUARTERS - 1981

Transit Company	Total Labor Costs[a] (L_h) (1)	Labor As Percent of Section 15 Admin. Costs[b] (2)	Overhead As Percent of Section 15 Admin. Costs[c] (3)	Overhead As Percent of Labor Costs[d] (OR_h) (4)	Monthly Overhead Costs[e] (OC_h) (5)
Los Angeles	24,292	41.9	4.9	11.7	2,842
Philadelphia	10,251	42.2[f]	9.3[f]	22.0	2,255
St. Paul	6,156	37.9[f]	7.4[f]	20.0	1,231
Seattle	6,963	55.8	12.6	22.6	1,574
Cincinnati	1,010	52.2	19.7	37.7	381
Portland	6,888	55.8[g]	12.6[g]	22.6	1,557
Norfolk	1,472	34.1[f]	8.5[f]	24.9	367
Sacramento	5,252	26.6[f]	22.2[f]	83.5	4,385
Richmond	1,963	29.7	20.3	68.4	1,343
Wilmington	1,175	42.6	15.2	35.7	419
Tucson	835	26.2	22.3	85.1	711

[a]Sum of all fare prepayment labor costs at headquarters for operating activities in Chapters 3 and 4, as defined in equation (4.9).

[b]Total non-operating administrative labor as a percentage of all administrative expenses based on the Section 15 reporting system as documented in Transportation Systems Center (1981), pp. 2-57 through 2-79.

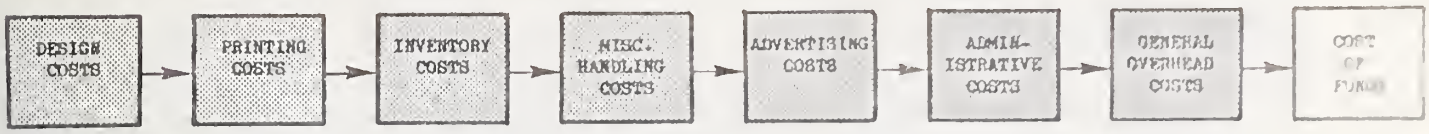
[c]Total administrative materials, supplies, and other expenses as a percentage of all administrative expenses based on the Section 15 reporting system as documented in Transportation Systems Center (1981), pp. 2-57 through 2-79.

[d]Computed by dividing column three by column two.

[e]Computed by multiplying columns one and four.

[f]Total non-operating labor and total materials, supplies, and other expenses as a percentage of all operating expenses based on the Section 15 reporting system as documented in Transportation Systems Center (1981), pp. 2-46 through 2-47.

[g]Data for Portland not available; Portland values based on Seattle data.



Description of Activities

One feature of fare prepayment plans is that their revenues are often collected by the transit company in advance of services being delivered. This positive cash flow resulting from fare prepayment sales reduces the financing requirements of a transit company, requirements which are usually met by a combination of funds from municipal taxes and debt obligations. A positive cash flow thereby results in benefits of interest accruals to a transit company. These benefits, however, are only attainable if revenues are obtained in advance of services being delivered.

Interest accruals from fare prepayment sales are only one of several benefits that characterize fare prepayment programs. Other benefits include decreases in boarding times and savings in coin and dollar bill handling costs. These important benefits, however, are not discussed in this report since this study is concerned solely with identifying the costs of fare prepayment programs.

Consideration of the cost of funds, however, must be incorporated in the analysis of fare prepayment costs in order to recognize cost differences between transit-operated and public/private outlet sales methods.[1] Even though these costs are not truly incurred by the transit company, they have been analyzed to permit comparisons between transit-operated outlets and public/private outlets. The reader should keep this important distinction in mind when focusing on comparisons other than outlet cost comparisons.

The principal factor affecting the cost of funds is the time delay between the moment fare prepayment plans are sold and the time revenues are transferred to the transit company's bank account. Typically, fare prepayment revenues from sales at transit-operated outlets and transit company headquarters are deposited daily. In contrast, public and private outlets generally return new revenues around the fifteenth of each month. It is the cost of funds implicit in these delays -- equivalent to lost interest or the cost of borrowing funds -- that must be accounted in this cost analysis.

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[1] A detailed analysis of these cost differences appears in Chapter 5.

Cost of Revenue Delay

Table 4-32 presents the average monthly revenues that are subject to delays and the average delay times for each transit company. The average delay time is defined as the number of days between the date of fare prepayment sales at public and private outlets and the date fare prepayment revenues from these outlets are credited to the transit company's bank account. This is a period of lost interest in comparison to the interest accrued from sales at transit-operated outlets since revenues from these outlets are collected and deposited daily. The delay time for tickets, tokens, and punch cards is half the outlet servicing period since these plans are assumed to be purchased continuously throughout the month.

The cost of funds is computed by multiplying the average monthly revenue that is subject to delay times the municipal borrowing rate (expressed as a daily rate) times the number of days of delay in transferring revenues to the transit company's bank account. This monthly cost can be computed from the following equation:

$$(4.10) \qquad CF = (i/365) \sum_{j=1}^{N_t} (N_j)(\overline{P}_j)(DD_j)$$

where:

CF = monthly cost of funds (dollars) defined as the interest lost each month due to delays in revenue deposits when contrasted with daily deposits of fare prepayment revenues

i = annual municipal borrowing rate

(i/365) = municipal borrowing rate expressed as a daily rate

N_t = total number of fare prepayment plans

N_j = number of monthly sales of fare prepayment plan j that are subject to delay

$\overline{P}_j$ = weighted average price per fare prepayment plan j

DD_j = number of days elapsing from the date of sale of fare prepayment plan j to the date when the funds are transferred to the transit company's bank account

Since the data obtained from interviews show a pattern of daily deposits of fare prepayment revenues from transit-operated outlets, as well as fare prepayment sales at headquarters, the number of delay days for these revenues is zero. For monthly pass sales at public and private outlets, the number of delay days is calculated from five days before the month of pass validity (i.e., from the date of sales) to the date when revenues were transferred to the transit company's bank account. The delay period for ticket plans is generally half the outlet servicing period as previously explained.

The average monthly cost of funds for each transit company is computed from equation (4.10) using the data in Table 4-32. The monthly totals are presented in Table 4-33. Los Angeles incurs the most cost because of the extremely high volume of monthly pass sales at commissioned outlets, and because pass revenues are not transferred until the fifteenth of the month (i.e., 20-day delay period). If the revenues from these 207 outlets could be transferred ten days earlier (i.e., by the fifth of the month), the fare prepayment program in Los Angeles could earn approximately $10,000 each month.

It is important to remember that Los Angeles is not losing money each month because of fare prepayment sales. These are opportunity costs that could be saved if revenues were transferred immediately, or if all fare prepayment sales occurred at transit-operated outlets where revenues are deposited daily. The true cost of funds can be computed by comparing these opportunity costs with the benefits of getting fare prepayment revenues in advance of cash revenues had there not been a fare prepayment program. This analysis, unfortunately, is beyond the scope of this report.

Table 4-32

TRANSIT FARE PREPAYMENT REVENUES AND AVERAGE DEPOSIT DELAY TIMES

Transit Company and Distribution Method	Fare Prepayment Plan	Number of Instruments Sold Monthly	Weighted Average Price Per Instrument	Monthly Revenue Subject To Delay	Average Delay Time (days)[a]
Los Angeles					
Commissioned Outlets	monthly passes	164,010	$18.73	$3,071,748	20
	individual tickets[b]	14,638	6.50	95,147	15
	ticket books[b]	18,629	6.50	121,089	15
Non-Commissioned Outlets	monthly passes	2,754	31.19	85,892	20
	individual tickets[b]	246	6.50	1,599	15
	ticket books[b]	313	6.50	2,035	15
Philadelphia					
Public Outlets	monthly passes	5,589	32.00	178,848	5
	weekly passes	71,282	8.25	588,077	4
	tokens[c]	17,280	6.50	112,320	3
St. Paul					
Public and Private Outlets	monthly passes	34,643	21.41	741,707	20
	commuter tickets	11,678	7.48	87,351	15
	elderly & dime zone	1,868	1.00	1,868	15
	student	7,983	8.00	63,864	15
	tokens[d]	7,239	10.00	72,390	15
Seattle					
Public and Employer Outlets	monthly passes	44,556	16.84	750,328	15
	annual passes	75	60.29	4,525	15
	20-trip ticket book	7,733	3.00	23,198	15
	40-trip ticket book	6,828	10.00	68,284	15
Cincinnati					
Public Outlets	tokens	8,237	3.00	24,711	0[e]
Portland					
Public and Employer Outlets	monthly passes	19,873	21.99	437,007	20
	ticket books[f]	21,500	5.95	127,925	15
Norfolk					
Public Outlets	monthly passes	1,544	$19.69	30,405	7
	10-trip ticket book	2,641	5.77	15,239	0[g]
Sacramento					
Public Outlets	monthly passes	4,443	12.56	55,804	17
	tokens[d]	1,432	5.01	7,174	15
Private and Employer Outlets	monthly passes	7,408	14.56	107,860	10
	tokens[d]	1,548	5.01	7,755	15
Richmond					
Public Outlets	weekly pass	6,500	6.75	43,875	6
	ticket books[h]	23,100	4.64	107,184	3
Wilmington					
Public Outlets	monthly passes	1,512	20.10	30,391	20
	10-trip strip tickets	17,908	3.98	71,274	15
Tucson					
Public and University Outlets	monthly pass	3,767	12.00	45,204	25
	semester pass	301	35.00	10,535	30
	20-trip punch card	560	6.00	3,360	15

[a]Defined as the average number of days between date of purchase and date of deposit.

[b]Individual tickets assumed sold in quantities of ten; books assumed to contain 10 tickets.

[c]Tokens assumed sold in quantities of 10.

[d]Tokens assumed sold in quantities of 20.

[e]Bank service collects token revenues daily.

[f]Five types of 10-trip ticket books sold.

[g]Unlike pass revenues, ticket revenues are collected daily.

[h]Four types of ticket books sold in quantities of 10, 20, and 45 tickets per book.

Table 4-33

MONTHLY COST OF FUNDS - 1981[a]

Transit Company	Average Monthly Revenue Subject to Delay	Monthly Cost of Funds[b]
Los Angeles	$3,377,510	$21,847
Philadelphia	879,245	1,178
St. Paul	967,180	5,989
Seattle	846,335	4,173
Cincinnati	24,711	0[c]
Portland	564,932	3,504
Norfolk	45,644	70
Sacramento	193,464	740
Richmond	151,059	193
Wilmington	101,665	551
Tucson	59,099	493

[a]The costs presented in this table are not true fare prepayment program operating costs, but instead indicate how much additional earned interest a transit company could receive if fare prepayment revenues are deposited daily.

[b]Based on annual municipal borrowing rate of 12 percent.

[c]Fare prepayment revenues are not subject to delay due to the fact that token revenues are picked-up from each of the public sales outlets on a daily basis.

5

GENERAL COST COMPARISONS

5

GENERAL COST COMPARISONS

INTRODUCTION

Chapters 3 and 4 of this report presented information on the costs of operating fare prepayment programs in 11 transit companies. Twelve cost categories were analyzed, and for each category, parametric equations were formulated to assist in financial and program planning. Although monthly costs were presented in the last two chapters, unit cost comparisons were not made across transit systems and for alternative methods of order delivery and sales distribution. Such comparisons would be useful for identifying high cost activities and for planning the most cost-effective methods of delivery and sales distribution. The costs of three order delivery activities, for example, were analyzed in Chapter 3. These activities included staff delivery, courier delivery, and postal service delivery. Based on that analysis, it is possible to determine which of the three methods incur the lowest total and unit cost under a set of conditions (i.e., generally related to sales volume). Having such tools available to assist in making these trade-offs is important when planning a fare prepayment program.

This chapter presents several important cross comparisons of the costs incurred by transit companies in different program areas. Specifically, this chapter presents cost comparisons by:

- transit company and cost category,
- type of fare prepayment plan,
- method of order delivery,
- method of sales distribution, and
- frequency of printing.

Actual cost data from the 11 transit companies are presented for the first two cost comparisons. However, in order to compare the costs of different fare prepayment plans, methods of order delivery and sales distribution, and printing and inventory, normalized costs must be used. A normalized cost comparison of these activities is possible by first selecting the parametric equations from Chapters 3 and 4 which describe the cost behavior of the activity (e.g., the labor and vehicle cost equations for staff delivery [equations (3.5) and (3.6)]) and then selecting the appropriate parameters and normalizing them across each equation used. For example, in order to compare the costs of weekly and monthly passes, it is important that the same wage and fringe benefit rates be used to compute the costs in a particular cost category. Similarly, if one is comparing the monthly cost of operating a 10-trip versus a 20-trip ticket program, it is important that the total number of monthly trips taken be assumed identical for the two programs.

This chapter is divided into five sections following the five cost comparisons mentioned above. The five sections are presented in Table 5-1 along with a description of the types of comparisons made and the types of costs used in the comparison. In the first section of this chapter, for example, three different cost ratios are presented for comparing the fare prepayment programs in each transit company. These ratios include cost per instrument, cost per revenue dollar, and cost per transit trip.

At the end of each section of this chapter, summary findings are presented which can be useful in fare prepayment program planning. These summaries, which appear in boxed tables, are based on the cost comparisons made and reflect the authors' judgments on how costs can be minimized. The final decision on the type of plan to implement or delivery method to employ will probably involve other information in addition to costs. It is hoped, however, that the findings presented in this chapter will be useful in minimizing fare prepayment program costs.

Table 5-1

GENERAL COST COMPARISONS

Section Headings	Type of Comparison	Unit of Comparison
Transit Company and Cost Category	Aggregate Program Costs by Transit Company	Cost Per Instrument Cost Per Revenue Dollar Cost Per Trip
	Transit Company Costs by Cost Category	Cost Per Instrument
	On-Board Sales Costs by Cost Category	Cost Per Instrument
Type of Fare Prepayment Plan	Fare Prepayment Plan Costs by Transit Company	Cost Per Instrument Cost Per Trip
	Normalized Fare Prepayment Plan Costs by Cost Category • Monthly and Weekly Passes • 10-, 20-, and 40-Trip Ticket Books • Tokens in Rolls of 20	Cost Per Instrument Cost Per Trip
Method of Order Delivery	Normalized Delivery Costs by Delivery Method • Transit Staff Delivery • Courier Delivery • Certified Mail Delivery	Cost Per Outlet
Method of Sales Distribution	Normalized Sales Costs by Sales Method • Transit-Operated Sales Outlets • Public and Private Sales Outlets • Public Outlets with Sales Contract • Direct Mail Programs • Telephone Order Programs	Cost Per Transaction
Frequency of Printing	Printing Costs and Inventory Costs by Printing Volume	Total Monthly Costs

In this section, three areas of comparisons are presented:

- aggregate program costs by transit company,
- transit company costs by cost category, and
- on-board sales costs by cost category.

The first two comparisons do not include the costs associated with on-board sales of day passes, since to do so would artifically decrease the unit costs for those transit companies operating day pass programs. In addition, the cost of funds is not included in this analysis since this category is not a true program operating cost.

Aggregate Program Costs By Transit Company

The monthly fare prepayment program costs for each of the 11 transit companies are presented in Table 5-2. Also included in this table are three indicators of the efficiency of each program: cost per instrument, cost per revenue dollar, and cost per trip.

The first indicator, cost per instrument, is a unit or average cost figure. To arrive at this figure, total monthly program costs are divided by the number of fare prepayment instruments sold each month. These figures, therefore, represent the total cost of selling each prepayment instrument to the public.

Generally, large fare prepayment programs will incur a higher unit cost than small programs as shown by the statistics presented in Table 5-3. Transit companies with large fare prepayment programs spend proportionally more money in two program areas than companies with small programs. These include:

i) sales commissions to public outlets - small transit companies can usually secure a network of public outlets without having to pay commissions; and

ii) advertising - small transit companies with set programs usually do not advertise.

Table 5-2

AGGREGATE PROGRAM COSTS BY TRANSIT SYSTEM - 1981[a]

Transit Company	Total Monthly Cost	Cost Per Instrument	Cost Per Revenue Dollar	Cost Per Trip
Los Angeles	$238,044	$0.893	$0.053	$0.017
Philadelphia	164,272	0.744	0.079	0.046
St. Paul	72,807	1.018	0.067	0.032
Seattle	53,743	0.925	0.061	0.022
Cincinnati	2,097	0.480	0.080	0.024
Portland	26,642	0.425	0.031	0.015
Norfolk	3,909	0.537	0.045	0.022
Sacramento	17,389	0.773	0.077	0.021
Richmond	4,049	0.137	0.027	0.011
Wilmington	2,602	0.134	0.026	0.011
Tucson	3,838	0.829	0.062	0.018

[a]Does not include the cost for on-board sales programs and excludes the cost of funds.

Table 5-3

GENERAL STATISTICS: COST PER INSTRUMENT

Cost Range	
$1.018 - $0.137	
Weighted Average Costs	
4 Large Programs:	$0.857
3 Medium Programs:	0.439
2 Small Programs:	0.136
All 11 Programs[a]:	$0.627

[a]Mean value of all 11 programs.

As shown in Table 5-3, the four largest fare prepayment programs spend 86 cents for each instrument they sell. Average-size programs spend 44 cents per instrument and small programs spend only 14 cents. Both Sacramento and Tucson incur very high costs due, in part, to the demonstration activities at these sites.

The second indicator presented in Table 5-2, cost per revenue dollar, represents the amount spent to earn a dollar of prepaid revenue. Computed by dividing total monthly cost by total monthly prepaid revenues, the cost incurred per revenue dollar earned at each transit company is remarkably consistent across sites. Ranging from 2.6 to 7.9 cents per dollar, the average cost for all 11 programs is 5.5 cents. The general statistics are presented in Table 5-4.

Table 5-4

GENERAL STATISTICS: COST PER REVENUE DOLLAR

Cost Range	
$0.079 - $0.026	
Weighted Average Costs	
4 Large Programs:	$0.062
3 Medium Programs:	0.034
2 Small Programs:	0.026
All 11 Programs[a]:	$0.055

[a]Mean value of all 11 programs.

As shown in Table 5-4, large programs once again incur proportionally higher costs than small programs. Large transit companies, therefore, spend slightly more to earn a dollar of prepaid revenue than small transit companies. The difference in costs, however, is very small. A transit company operating a "typical" fare prepayment program can be expected to incur a cost of almost six cents to earn a dollar of prepaid revenue.

The final cost indicator presented in Table 5-2 is cost per trip. Computed by dividing total monthly cost by the total number of one-way trips taken with prepaid plans, this cost indicator identifies how much the transit company must spend to process a prepaid trip. These cost figures should be contrasted with the benefits of diverting cash patrons to prepaid fares in order to measure the net benefits (or costs) of a fare prepayment program.

The comparison statistics presented in Table 5-5 show once again that large fare prepayment programs incur a higher cost per trip than small programs. The range of costs, however, is very narrow. The average cost per trip for all 11 programs is only 2.2 cents.

Table 5-5

GENERAL STATISTICS: COST PER TRIP

Cost Range	
$0.046 - $0.011	
Weighted Average Costs	
4 Large Programs:	$0.024
3 Medium Programs:	0.016
2 Small Programs:	0.011
All 11 Programs[a]:	$0.022

[a]Man value of all 11 programs.

Los Angeles incurs a cost below the mean because so many trips are taken by monthly pass users, Los Angeles' principal fare prepayment plan. Philadelphia and St. Paul both incur high per trip costs because of higher sales, printing, administrative, and overhead costs. The two demonstration sites (Tucson and Sacramento) incur costs per trip equal approximately to the mean for all 11 sites.

Transit Company Costs By Cost Category

The costs per instrument incurred by each transit company that were presented in Table 5-2 reappear in Table 5-6. This time, however, the unit costs are subdivided by cost category in order to provide an opportunity to compare costs across sites.

Order preparation costs are fairly consistent across sites. Cincinnati is the most costly site in this category due to the cost of wrapping tokens. Norfolk has unusually high order delivery costs because all outlets are serviced by staff and relatively few passes are sold, thereby bringing the average cost up.

Direct sales costs are extremely high for the four largest transit systems because of commissions paid to sales outlets. Richmond and Tucson neither operate sales outlets nor pay commissions to their public outlets. Accounting costs are relatively low for most programs except Cincinnati's, and design costs are insignificant.

Printing costs are high for Philadelphia, Seattle, Cincinnati, and Norfolk. Seattle and Norfolk print relatively small volumes of some of their plans; Cincinnati's costs are exclusively minting costs for tokens. A special printing process is used in Philadelphia to reduce the opportunities for counterfeiting which explains its high printing costs.

Inventory and miscellaneous handling costs are minor for most systems. Advertising costs, while zero for most programs, is significant when advertising is done. More than ten cents is spent on each fare prepayment instrument sold at the three sites advertising their programs.

Administrative and overhead expenses are high for the large fare prepayment programs and the two demonstration sites. With the exception of Philadelphia, the large transit companies and Tucson also incur high opportunity costs due to the delay in depositing fare prepayment revenues.

Table 5-6: UNIT TRANSACTION COSTS BY COST CATEGORY - 1981[a]

Transit Company	Order Preparation	Order Delivery	Direct Sales	Recording and Accounting	Design	Printing	Inventory	Miscellaneous Handling	Advertising	Administrative	Overhead	TOTAL COST
Los Angeles	$0.017	$0.010	0.601	$0.033	$ 0	$0.040	$0.002	$ 0	$0.116	$0.025	$0.049	$0.893
Philadelphia	0.002	0.015	0.432	0.054	0.001	0.153	0	0	0	0.005	0.082	0.744
St Paul	0.026	0.020	0.839	0.026	0.001	0.045	0.001	0	0	0.034	0.026	1.018
Seattle	0.059	0.008	0.388	0.027	0	0.117	0.001	0	0.260	0.029	0.036	0.925
Cincinnati	0.075	0.044	0.004	0.131	0	0.110	0.002	0	0	0.023	0.091	0.480
Portland	0.016	0.038	0.174	0.070	0.002	0.044	0.002	0.010	0	0.007	0.062	0.425
Norfolk	0.020	0.105	0.112	0.079	0.003	0.129	0.004	0	0	0.002	0.063	0.537
Sacramento	0.027	0.033	0.233	0.070	0.003	0.028	0.001	0	0	0.153	0.225	0.773
Richmond	0.006	0.030	0	0.030	0	0.018	0.002	0	0	0.004	0.045	0.137
Wilmington	0.002	0.002	0.014	0.043	0	0.030	0.001	0.013	0	0.005	0.022	0.134
Tucson	0.029	0.037	0	0.068	0.001	0.066	0.006	0	0.431	0.057	0.134	0.829
Weighted Average	0.017	0.017	0.463	0.043	0.001	0.079	0.002	0.001	0.063	0.021	0.061	0.768
Percent of Total	2.2	2.2	60.3	5.6	0.1	10.3	0.3	0.1	8.2	2.7	8.0	100.0

[a]Computed by dividing each cost by the total number of monthly transactions at each site.

Since most of the costs vary depending on the size of the fare prepayment program, Table 5-7 was prepared to present the unit transaction costs for each cost category by program size. The four categories of program sizes correspond to the divisions made earlier in this section.

As a percentage of cost, direct sales costs clearly decrease with the size of the program. Once again, this reflects the fact that managers in small programs can usually persuade banks and department stores to sell fare prepayment plans without charging a commission. At very large volumes, however, most public outlets will require a commission on sales or another form of payment.

Order delivery, accounting, printing, inventory, and overhead costs generally increase as a percentage of total costs as the size of the program decreases. Thus, while direct sales is the dominant cost factor in large programs, accounting, overhead, printing, and delivery incur the most costs in small fare prepayment programs. Understanding the differences in the distribution of costs is critical when planning a fare prepayment program.

On-Board Sales Costs By Cost Category

The cost analysis presented above did not include the costs of operating and maintaining day pass and weekend pass programs. This was necessary because these high volume programs have very low unit costs. By including these costs with conventional fare prepayment programs costs, unit costs would have appeared artifically low, making across-site comparisons difficult.

Table 5-8 presents the costs of operating four pass programs by cost category. Of the four programs, only Sacramento is a day pass program. The other three sites sell weekend day passes only.

The monthly costs of operating day pass programs are relatively stable across sites, ranging from $1,057 to $1,871 per month. The cost per pass sold, however, varies because of differences in the number of passes sold. Total costs in St. Paul and Seattle are at about three to four cents per pass. In Sacramento a pass costs less than a penny only because so many are sold. In Tucson the unit cost is 80 cents due to very low sales volumes and high printing costs. On an average weekend, SunTran prints 3,500 passes but sells less than 500. SunTran's monthly printing costs, however, probably cannot be reduced much

Table 5-7

UNIT TRANSACTION COSTS BY COST CATEGORY AND PROGRAM SIZE -- 1981

Cost Category	4 Large Sites		3 Medium Sites		2 Small Sites		2 Demo. Sites	
	Cost Per Instrument	%	Cost Per Instrument	%	Cost Per Instrument	%	Cost Per Instrument	%
Order Preparation	$0.017	2.0	$0.020	4.5	$0.005	3.7	$0.027	3.5
Order Delivery	0.013	1.5	0.045	10.2	0.020	14.7	0.034	4.3
Direct Sales	0.548	63.8	0.158	36.0	0.006	4.4	0.193	24.7
Recording & Accounting	0.039	4.6	0.074	16.9	0.035	25.7	0.070	8.9
Design	Negl.	0	0.002	0.5	0	0	0.002	0.3
Printing	0.088	10.3	0.056	12.8	0.023	16.9	0.034	4.3
Inventory	0.001	0.1	0.002	0.5	0.002	1.5	0.002	0.3
Miscellaneous Handling	0	0	0.010	2.3	0.005	3.7	0	0
Advertising	0.075	8.8	0	0	0	0	0.074	9.5
Administrative	0.019	2.2	0.008	1.8	0.004	2.9	0.136	17.4
Overhead	0.057	6.7	0.064	14.5	0.036	26.5	0.210	26.8
Total	$0.857	100.0	$0.439	100.0	$0.136	100.0	$0.782	100.0

unless they begin printing their passes annually or semi-annually as in St. Paul and Seattle. At the present time, weekend day passes in Tucson are printed weekly.

Table 5-8

TRANSIT COMPANY COSTS FOR ON-BOARD SALES BY COST CATEGORY -- 1981

Cost Category	St. Paul (Weekend Pass)	Seattle (Weekend Pass)	Sacramento (Day Pass)	Tucscon (Weekend Pass)
Order Preparation	$ 51	$ 63	$ 96	$ 39
Accounting	354	290	0	69
Printing	629	614	1,676	1,399
Inventory	2	10	19	Negl.
Overhead	81	80	80	92
Total Cost	$1,117	$1,057	$1,871	$1,599
Total Monthly Sales	34,927	24,826	209,875	2,000
Cost Per Instrument	$0.032	$0.043	$0.009	$0.800

Summary

This section presented an analysis of fare prepayment program costs by transit company and cost category. The three areas of comparison included:

- aggregate program costs by transit company,
- transit company costs by cost category, and
- on-board sales costs by cost category.

A summary of the principal findings of this section is presented in Table 5-9.

Table 5-9

SUMMARY FINDINGS OF FARE PREPAYMENT PROGRAM COSTS

- The unit cost of fare prepayment programs varies from $0.137 to $1.018 per instrument (excluding the opportunity cost of funds).
- Large fare prepayment programs incur higher unit costs than small programs, primarily by spending more on sales commissions and advertising.
- Day pass and weekend day pass programs cost between $1,000 and $2,000 per month; their unit cost is between three and four cents per pass.

SUMMARY COSTS

	Cost Per Instrument	Cost Per Revenue Dollar	Cost Per Trip
Large Programs:	$0.857	$0.062	$0.024
Medium Programs:	0.439	0.034	0.016
Small Programs:	0.136	0.026	0.011
All Programs:	$0.627	$0.055	$0.022

The costs presented in the last section showed that large fare prepayment programs incur higher unit costs than small programs. The fare prepayment programs at the 11 sites, however, are not identical. For example, weekly passes are sold in Philadelphia and not in Los Angeles. For this reason, Philadelphia incurs more cost than Los Angeles in delivering orders (i.e., weekly deliveries rather than monthly) and in printing costs.

This section presents a comparison of the unit costs of the fare prepayment plans in all 11 transit companies. For a true cost comparison, however, this section also presents the normalized costs of operating selected fare prepayment plans. The plans analyzed include:

- monthly and weekly passes,
- 10-trip, 20-trip, and 40-trip ticket books, and
- tokens sold in quantities of 20.

The costs for this comparative analysis were obtained from the cost equations presented throughout Chapters 3 and 4. The parameters used in these equations were normalized in order to provide a clear and accurate comparison of the differences in operating cost by cost category.

Thus, this section is divided into two parts. The first part presents the actual unit cost data of the fare prepayment plans in each of the 11 transit companies. In the second part, normalized costs for different fare prepayment plans are presented by cost category. The section concludes with a review of the summary findings on fare prepayment plan costs.

Fare Prepayment Plan Costs By Transit Company

The 11 transit companies reviewed in this study offer a variety of fare prepayment plans to their riders. Nearly all of them offer at least one pass plan (usually a monthly pass) and an unlimited-duration ticket or token plan. The number of principal plans offered varies between one and four.

The principal plans offered by the 11 transit companies are presented in Table 5-10 along with their unit costs. Notice that the cost per pass or ticket decreases as one moves down the table to smaller fare prepayment programs. On

Table 5-10: COSTS OF FARE PREPAYMENT PLANS BY TRANSIT COMPANY -- 1981
(excluding the opportunity cost of funds)

	Cost Per Instrument	Cost Per Trip
Los Angeles		
Monthly Pass	$0.95	$0.016
Tourist Pass	1.82	0.171
Individual Tickets (10)[a]	0.38	0.038
10-Trip Ticket Books	0.56	0.056
Philadelphia		
Monthly Pass	$1.02	$0.018
Weekly Pass	0.77	0.055
Tokens (10)[a]	0.54	0.054
St. Paul		
Monthly Pass	$0.96	$0.020
10-Trip Ticket Book	1.45	0.145
10-Trip Punch Cards	0.92	0.092
Tokens (20)[a]	1.44	0.072
Seattle		
Annual Pass	$8.91	$0.018
Monthly Pass	0.90	0.021
20-Trip Ticket Book	0.96	0.048
40-Trip Ticket Book	0.96	0.024
Cincinnati		
Tokens (20)[a]	$0.48	$0.024
Portland		
Monthly Pass	$0.45	$0.009
10-Trip Ticket Book	0.41	0.041
Norfolk		
Monthly Pass	$0.61	$0.013
10-Trip Ticket Book	0.49	0.049
Sacramento		
Monthly Pass	$0.58	$0.012
Tokens (20)[a]	0.57	0.028
ID Cards	2.71	N.A.
Richmond		
Weekly Pass	$0.15	$0.014
10-Trip Ticket Book	0.13	0.013
20-Trip Ticket Book	0.13	0.007
45-Trip Ticket Book	0.13	0.003
Wilmington		
Monthly Pass	$0.42	$0.009
10-Trip Strip Tickets	0.11	0.011
Tucson		
Semester Pass	$2.96	$0.019
Monthly Pass	0.34	0.008
20-Trip Punch Card	2.96	0.148

[a]Assumed sold in quantities as indicated.

a cost per trip basis, however, this change is less evident. Monthly passes in Los Angeles cost $0.95 each while in Norfolk they are only two-thirds that price. However, because Los Angeles pass holders use their pass over 70 times each month, the cost per monthly pass trip in Los Angeles is only slightly higher than the cost per trip in Norfolk.

Of the 11 transit companies, only Norfolk and Portland offer comparable programs, and their costs are remarkably similar. Both transit companies sell monthly passes and 10-trip ticket books. Norfolk's costs per instrument are slightly higher than Portland's costs because of the difference in the size of the two programs. Portland sells more than eight times as many plans as Norfolk which reduces its unit costs by about 25 percent.

Of the 11 transit companies presented in Table 5-10, nine offer monthly passes, two offer weekly passes, one offers a semester pass, and one provides an annual pass. The mean values of the cost per pass and cost per trip are summarized in Table 5-11.

Table 5-11

AVERAGE UNIT COSTS FOR PASS PLANS -- 1981

	Cost Per Pass	Cost Per Trip
Annual Pass (1 plan)	$8.91	$0.018
Semester Pass (1 plan)	2.96	0.019
Monthly Pass (9 plans)	0.69	0.014
Weekly Pass (2 plans)	0.46	0.035

As shown in Table 5-11, the cost of issuing a weekly pass is only two-thirds the cost of issuing a monthly pass because the normally higher volume of weekly passes sold each month results in some economies of scale. A weekly pass program, however, is twice as expensive as a monthly pass program on a per trip basis. This is generally due to the higher printing and delivery costs.

Although the annual and semester passes are only represented by one site each, it is interesting to note that the cost of a semester pass is approximately four times the cost of a monthly pass, and the cost of an annual pass is 12 times the cost of a monthly pass. Because of the relatively low sales volume and high production costs (e.g., photographic equipment for annual passes) of these long-term plans, their unit costs increase in direct proportion to their term of validity. On a per trip basis, however, their costs are almost identical to the cost per monthly pass trip.

The unit costs of ticket programs vary considerably from $0.11 in Wilmington (where ticket strips are sold) to $1.45 in St. Paul. Although there are too few large-quantity ticket book programs to draw definitive conclusions, the average costs of ticket plans appear not to change with quantity; that is, 40-trip ticket programs cost the same as 10-trip ticket programs on a per instrument basis. Since the unit costs are similar, the cost per trip falls in proportion to the quantity of tickets included in the ticket books.

Only four transit companies sell tokens to their customers and most of these sales vary in quantity. The average quantities sold by each transit company were imputed from the best available evidence. Philadelphia, for example, was assumed to sell tokens in quantities of 10, the remaining three were assumed to be selling 20 tokens per transaction.

The average cost per transaction for all four token programs is $0.76, or slightly more than the unit cost of operating a ticket program. However, without the St. Paul values, the unit costs and per trip costs of token programs are identical to the average and per trip costs of ticket programs. Philadelphia's cost for its token plan is $0.54 per roll of 10, while Cincinnati and Sacramento are incurring an average $0.53 per roll of 20. St. Paul's very high cost of $1.44 per token roll is almost identical to the cost of its 10-trip ticket book plan ($1.45). A summary of the unit costs of ticket and token plans is presented in Table 5-12.

Table 5-12

AVERAGE UNIT COSTS FOR TICKET AND TOKEN PLANS -- 1981

	Cost Per Instrument	Cost Per Trip
Ticket Plans		
10-Trip Tickets (6 plans)	$0.53	$0.053
20-Trip Tickets (2 plans)	0.55	0.028
40/45-Trip Tickets (2 plans)	0.55	0.014
Token Plans		
Rolls of 10 (1 plan)	$0.54	$0.054
Rolls of 20 (3 plans)	0.83	0.041

Normalized Fare Prepayment Plan Costs By Cost Category

Although the costs presented above provide evidence of the actual costs incurred by transit companies, they can not be used to make valid comparisons of the costs of alternative fare prepayment plans. Much more data would be required in order to compensate for the differences that exist in each program. An alternative, however, is to calculate and then compare a set of normalized costs by cost category for selected fare prepayment plans. How these calculations were made and the results of the cost comparison are presented here.

Two pass plans, three ticket book plans, and a token plan were chosen for the comparison. These six plans are perhaps the most common fare prepayment plans offered by transit companies. They include:

- monthly and weekly pass,
- 10-, 20-, and 40-trip ticket books, and
- tokens sold in rolls of 20.

Total monthly costs were computed for each plan as if it were the only plan sold. The independent cost equations presented throughout Chapters 3 and 4 were used to calculate total monthly costs for each of 10 cost categories.[1] Since

[1]The cost of advertising and cost of funds are excluded from this analysis.

the total monthly cost (and consequently unit cost) is affected by the size and dimension of the fare prepayment program chosen as the basis for comparison, the values of the parameters used in these equations were developed by reviewing the actual values obtained from the 11 case sites. A list of the parameters from the cost equations is presented in Table 5-13 along with the values chosen for this cost comparison. These values were chosen based on a review of the actual values at each site. An attempt was made to chose parametric values that would portray a "typical" fare prepayment program. Other basic assumptions used in this cost comparison, such as the delivery and sales distribution methods employed, are also presented in Table 5-13.

The normalized costs of the six fare prepayment plans were computed using the appropriate equations from Chapters 3 and 4, and the information in Table 5-13. The results are presented in Table 5-14. The total monthly cost of operating each of the six plans is presented first, followed by each plan's unit cost and cost per trip.

Table 5-14: MONTHLY NORMALIZED COSTS BY FARE PREPAYMENT PLAN -- 1981
(excluding cost of advertising and cost of funds)

	Monthly Pass	Weekly Pass	10-Trip Ticket	20-Trip Ticket	40-Trip Ticket	20-Token Roll
Total Monthly Cost	$18,801	$35,656	$26,007	$20,908	$18,321	$23,131
Cost Per Instrument	0.470	0.206	0.150	0.242	0.423	0.267
Cost Per Trip	0.011	0.021	0.015	0.012	0.011	0.013

Because they are consumed and replaced so rapidly, weekly passes and 10-trip ticket books are the most costly of the six plans to implement. Tokens are slightly more expensive than tickets of the same quantity. Monthly passes and 40-trip ticket books, the two plans of the longest duration, are the least expensive.

In order to be able to identify why the costs of operating fare prepayment programs differ by type of fare prepayment plan, Tables 5-15 and 5-16 were prepared, which present normalized unit costs disaggregated by cost category. Table 5-15 presents the costs per instrument sold for each of the six fare prepayment plans by cost category. The same format is used in Table 5-16 but the costs presented (in cents) are costs per trip taken. Both tables provide the basis for the comparisons of fare prepayment plans that follows.

Table 5-13

BASIC ASSUMPTIONS AND VALUES OF THE PARAMETERS USED IN NORMALIZED COST COMPARISON

FARE PREPAYMENT PLAN STATISTICS

	Number of Instruments Sold Per Month[a]	Price Per Instrument
Monthly Pass	40,000	$21.65
Weekly Pass	173,200	5.00
10-Trip Ticket Book	173,200	5.00
20-Trip Ticket Book	86,600	10.00
40-Trip Ticket Book	43,300	20.00
20-Token Roll	86,600	10.00

TYPE AND NUMBER OF SALES OUTLETS

Headquarter Outlet	1
Transit-Operated Outlets	2
Commissioned Outlets	100
Non-Commissioned Outlets	47
Number of Outlets[b]	150

STAFF DELIVERY PARAMETERS

- 30 minute per outlet delivery
- 3 miles driven per outlet delivery
- $0.3531 per mile for the ownership and operating cost of a vehicle

WAGE RATES

$8.25/hour - order preparation
- order delivery
- direct sales
- recording

$9.50/hour - accounting

$11.00/hour - administration

Fringe Benefit Rate = 36.2 percent

AVERAGE VOLUME PRINTED PER MONTH

- 60,000 monthly passes (i.e., 1.5 x sales)
- 259,800 weekly passes (i.e., 1.5 x sales)
- 173,200 10-trip ticket books
- 86,600 20-trip ticket books
- 43,300 40-trip ticket books
- 2,000,000 tokens minted with 10-year life and 12% discount rate

MISCELLANEOUS PARAMETRIC VALUES AND ASSUMPTIONS

- frequency of printing = 6 months
- commission rate = 2 percent of sales revenue
- storage costs = $0.06 per cubic foot per month
- no advertising expenses or cost of funds incurred
- overhead rate at headquarters is 39.5%

[a]All plans yield 1,732,000 prepayment trips per month. On average there are 4.33 weeks per month.

[b]Plans are delivered by staff only to the 149 outlets away from headquarters.

Table 5-15

NORMALIZED COSTS PER INSTRUMENT FOR SIX FARE PREPAYMENT PLANS BY COST CATEGORY -- 1981

Cost Category[a]	Monthly Pass	Weekly Pass	10-Trip Ticket	20-Trip Ticket	40-Trip Ticket	20 Token Roll
Order Preparation	$0.010	$0.010	$0.002	$0.005	$0.010	$0.020
Order Delivery	0.025	0.025	0.006	0.012	0.023	0.012
Direct Sales	0.303	0.080	0.080	0.147	0.281	0.147
Accounting	0.044	0.023	0.023	0.030	0.044	0.030
Design	0.002	0.001	0	0	0	0
Printing	0.038	0.038	0.020	0.020	0.020	0.026
Inventory	0.002	0.002	0.002	0.002	0.002	Negl.
Administrative	0.011	0.003	0.003	0.005	0.010	0.005
General Overhead	0.035	0.024	0.014	0.021	0.033	0.027
TOTAL COST	$0.470	$0.206	$0.150	$0.242	$0.423	$0.267

[a]The cost of advertising and the cost of funds are not included in this analysis.

Table 5-16

NORMALIZED COSTS PER TRIP FOR SIX FARE PREPAYMENT PLANS BY COST CATEGORY -- 1981

Cost Category[a]	Monthly Pass	Weekly Pass	10-Trip Ticket	20-Trip Ticket	40-Trip Ticket	20 Token Roll
Order Preparation	0.02¢	0.10¢	0.02¢	0.02¢	0.02¢	0.10¢
Order Delivery	0.06	0.25	0.06	0.06	0.06	0.06
Direct Sales	0.70	0.80	0.80	0.73	0.70	0.73
Accounting	0.10	0.23	0.23	0.15	0.11	0.15
Design	Negl.	0.01	0	0	0	0
Printing	0.09	0.38	0.20	0.10	0.05	0.13
Inventory	0.01	0.02	0.02	0.01	0.01	Negl.
Administrative	0.03	0.03	0.03	0.03	0.03	0.03
General Overhead	0.08	0.24	0.14	0.11	0.08	0.14
TOTAL COST	1.09¢	2.06¢	1.50¢	1.21¢	1.06¢	1.34¢

[a]The cost of advertising and the cost of funds are not included in this analysis.

Before reviewing the costs of each plan, it is important to recall some of the basic assumptions of this analysis that were presented in Table 5-13. First, it is assumed that the usage of each fare prepayment plan is identical; that is, the same number of prepaid trips are taken each month with each of the six plans. This assumption does not imply that the plans are easily transferable, or that decisions on the selection of a fare prepayment plan should be made on cost and cost alone. The market for a monthly pass, for example, is not the same as the market for a 10-trip ticket book. Second, the size of the program chosen (i.e., 1.7 million prepaid trips per month) is equivalent to a medium-to-large fare prepayment program. Portland, for example, sells 1.75 million prepaid trips each month. Smaller programs will probably witness slightly lower unit costs. Finally, the parameters selected for this analysis (including the type of sales outlets and delivery method) represent a unique fare prepayment program. As these parameters change, so will the program's costs. Thus, what is important in the analysis that follows is not the absolute value of the costs, but rather their relative costs.

Monthly vs. Weekly Pass

Weekly pass programs are twice as expensive as monthly pass programs as reflected in the total cost and cost per trip tables. Each weekly pass, however, costs about half of what it would cost to sell a monthly pass since there are over four times as many weekly passes sold each month. The higher total monthly cost for a weekly pass program is due primarily to the higher labor cost in preparing orders and in delivering orders to outlets every week.

Weekly pass programs are substantially more expensive than monthly pass programs in nearly every cost category. The exceptions include direct sales costs and administrative costs. Direct sales costs are only slightly greater for weekly passes because most of the costs incurred in this category are from commissions paid to sales outlets. Commissions are based on a fixed rate of revenues and not on volume sold. Administrative costs are identical, not only for monthly and weekly passes, but for all programs.

Weekly Pass vs. 10-Trip Ticket Book

Weekly pass programs are 37 percent more expensive than 10-trip ticket book programs primarily because weekly passes have to be prepared and delivered to outlets every week. An assumption used in this analysis is that weekly passes are the only plans that are not prepared and delivered to sales outlets on a monthly basis. If four sets of weekly passes are prepared and delivered monthly, weekly pass program costs would decrease to a level just above the cost of a 20-trip ticket program. Printing and design costs, however, would remain higher. General overhead costs are higher for weekly passes as a result of the higher labor costs in order preparation and delivery.

10-Trip vs. 20-Trip vs. 40-Trip Ticket Book

Fare prepayment programs using 10-trip ticket books are 24 percent more expensive than programs with 20-trip ticket books, and 42 percent more expensive than programs with 40-trip ticket books. The larger quantity plans are less expensive overall because fewer transactions have to be made and fewer books have to be printed to service the same level of demand. Order preparation and order delivery monthly costs are identical for all three plans. Direct sales costs and overhead costs decrease as the quantity of tickets per book increases because fewer transactions are made requiring fewer people to do the selling and accounting. Printing and inventory costs are also inversely related to ticket book quantity because fewer plans are needed to supply the same number of prepaid trips.

20-Trip Ticket Book vs. 20 Token Roll

The last category of comparison is between 20-trip ticket books and tokens sold in rolls of 20. As shown in the cost tables, token programs are about 10 percent more expensive than programs using 20-trip ticket books. This higher cost is primarily due to wrapping tokens for reuse and to the high cost of token replacement. If tokens last less than ten years, minting tokens will be more expensive on a per trip basis than printing ticket books. Thus, there is no real cost advantage to token programs. There are, however, several operational advantages for using tokens. For example, tokens can easily be

assimilated into traditional fare collection programs. Tickets, moreover, can cause problems with vacuum-operated fare collection systems.

Summary

This section presented an analysis of the unit costs of fare prepayment plans for each of the 11 transit systems. In addition, this section presented the normalized costs of operating selected fare prepayment plans. The plans analyzed included:

- monthly and weekly passes,
- 10-trip, 20-trip, and 40-trip ticket books, and
- tokens sold in quantities of 20.

A summary of the principal findings of this section is presented in Table 5-17.

Table 5-17

SUMMARY FINDINGS OF FARE PREPAYMENT PLAN COSTS

- The cost per weekly pass is two-thirds the cost of a monthly pass because of the normally higher volume of weekly passes sold each month at the case sites.
- Long-term pass plans, such as annual passes, are much more expensive than monthly passes to produce but may result in as low a per trip cost.
- The unit cost of actual ticket programs varies considerably from $0.11 to $1.45. The average ticket book costs about 55 cents to produce and sell.
- Ticket programs are generally less expensive than pass programs of comparable duration as shown by the normalized total monthly costs. The unit costs for these programs will increase as the quantity of tickets or time duration increases.

SUMMARY OF NORMALIZED COSTS

	Cost Per Instrument	Cost Per Trip
Monthly Pass	$0.470	$0.011
Weekly Pass	0.206	0.021
10-Trip Ticket	0.150	0.015
20-Trip Ticket	0.242	0.012
40-Trip Ticket	0.423	0.011
20 Token Roll	0.267	0.013

METHOD OF ORDER DELIVERY

Successful fare prepayment programs, whether they are large or small, will always involve a network of conveniently located sales outlets. In some cases these outlets are owned and operated by the transit company; however, most often sales outlets are businesses and public institutions such as banks, department stores, schools, and social service agencies. Regardless of how the outlets are managed, it is important that a new supply of fare prepayment plans be delivered to each outlet on a timely basis. A fare prepayment program manager must choose, therefore, the safest, most reliable, and least costly method among several delivery options. As reviewed in Chapter 3, the three principal delivery methods include:

- transit staff delivery,
- courier delivery, and
- certified mail delivery.

Transit staff delivery is perhaps the safest and most reliable method of getting new fare prepayment plans to sales outlets. It is also very costly. Staff labor and overhead charges must be covered along with the cost of owning and operating a service vehicle.

Courier delivery service is also a reliable method of transporting plans to sales outlets. The cost for such service is reasonable especially if distances between outlets are great. Most courier services will charge a fixed rate per package regardless of the quantity of instruments within the package. The rate will usually depend on the number of outlets served during each delivery. In very large urban areas, courier companies will often divide the region into several large zones with the per package delivery charge increasing with the distance between zones.

The third and final method of fare prepayment delivery is the U.S. Postal Service. Although the U.S. Postal Service does not enjoy a good reputation for being prompt and reliable, packages sent certified mail generally arrive on time. Although it is not recommended that high volume outlets be serviced by certified mail, this delivery method is ideal for very low volume sales outlets. Moreover, the cost of sending a package certified mail increases with package size since postage and envelope costs increase in proportion to volume.

This section presents a comparison of the normalized costs of delivering fare prepayment plans to sales outlets by the three methods just discussed. Following a brief analysis of the cost behavior of each method individually, the three methods are compared in order to determine which method incurs the lowest cost per outlet delivery at various outlet sales volumes. This section concludes with a list of the summary findings.

Transit Staff Delivery

Transit staff delivery costs include the cost of labor in delivering fare prepayment plans to sales outlets and the cost of owning and operating an automobile or van used in the delivery. These two costs can be estimated using equations (3.5) and (3.6) from Chapter 3. Values for some of the parameters used in these two equations were given in the earlier section of this chapter that appeared on Table 5-13. These parametric values are:

- the average hourly wage rate for the delivery of fare prepayment plans to sales outlets: W_d = \$8.25,
- the fringe benefit rate: F_r = 36.2%
- the number of employees per vehicle: N_e = 1, and
- the cost per mile for owning and operating a standard automobile MR = \$0.3531.

Using these parameters and equations (3.5) and (3.6), the cost for transit staff to deliver to each outlet becomes:

$$MC_d = 0.1873\ D_t + 0.3531\ \bar{M}_d \tag{5.1}$$

where:

MC_d = the month cost (dollars) for staff to deliver fare prepayment plans to each outlet

D_t = the average number of minutes required to deliver fare prepayment plans to each sales outlet

$\bar{M}_d$ = the average mileage between outlets

Thus, once the system's parameters are known, the cost of servicing each outlet depends only on the average distance and travel time between outlets. The cost of servicing each outlet is plotted in Figure 5-1 as a function of the miles

driven per outlet and the average vehicle operating speed, which is a proxy for the density of the urban area. As shown, the cost per outlet increases as the congestion in the city increases and as the distance between outlets increases. The average distance between outlets for 10 of the 11 sites involved in this study is 3.15 miles; the average speed in servicing each outlet is 6.24 mph.[1] Given these conditions, the average cost to delivery fare prepayment plans to each outlet is $6.79.

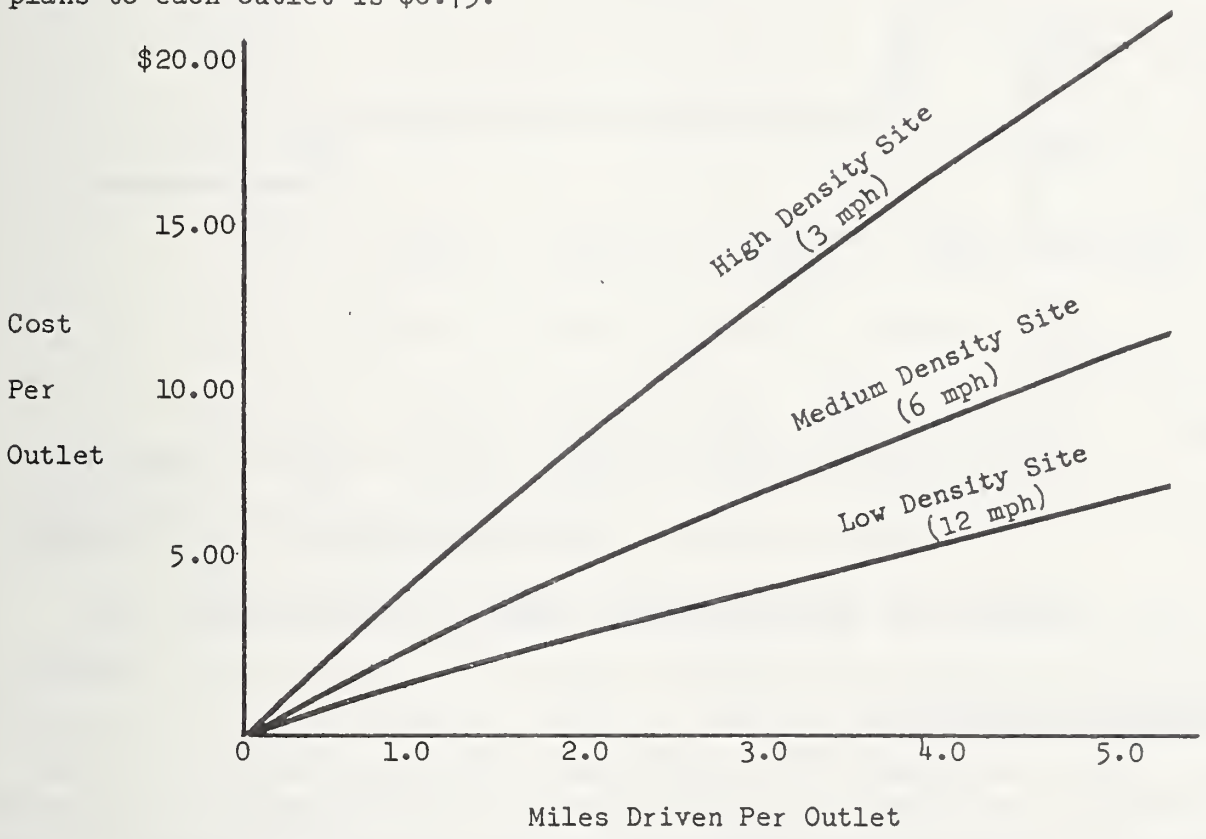

Figure 5-1: TRANSIT STAFF DELIVERY COSTS PER OUTLET -- 1981

Courier Delivery

The cost of courier service depends on the number of outlet stops and the size of the city. As mentioned in Chapter 3, Purolator Courier charges SEPTA in Philadelphia $5.00 per outlet for servicing 75 outlets on a weekly basis. The 1981 cost estimates provided by the same company for servicing Tri-Met's sales outlets in Portland varied from $2.67 to $5.50 depending on the number of outlet stops. Because Tri-Met is a medium-size transit company, the costs for servicing Tri-Met's outlets are used in this cost analysis.

[1]See Table 3-8 in Chapter 3.

Figure 5-2 presents the cost of servicing each outlet by courier delivery. Note that this unit cost decreases as the number of outlets served increases.

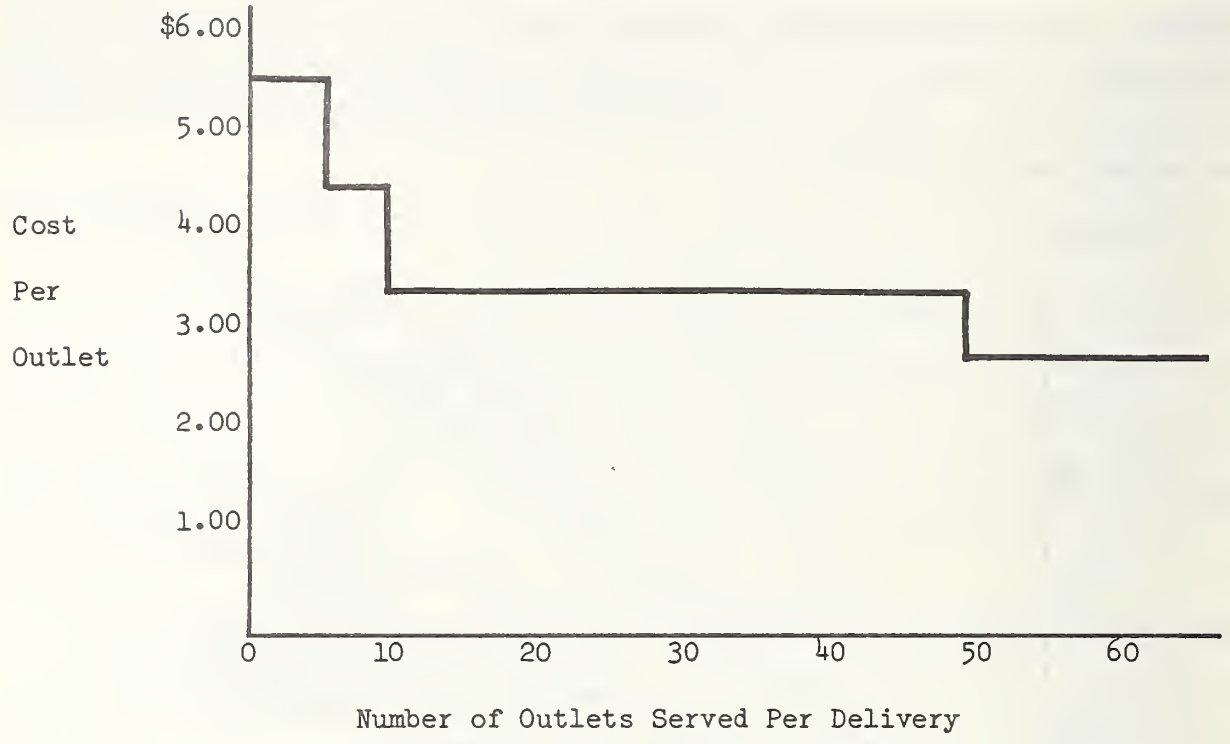

Figure 5-2: COURIER DELIVERY COSTS PER OUTLET -- 1981

Certified Mail Delivery

The third and final method of delivering fare prepayment plans to sales outlets is by certified mail. The cost for this service is a function of the number of instruments sent to each outlet. As the volume sent increases, so does the first class postage rate and the size -- and thus cost -- of the envelopes used in mailing plans to sales outlets.

Four of the eleven transit companies reviewed here use the U.S. Postal Service for the delivery of fare prepayment plans to sales outlets. All four send only monthly passes through the mail and all packages are sent certified mail. The costs used in this analysis, therefore, will be for passes only. The cost for the same volume of ticket books is slightly higher because they are heavier than passes.

The cost per package sent certified mail is a function of the number of passes included in a package as shown in Figure 5-3. The cost data are from Table 3-17 in Chapter 3 and include an additional $1.35 per package for certified mail and return receipt.

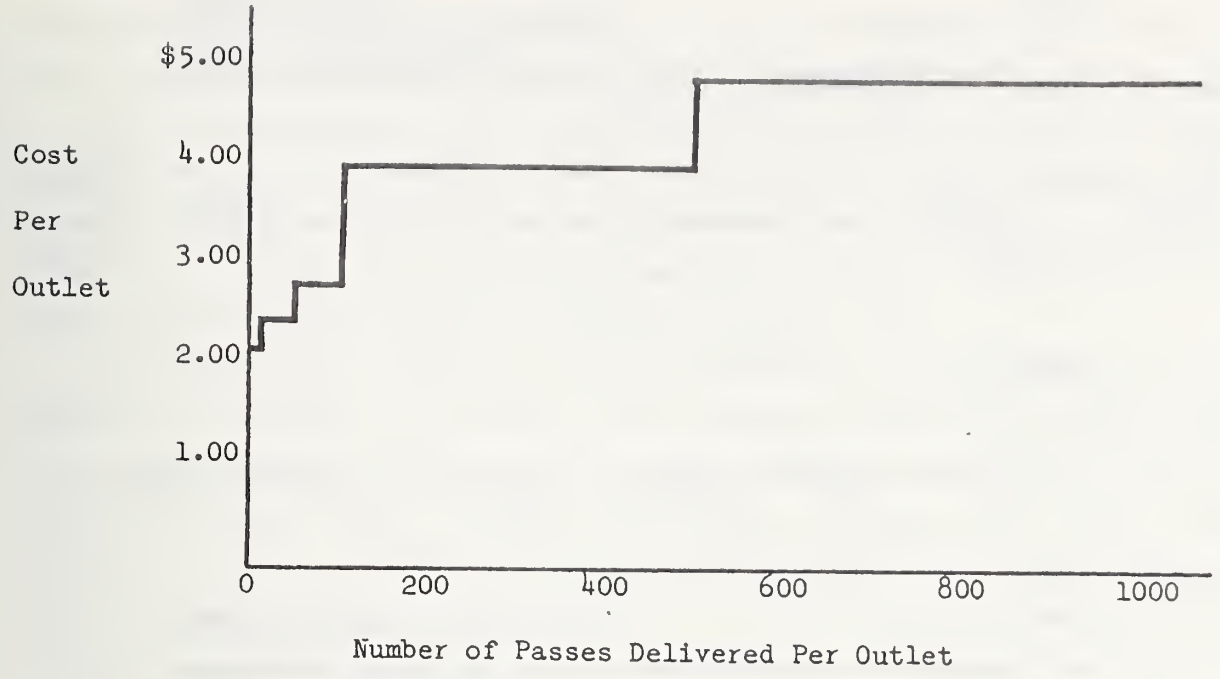

Figure 5-3: CERTIFIED MAIL DELIVERY COSTS PER OUTLET -- 1981

A Comparison of Order Delivery Costs

Based on these three methods of delivery, the cost of delivering fare prepayment plans to each sales outlet can be as low as $2.05 using certified mail or over $20 if staff are used for the delivery. The actual cost per outlet in a particular setting will depend on the number of outlets served, the average distance between outlets, the density of the city (i.e., average vehicle driving speed), and the number of fare prepayment instruments delivered to each outlet. Given this information, it is possible to choose the least costly method of fare prepayment delivery.

Figure 5-4 presents the least costly methods of fare prepayment delivery in three types of urban settings. The top graph presents the costs of servicing each outlet in a high density environment; a medium density environment is represented in the middle graph and a low density environment in the bottom graph. The certified mail costs and courier costs are identical in the three graphs since urban size and density do not affect these costs. Staff delivery costs, however, drop as the time required to service each outlet declines. The bottom graph, therefore, represents the least costly environment for staff delivery. Since in each graph the staff delivery costs will increase as the average distance between outlets increases, staff delivery costs for one and two mile

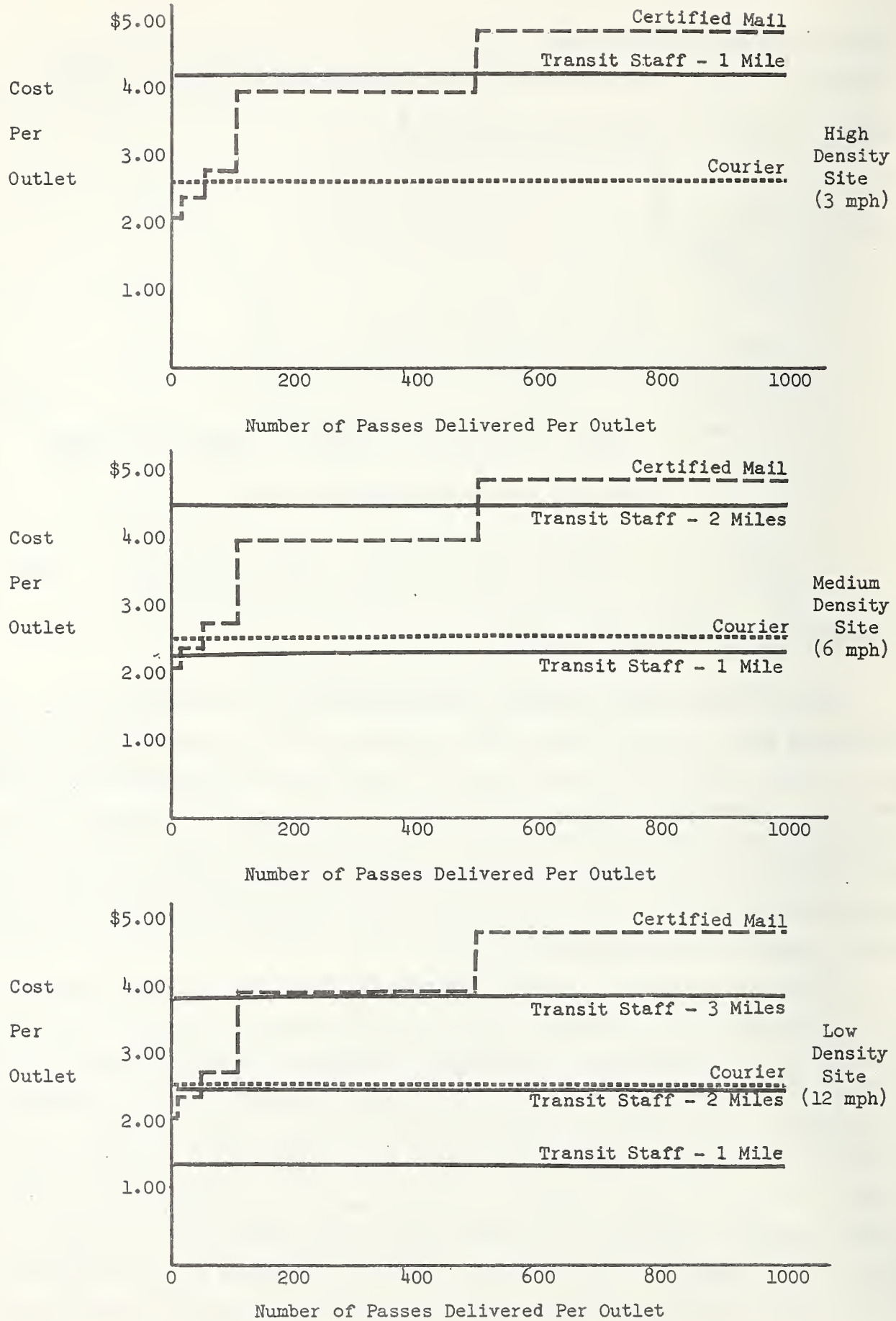

Figure 5-4: COMPARISON OF DELIVERY METHOD COSTS -- 1981

distances between outlets are presented in the middle graph; costs for one, two, and three mile distances are presented in the bottom graph.

Another assumption used to formulate these graphs is that more than 50 sales outlets are served during each delivery period. This assumption provides us with a fixed rate for courier service at all pass levels. If less than 50 outlets are served, the horizontal line at the $2.67 level should be moved down accordingly based on the rates shown in Figure 5-2.

With the costs of the three delivery methods now superimposed on a single graph, it is possible to determine which method results in the least cost to the transit company. In the first graph, certified mail is the least costly method at volumes below 50 passes per outlet. Beyond that volume, courier service is the least costly solution. Note that in a very high density site, staff delivery of fare prepayment plans is not economical when the average distance between outlets is more than one mile. If the average distance is less than one mile, however, staff delivery may be economical. For example, if outlets are only one-half mile apart, the average staff delivery cost per outlet would only be $2.05, or exactly as expensive as certified mail at volumes below 10 passes per outlet. Very few transit companies operate sales outlets this close together.

The bottom two graphs show that staff delivery can compete on price with certified mail and courier service in less dense environments. For example, in a low density environment where outlets are spaced one mile apart on average, staff delivery can be the least costly method of fare prepayment delivery, even at very low volumes. Table 5-18 summarizes the results of these three graphs, presenting the lowest cost solutions for different urban settings as a function of the number of passes delivered to each outlet.

Summary

This section presented an analysis of the costs of delivering fare prepayment plans to sales outlets. The three delivery methods compared were:

- transit staff delivery,
- courier delivery, and
- certified mail delivery.

Table 5-18: LOWEST COST DELIVERY METHODS FOR DIFFERENT URBAN SETTINGS

URBAN DENSITY AND DISTANCE BETWEEN OUTLETS[a]		NUMBER OF PASSES DELIVERED TO EACH OUTLET[b]				
		Less than 10	10 - 50	51 - 100	101 - 500	501 - 1000
HIGH DENSITY SITE	1 mile per outlet	Certified Mail	Certified Mail	Courier Service	Courier Service	Courier Service
	2 miles per outlet	Certified Mail	Certified Mail	Courier Service	Courier Service	Courier Service
	3 miles per outlet	Certified Mail	Certified Mail	Courier Service	Courier Service	Courier Service
MEDIUM DENSITY SITE	1 mile per outlet	Certified Mail	Staff Delivery	Staff Delivery	Staff Delivery	Staff Delivery
	2 miles per outlet	Certified Mail	Certified Mail	Courier Service	Courier Service	Courier Service
	3 miles per outlet	Certified Mail	Certified Mail	Courier Service	Courier Service	Courier Service
LOW DENSITY SITE	1 mile per outlet	Staff Delivery	Staff Delivery	Staff Delivery	Staff Delivery	Staff Delivery
	2 miles per outlet	Certified Mail	Certified Mail	Staff Delivery	Staff Delivery	Staff Delivery
	3 miles per outlet	Certified Mail	Certified Mail	Courier Service	Courier Service	Courier Service

[a]Travel speeds in high density sites were assumed to be 3 mph, 6 mph in medium density sites, and 12 mph in low density sites.

[b]It is assumed that over 50 outlets are served during each delivery.

This analysis has shown that any one of the three methods can be the lowest cost delivery method depending on the set of conditions in which the transit company is operating. Moreover, since the same volume of passes is usually not sent to all sales outlets, utilization of more than one delivery method could result in the lowest operating cost to a transit company. For example, in a low density site where outlets are spaced two miles apart on average (refer to Table 5-18), transit staff should be used for the delivery of passes to high volume outlets only; that is, staff delivery should be employed only when more than 50 passes are delivered to an outlet. For those outlets receiving less than 50 passes, certified mail should be used. Thus, the combination of staff and certified mail delivery will result in the lowest operating cost for the program.

A summary of the principal findings of this section is presented in Table 5-19.

Table 5-19

SUMMARY FINDINGS OF FARE PREPAYMENT DELIVERY COSTS

- Staff delivery costs are directly related to the time spent delivering fare prepayment plans (labor cost) and the distance between outlets (vehicle cost).
- Courier delivery costs per outlet will generally decline as the number of outlets serviced increases.
- Certified mail costs per outlet will increase as the number of prepayment plans sent increases.
- Determination of the lowest cost delivery method will depend on the unique circumstances of each urban area. However, an attempt was made to analyze the costs of a "typical" fare prepayment program. Under these conditions, the following least-cost solutions resulted:

  i) certified mail should be used if less than 50 passes are sent to an outlet, unless outlets are spaced very close to one another;

  ii) courier service offers a very good alternative to staff delivery; staff delivery, however, is less costly if outlets are closely spaced;

  iii) staff delivery should only be used when the travel time and distance between outlets is very short; otherwise courier or certified mail delivery should be employed.

METHOD OF SALES DISTRIBUTION

Just as transit managers must choose among alternative delivery methods, they must also choose the type of sales programs they will operate in order to maximize fare prepayment sales at minimum cost. Most programs employ the basic methods such as sales at transit company offices and through banks and department stores. Many transit companies operate their own conveniently located sales and information outlets if demand is sufficiently large. In addition, some transit managers are implementing direct mail and telephone order programs to make it more convenient for customers located far from sales outlets to purchase fare prepayment plans. The cost-effectiveness of each of these methods, as well as other more innovative methods, is being examined in detail in a Federally-funded demonstration in Sacramento.[1] The cost data presented in this study, however, does provide enough information to present a comparison of the transaction costs of several distribution methods. The costs of five methods are compared in this section.

The first method of sales distribution discussed in this section is the staff-operated sales outlet. Although generally located in the transit company's headquarters, many transit systems also operate sales outlets throughout the downtown areas of large cities. In addition to selling fare prepayment plans, outlet representatives also assist consumers in their travel needs by providing information on bus schedules, route locations, and special fare programs.

Sales of fare prepayment plans through public and private institutions is discussed next. These outlets include financial institutions, department stores, schools, hospitals, social service agencies, and employers. Although there are usually differences in the clientele for these distribution outlets, the distribution costs incurred by the transit company in servicing them are similar.

An alternative or supplement to the public and private sales outlet network is to obtain a contract from a single retail chain and have that organization distribute and sell plans throughout the region for a set or variable commission. Although none of the case sites used this type of distribution network at the time of the interviews, Tri-Met in Portland has subsequently contracted with the Seven-Eleven retail food store chain to distribute and sell tickets and

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[1]Ecosometrics, Inc. "A Comprehensive Demonstration of Distribution Systems For Fare Prepayment: The Sacramento Regional Transit Project." Prepared for the Office of Service and Methods Demonstrations, Urban Mass Transportation Administration, Washington, D.C., February 1981.

passes in Tri-Met's service area. The costs resulting from this service contract are presented in this section.

Finally, transit managers can sell and distribute fare prepayment plans without using sales outlets. Direct mail and telephone order programs are being used in several transit systems to provide customers with the convenience of purchasing plans by mail with a personal check or by calling in an order and charging the purchase to one's personal bank credit card. The costs of both of these sales methods are also presented in this cost comparison.

The costs presented in this section have been normalized based on the cost equations developed in Chapters 3 and 4. Average costs on a per outlet basis are computed as a function of the number of sales transactions. The normalized costs presented in this section, however, include only those costs directly associated with and in support of the particular distribution method. Common costs, such as, printing, inventory, and administrative costs, are not incorporated in this analysis. The specific cost categories included in this analysis are presented in Table 5-20 along with the distribution methods in which these costs are incurred. Following a brief analysis of the cost behavior of each sales method individually, the five distribution methods are discussed jointly in order to illustrate how their costs compare at different sales volumes. The section concludes with a list of the summary findings.

Table 5-20

FIVE METHODS OF SALES DISTRIBUTION AND THE CATEGORIES OF COSTS THAT ARE INCURRED

Category	Sales Outlets			Direct Mail Program	Telephone Order Program
	Transit-Operated	Public/Private	Sales Contract		
Order Preparation	X	X	X		
Order Delivery	X	X	X		
Direct Sales	X			X	X
Sales Commissions		X	X		
Recording	X			X	X
Overhead	X	X	X	X	X
Cost of Funds[a]		X	X		

[a]The cost of funds is assumed to be zero at transit-operated outlets and headquarters.

Basic Assumptions of Cost Analysis

Before proceeding with a presentation of the normalized sales costs, it is appropriate to first identify the assumptions used in this cost analysis. Just as the cost of delivering fare prepayment plans varied for different urban settings depending on the number of outlets served, the wage rate, etc., so do the costs associated with selling fare prepayment plans. Every attempt was made to select values for the parameters to simulate the costs and characteristics of an average-sized transit fare prepayment program. The costs presented in this section, therefore, will change if different parametric values are selected. Table 5-21 presents a list of the assumptions and parametric values selected for this cost comparison.

Table 5-21

ASSUMPTIONS AND PARAMETRIC VALUES SELECTED FOR A COMPARISON OF SALES DISTRIBUTION COSTS

BASIC ASSUMPTIONS

- all sales are of monthly passes
- staff-operated sales outlets are manned by at least one person full-time
- a minimum commission of $1,000 per month is assumed for the retail firm with a sales contract
- no minimum sales level or sales commission exists for public and private outlets
- only staff delivery is employed where delivery to sales outlets is required
- monthly pass revenues are deposited daily from transit-operated outlets and from headquarters.

PARAMETRIC VALUES

- the average hourly wage rate for order preparation, order delivery, direct sales, and recording: $W_{op} = W_d = W_s = W_r = \$8.25$
- the fringe benefit rate: $F_r = 36.2\%$
- the total number of sales outlets: $N_{op} = N_o = N_{to} = 150$
- number of employees per delivery vehicle: $N_e = 1$
- staff delivery time: $D_t = 30$ minutes/outlet delivery
- average monthly mileage for delivery: $M_d = 450$ miles or $\bar{M}_d = 3$ miles
- passenger vehicle mileage rate: $MR = \$0.3531$
- overhead rate at transit-operated outlets: $OC_t = 20\%$
- overhead rate at transit headquarters: $OC_h = 39.5\%$
- price of the monthly pass: $P = \$21.65$
- number of delay days in transferring pass revenues from outlets: $DD_j = 20$ days
- annual municipal borrowing rate: $i = 12$ percent

Transit-Operated Sales Outlets

The costs associated with staff-operated outlets include the cost of preparing orders for delivery, actual order delivery, direct sales, recording sales at the outlet, and outlet overhead. The costs related to operating a sales outlet can be estimated for all cost categories by using equations (3.1), (3.5), (3.6), (3.11), (3.21b), (4.8), and (4.9). From these equations and using the parametrics values presented in Table 5-21, the monthly cost of servicing and operating each staff-operated sales outlet is:

$$(5.2) \qquad MC_S = \begin{cases} 2348.21 & \text{for } \bar{N}_S \leq 2561 \\ 2348.21 + 0.23\,(R_S + MM_Y)(\bar{N}_S - 2561) & \text{for } \bar{N}_S > 2561 \end{cases}$$

where:

MC_S = monthly cost (dollars) of servicing and operating each staff-operated sales outlet

$\bar{N}_S$ = average number of monthly passes sold per outlet per month

R_S = average time required (minutes) to make each sales transaction following the schedule presented in Table 3-21 of Chapter 3

MM_Y = average time required (minutes) to record each sales transaction following the schedule presented in Table 3-35 of Chapter 3

Both R_S and MM_Y are productivity parameters that are based on the average number of monthly passes sold at each outlet per month ($\bar{N}_S$). Thus, once the transit company and fare prepayment program parameters are known, the monthly cost of operating a sales outlet depends only on the number of passes sold that month. Since R_S and MM_Y decrease as the number of passes sold each month increases, the average cost or cost per sales transaction will also decrease. The average monthly cost of servicing and operating a sales outlet is plotted in Figure 5-5 as a function of the number of passes sold each month at the outlet.[1] As shown, the costs decrease with higher output. The fixed cost of

[1] It is important for the reader to remember that the average costs presented here and in the sections that follow are per outlet costs assuming there are 150 outlets. Moreover, the average costs -- in this case for a staff-operated outlet -- include not only the cost of operating the outlet, but also the cost of supporting that type of sales distribution. Order preparation costs, for example, are included in equation (5.2) but not in the equation which describes the costs of operating a direct mail program because orders do not have to be prepared.

$2,348.21 is the cost of wages and fringe for the first staff person. The sales volume of 2,561 passes is the average monthly volume that can be handled by an individual. Beyond this volume, it is assumed that labor can be obtained according to need. Thus, these additional staff members would be involved in other activities such as consumer information.

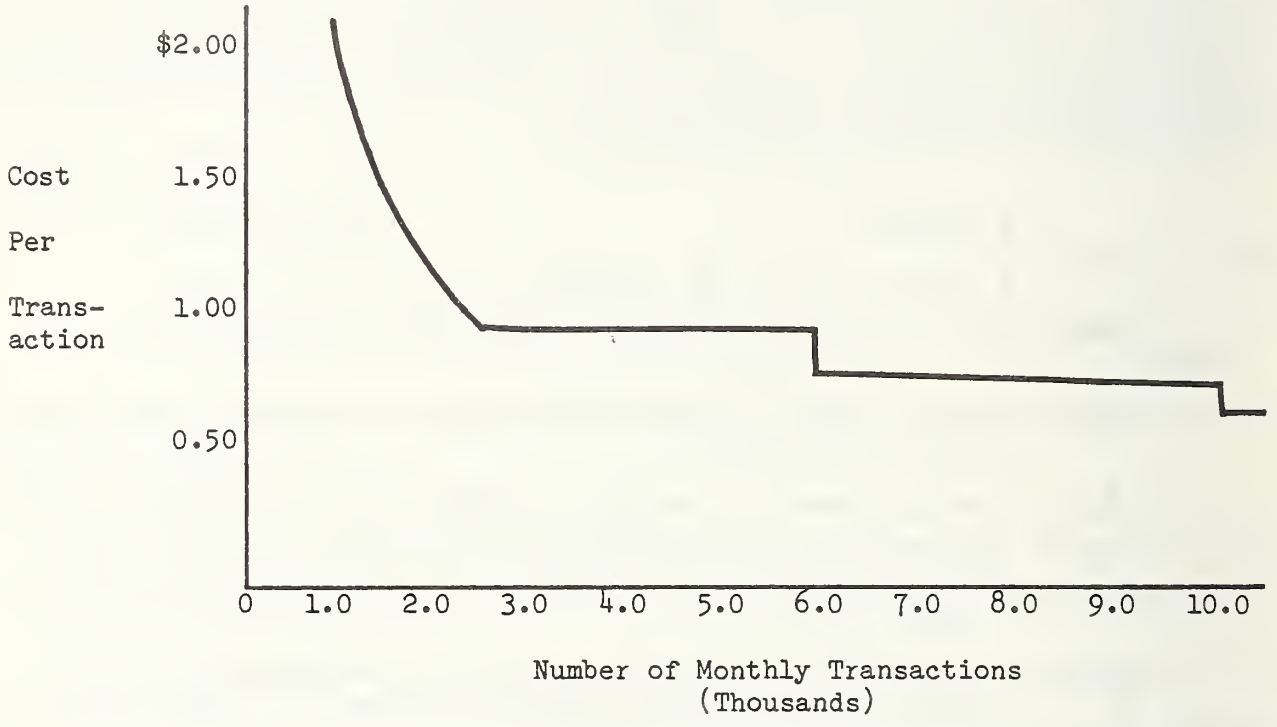

Figure 5-5: AVERAGE COST FOR TRANSIT-OPERATED SALES OUTLETS -- 1981

Public and Private Sales Outlets

Many of the costs associated with distributing and selling fare prepayment plans to staff-run sales outlets are the same for serving public and private outlets. Orders have to be prepared at headquarters and then delivered to all the outlets, and there is an overhead cost for this labor. However, instead of paying salaries and operating expenses for running sales outlets, many public outlets charge a fixed commission on sales. In most small transit systems, public outlets will provide this service and not charge a sales commission. In addition, public and private sales outlets generally do not return pass revenue until late in the month during which the passes are valid. This time delay results in lost interest that the transit company could earn if revenues are transferred sooner. Thus, the cost of funds is a key cost element in operating public and private sales outlets.

The costs related to servicing and maintaining public and private sales outlets can be estimated for all four cost categories identified in Table 5-20 by using equations (3.1), (3.5), (3.6), (3.12b), (4.9), and (4.10) from Chapters 3 and 4. From these equations and using the parametric values and assumptions presented in Table 5-21, the monthly cost of servicing each public and private sales outlet is:

$$(5.3) \qquad MC_o = 12.82 + \overline{N}_s(21.65\ CMP + 0.14)$$

where:

MC_o = monthly cost (dollars) of servicing and maintaining each public and private sales outlet

$\overline{N}_s$ = average number of monthly passes sold per outlet per month

CMP = commission rate (decimal) charged by the sales outlet as a percentage of fare prepayment revenues

The cost per fare prepayment transaction at each sales outlet is related to the commission rate charged by the institution. If no commission is charged, the average cost of selling a monthly pass through public or private outlets will be approximately \$0.14 at very high sales volumes, or equivalent to the opportunity cost of funds on each pass. However, most outlets only begin to charge commissions when sales begin to interfere with the institution's normal business. Because high volume outlets throughout the country charge different rates (i.e., generally between one and three percent), Figure 5-6 presents the transaction costs for public and private outlets at three commission levels. Note that the average transaction costs drop quickly at low sales levels and then levels off at around 500 transactions per month.

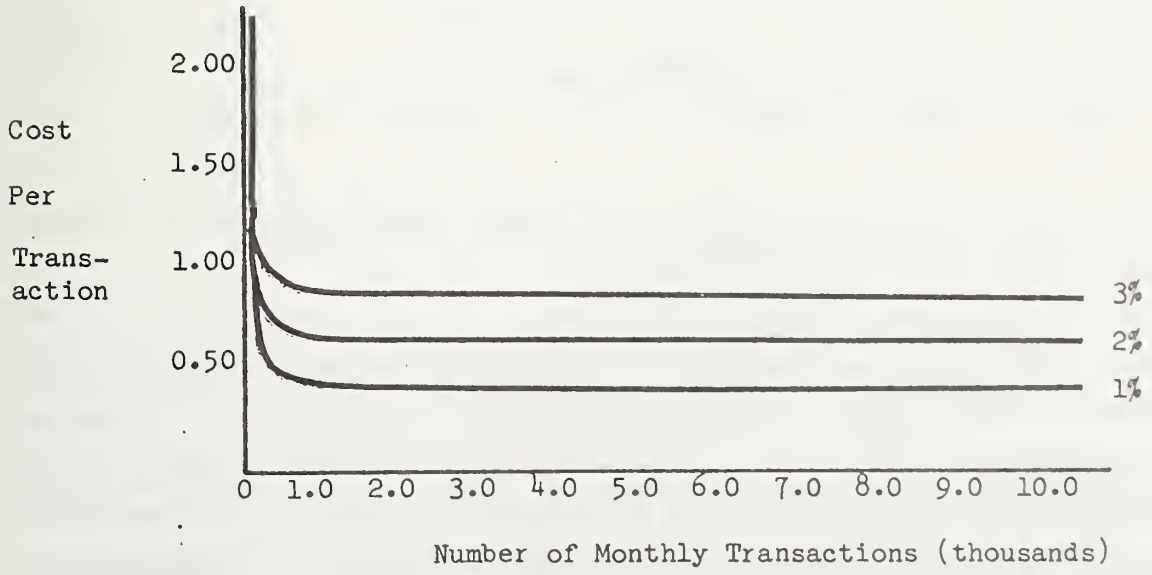

Figure 5-6: AVERAGE COST FOR PUBLIC AND PRIVATE SALES OUTLETS -- 1981

Public Outlets With Sales Contract

Several transit companies across the country have begun negotiations with large retail chains for distribution and sales of fare prepayment instruments. Grocery store and department store chains offer an advantage over individual public outlets because of their existing distribution system and sales activity. Tri-Met in Portland, Oregon, for example, negotiated a contract with the Seven-Eleven retail food store chain to distribute and sell fare prepayment instruments. Seven-Eleven operates many 24-hour establishments throughout Tri-Met's service area. The managers of these stores are eager to increase the number of customers entering the stores because this leads to increased sales. In addition, Seven-Eleven was awarded a contract that provides the chain with a financial incentive to maximize fare prepayment sales. The schedule of commissions paid by Tri-Met to Seven-Eleven is as follows:

- 1% commission for sales less than $150,000 per month
- 2% commission for sales from $150,000 to $300,000 per month
- 2.3% commission for sales from $300,000 to $500,000 per month
- 2.6% commission for sales over $500,000 per month

The rising commission rate provides Seven-Eleven with an incentive to sell as many fare prepayment plans as possible.

Tri-Met can benefit substantially from this contract because Seven-Eleven will provide the following functions:

- distribute plans frequently throughout the month from two warehouse locations to all of its retail outlets,
- sell the plans directly to Tri-Met passengers,
- account for all sales by location, and
- deduct all sales commissions from fare prepayment revenues.

In addition, Seven-Eleven will mention the transit company and the fare prepayment plans in its advertising program.

The only costs the transit company incurs include preparing two orders each month, delivering these packages to Seven-Eleven's two warehouses, paying commissions on sales, and the overhead costs and cost of funds. It is assumed that fare prepayment revenues are transferred to the transit company only once per month as in the case of public and private outlets. Thus, the costs related directly to this form of sales distribution can be estimated by using equations (3.1), (3.5), (3.6), (4.9), and (4.10), in addition to the commission schedule

presented above. Assuming there are 150 Seven-Eleven outlets, and that the chain requires a $1,000 minimum commission each month (i.e., 1% of $100,000 in monthly sales), the monthly cost to the transit company for each Seven-Eleven outlet is:

$$(5.4) \qquad MC_c = 0.32 + \begin{cases} 6.67 + 0.14\ \bar{N}_s & \text{for } \bar{N}_s < 31 \\ 0.35\ \bar{N}_s & \text{for } 31 \leq \bar{N}_s < 46 \\ 0.57\ \bar{N}_s & \text{for } 46 \leq \bar{N}_s < 92 \\ 0.64\ \bar{N}_s & \text{for } 92 \leq \bar{N}_s < 154 \\ 0.70\ \bar{N}_s & \text{for } \bar{N}_s \geq 154 \end{cases}$$

where:

MC_c = monthly cost (dollars) for each Seven-Eleven outlet

$\bar{N}_s$ = average number of monthly passes sold per Seven-Eleven outlet per month

The very low fixed cost of 32 cents per outlet per month is due to the fact that the transit company only has to prepare and deliver two packages each month. Seven-Eleven incurs all the distribution sales costs. Given the assumption that 150 outlets are used, Seven-Eleven can reach the maximum commission rate of 2.6 percent if an average of 154 passes are sold each month at each outlet.[1] Figure 5-7 presents the average transaction costs at each outlet based on equation (5.4) at different monthly sales volumes.

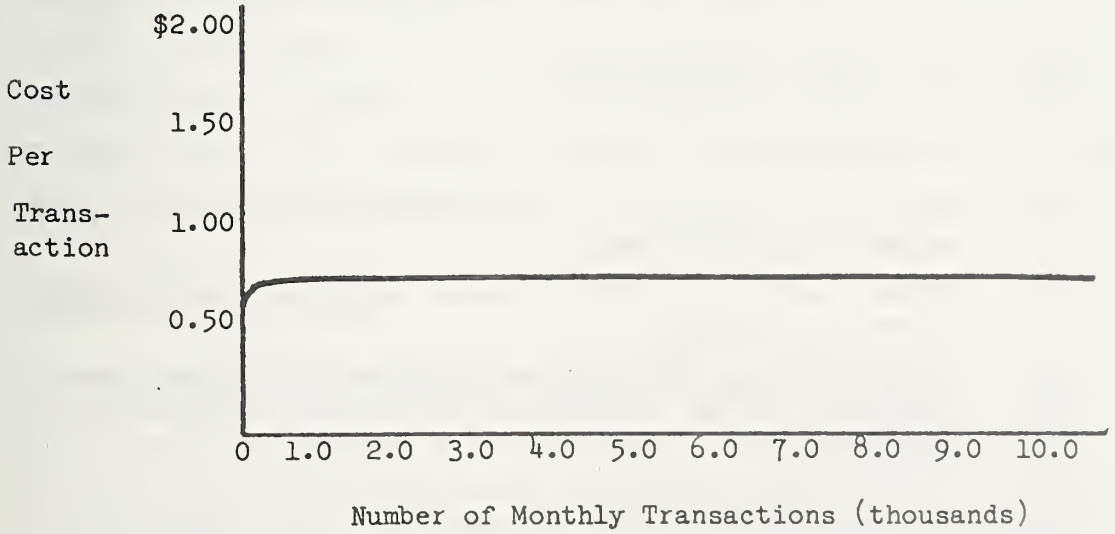

Figure 5-7: AVERAGE COSTS FOR PUBLIC OUTLETS WITH SALES CONTRACT -- 1981

[1] 154 passes per month per outlet is equivalent to a monthly pass sales rate of 23,100 each month assuming 150 outlets. At the time of the interview, Portland was selling 30,111 passes each month. Thirty-four percent of these, however, were sold at the transit authority's own customer assistance office located downtown.

Direct Mail Programs

Unlike the previous three distribution methods that involve personal over-the-counter transactions, sales through direct mail programs are handled impersonally through the mail. The costs associated with this sales method include labor processing costs, material expenses, recording costs, and overhead expenses. There are no large outlet orders to prepare as with sales outlet programs, no staff deliveries are made, and revenues are deposited daily. The specific costs related to direct mail order processing and distribution can be estimated from equations (3.14), (3.15), (3.21a), and (4.9) from Chapters 3 and 4. In addition to the assumptions and parametric values presented in Table 5-21, the following parametric values were chosen based on the data presented in Chapter 3:

- C_{dm} = cost per mailer = \$0.0325
- BRM = business reply mail monthly fee = \$3.33
- C_p = first class postage = \$0.18
- C_{ps} = postage surcharge for business reply mail \$0.05
- C_e = cost per envelope = \$0.065

Using normal values for the productivity parameters, the monthly cost of processing and distributing fare prepayment plans by mail is:

$$(5.4) \qquad MC_m = 3.33 + \bar{N}_s\,(1.37 + 0.19\,MM_r)$$

where:

MC_m = monthly cost (dollars) of processing and distributing fare prepayment plans by mail

$\bar{N}_s$ = average number of monthly passes sold per month through direct mail program

MM_r = average time required (minutes) to record each sales transaction following the schedule presented in Table 3-35 of Chapter 3

MM_r is a productivity parameter that is based on the average number of monthly passes sold each month ($\bar{N}_s$). Thus, the monthly cost of processing and distributing passes depends only on the number of passes sold each month.

Figure 5-8 presents the average costs per transaction for a direct mail program as a function of the number of passes sold each month.

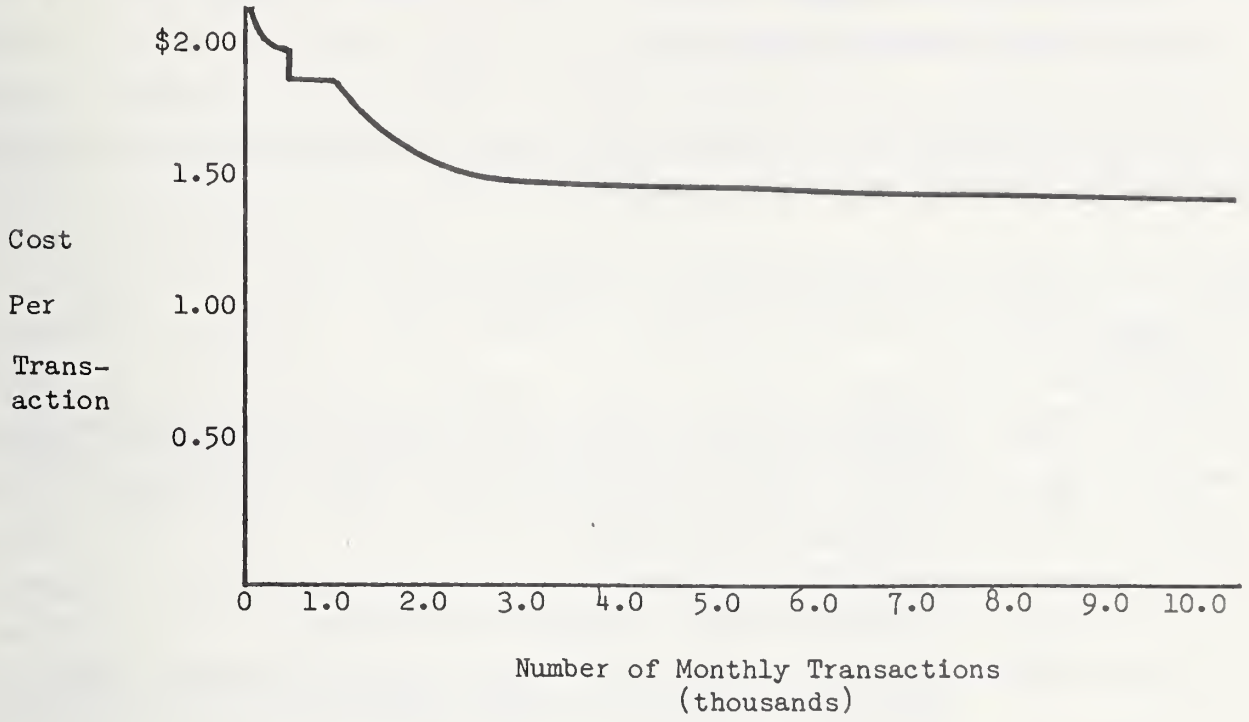

Figure 5-8: AVERAGE COSTS FOR A DIRECT MAIL PROGRAM -- 1981

At very low volumes the cost per sales transactions is not that great. For example, if only 50 passes are sold each month, the cost per pass is $2.03. However, as the number of passes sold increases, the unit costs do not decrease substantially. A minimum cost of approximately $1.40 is all that can be obtained because direct mail programs are extremely labor-intensive since each pass order has to be handled individually.

Telephone Order Programs

Like direct mail programs, telephone order programs are labor intensive and do not require a network of sales outlets. The costs associated with this sales activity include the labor cost of taking each order over the telephone and processing the order, the material cost, including the finance charge for credit card use, and the recording and overhead costs. The specific costs associated with this distribution method can be estimated using equations (3.16), (3.17), (3.21a), and (4.9). In addition to the parametric values presented in Table 5-21, the following assumptions were made based on the data presented in Chapter 3:

- TC = monthly telephone charge = $37.00
- C_e = cost per envelope = $0.065
- C_p = first class postage = $0.18

Thus, the monthly cost of processing and distributing fare prepayment plans by telephone order and mail distribution is:

$$(5.5) \qquad MC_t = 37 + \overline{N}_s (21.65\ DR + 0.19\ MM_t + 1.11)$$

where:

MC_t = monthly cost (dollars) of processing and distributing fare prepayment plans by telephone order and mail distribution

$\overline{N}_s$ = average number of monthly passes sold per month through the telephone order program

DR = financial institution bankcard discount rate based on schedule presented in Table 3-31 of Chapter 3

MM_r = average time required (minutes) to record each sales transaction following the schedule presented in Table 3-35 of Chapter 3

The values of DR and MM_r decrease with higher output. The average transaction cost, therefore, will decrease as more passes are sold. However, at volumes over 3,000 monthly transactions, the rate of decrease in the average cost of selling a pass through a telephone order program is negligible. As shown in Figure 5-9, the cost of selling a pass by this method will not drop below $2.20 at very high demand levels.

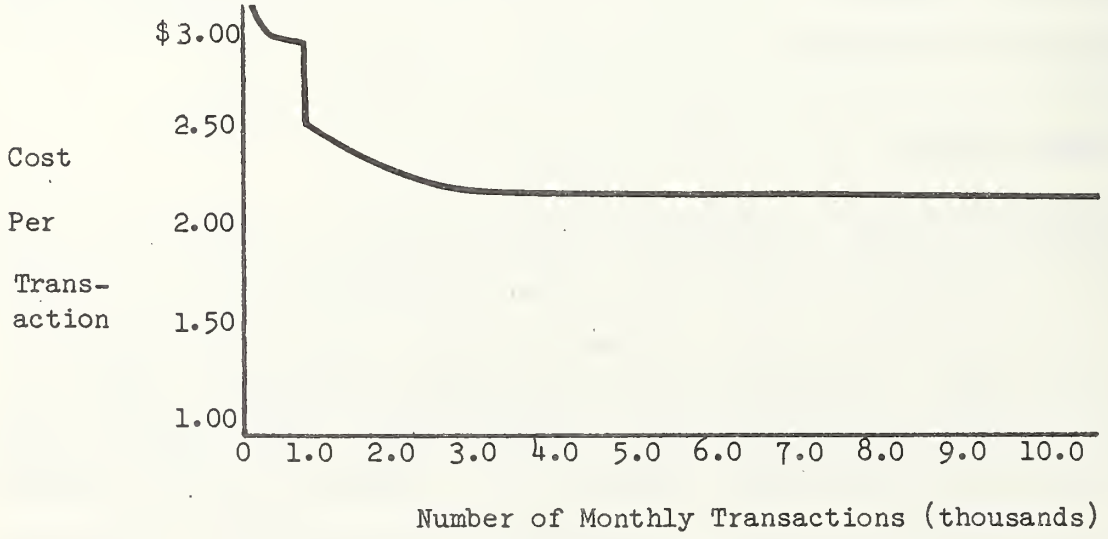

Figure 5-9: AVERAGE COSTS FOR A TELEPHONE ORDER PROGRAM -- 1981

A Comparison of Sales Distribution Costs

This cost analysis of five methods of sales distribution has shown that the cost of selling a monthly pass will vary considerably depending on the method used and the volume sold. With the exception of the Seven-Eleven program in Portland, the distribution methods exhibit clear economics of scale. Average transaction costs increase at low volumes in the Seven-Eleven program because of the progressive variable commission rate that Seven-Eleven secured in its contract with Tri-Met.

Figure 5-10 presents a comparison of the transaction costs by all five distribution methods as sales volumes ranging from zero to 1,000 passes per month. The curves clearly indicate that it is less expensive to sell monthly passes through public outlets than through a transit-operated sales outlet that must be manned full time. Public outlets generally do not have sales minimums. In fact, most public outlets charge no commission until high volumes are reached. Obviously, if a transit manager can secure the services of public and private institutions for selling fare prepayment plans at these volumes, it is not economical to augment these outlets with a staff-run outlet unless other services (e.g., passenger information) are offered.

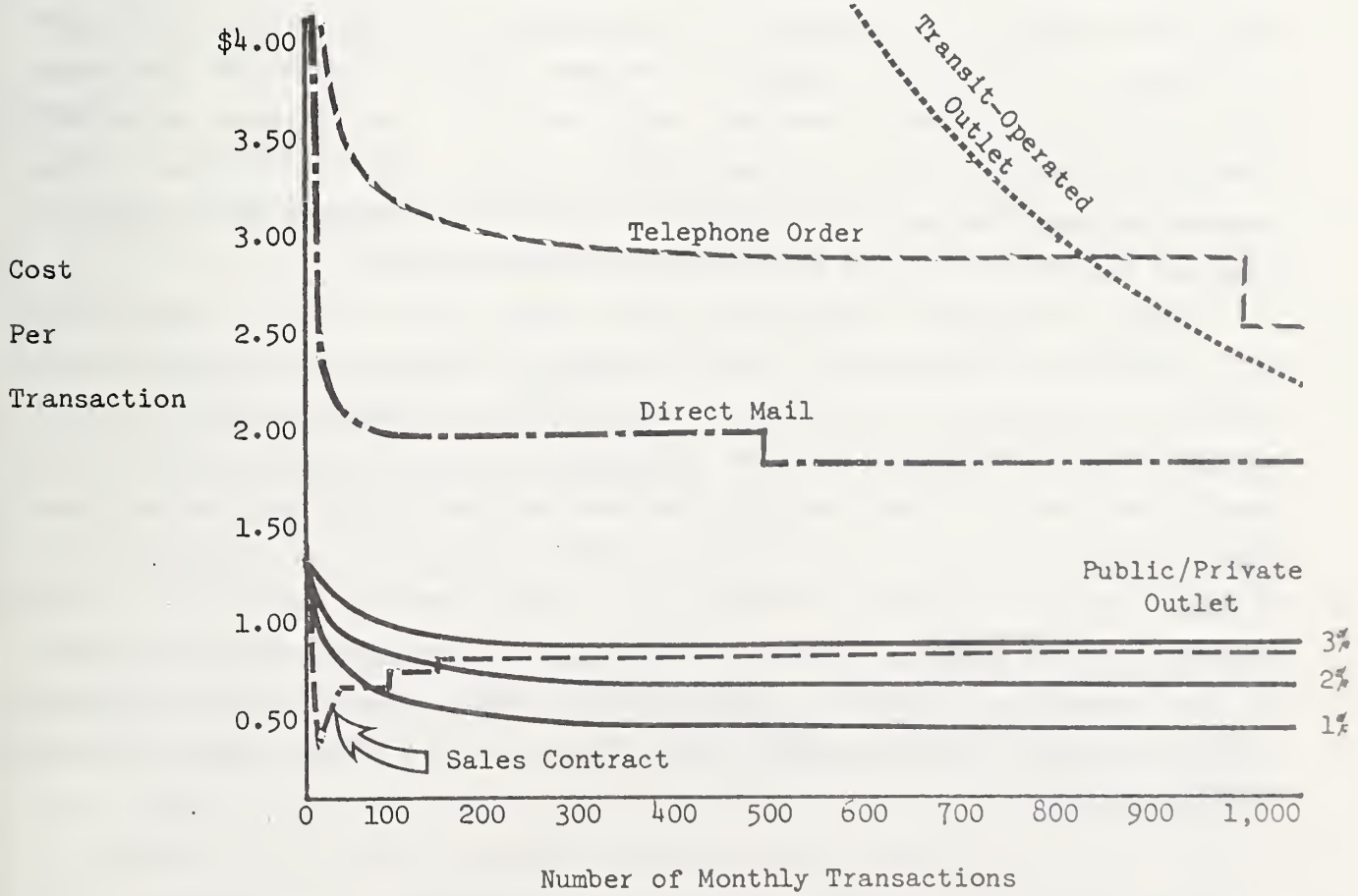

Figure 5-10: A COMPARISON OF AVERAGE COSTS FOR FIVE DISTRIBUTION METHODS AT LOW SALES VOLUME -- 1981

In interpreting these cost curves, it is important to recall some of the assumptions used. First, it was assumed that the transit-operated outlet would be manned, at least, by one person full time. Many transit systems are able to operate a sales outlet for only a few days a month when demand is high. The average costs under these conditions will obviously be lower than the costs shown in Figure 5-10. A second assumption was that public sales outlets could be used with no minimum sales requirement. As already mentioned, this assumption is realistic since most institutions are more interested in serving their clients than in providing what many consider, a public service. The third major assumption was that a retail chain would require at least $1,000 per month in commissions in order to participate. This assumption is also reasonable since it is very unlikely that a large retail chain would bother with such a program if less than 4,500 people would be involved.

A comparison of the average sales distribution costs for all five methods is presented in Figure 5-11 for high volume conditions. As shown, a telephone order program is the most expensive method of selling monthly passes at volumes over 800 transactions per month. A transit-operated outlet becomes less expensive than a direct mail program at volumes around 1,500 passes per month. This comparison, however, does not imply that only one of these two methods should be employed, since the two methods are not clear substitutes. Those purchasing a monthly pass by mail may be scattered throughout the metropolitan area and not able to use an over-the-counter sales outlet.

A more interesting comparison exists toward the bottom of Figure 5-11. If a reliable, conveniently located network of public and private outlets cannot be maintained at commission rates below two percent, than a transit manager should seriously consider negotiating a sales contract with a large retail chain such as the contract obtained between Tri-Met and Seven-Eleven. This contract, even at a 2.6 percent commission, results in a slightly lower average cost than would be obtained at a transit-operated outlet below 10,000 transactions per month. At higher volumes, transit operated outlets are slightly less expensive. Moreover, most staff-run outlets perform other functions, such as customer information and direct public exposure which are not considered in this analysis.

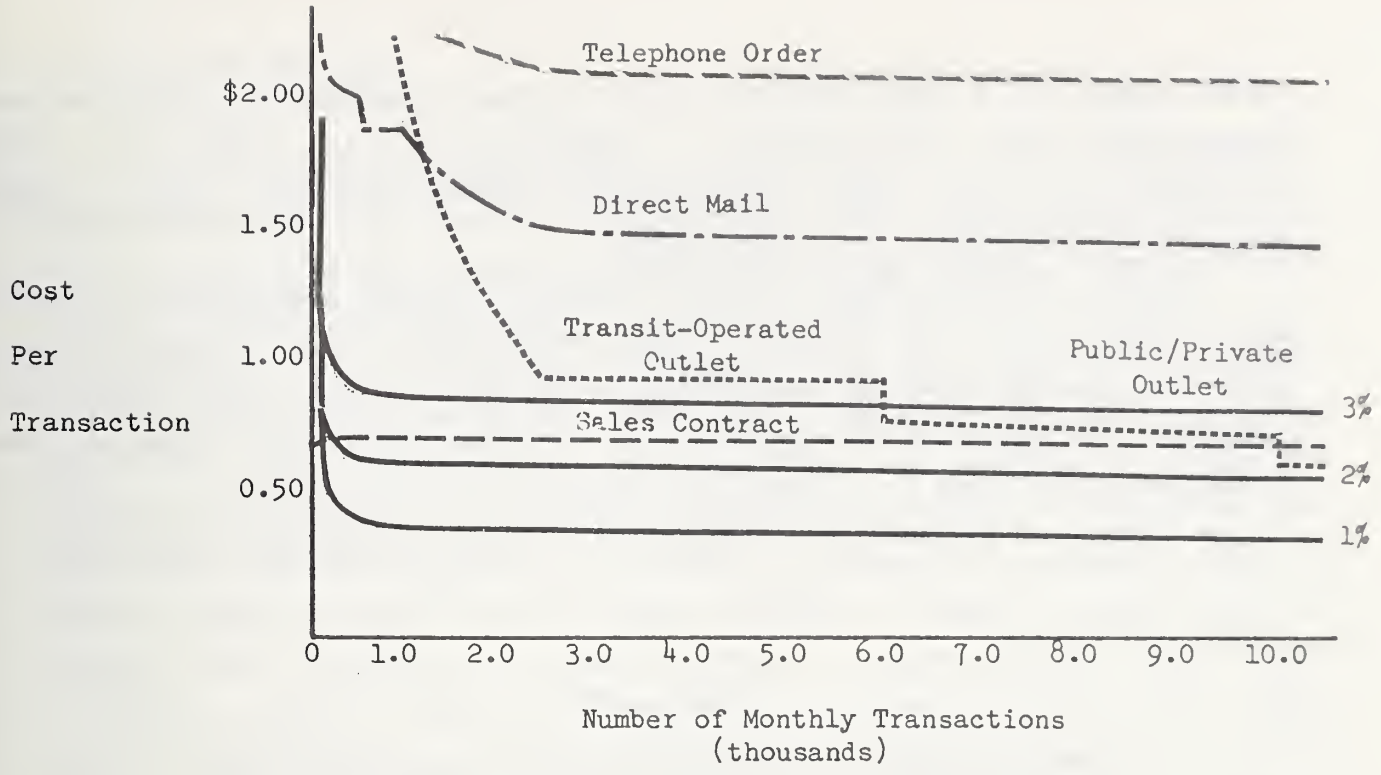

Figure 5-11: A COMPARISON OF AVERAGE COSTS FOR FIVE DISTRIBUTION METHODS AT HIGH SALES VOLUME

Summary

This section presented an analysis of the costs of selling monthly passes by five different distribution methods. The five sales distribution methods compared were:

- transit-operated sales outlets,
- public and private sales outlets.
- public outlets with sales contract,
- direct mail programs, and
- telephone order programs.

This analysis has shown that telephone order and direct mail programs are relatively expensive programs to operate with little or no economies of scale. In order to make them cost-effective, they should only be marketed to those without access to lower-cost public and private, over-the-counter sales outlets.

Depending on the sales commission rates asked by public and private sales outlets, it may be less expensive for the transit company to staff and maintain a sales outlet if very high outlet volumes are obtained. In this analysis

it was found that a staff-operated outlet is less expensive than public outlets charging more than 2 1/2 percent in commissions only at volumes over 10,000 pass sales per month. Most staff-operated outlets, therefore, must be judged and justified on grounds other than costs.

Finally, transit managers should seriously consider negotiating a contract with a retail chain for the distribution and sales of fare prepayment plans, since such contracts can be less expensive if public outlets charge higher commissions. In addition, contracting for the distribution and sales of fare prepayment plans frees the transit company from these activities.

A summary of the principal findings of this section appear in Table 5-22.

Table 5-22

SUMMARY FINDINGS OF ALTERNATIVE SALES DISTRIBUTION COSTS

- With the exception of the Seven-Eleven retail network with its progressive variable commission rate, sales distribution methods exhibit economies of scale at relatively low sales volumes. At high volumes all five methods have constant average costs.
- Direct mail and telephone order programs are very expensive and should only be employed at low volumes. In addition, transit managers should direct these programs toward only those unable to use the less expensive sales outlets.
- Transit-operated outlets are more expensive to service and run than public and private outlets unless the latter request commissions in excess of 2 1/2 percent and outlet sales volumes exceed 10,000 transactions per month.
- Contracting distribution and sales with large retail establishments may be a cost-effective alternative to both transit-operated and public and private sales outlets.

FREQUENCY OF PRINTING

A minor but, nevertheless, relevant trade-off that must be made in any fare prepayment program concerns the frequency with which fare prepayment plans are ordered and the inventory space needed to store them. As was shown in Chapter 4, there are definite economies of scale in printing fare prepayment plans. As a general rule, large volume printing orders will result in lower unit printing costs, all other factors being equal. The equivalent monthly printing cost for a fare prepayment program, therefore, will decrease as plans are ordered less frequently. An example presented in Chapter 4 illustrated that one transit system could save 21 percent by ordering one 12-month supply of monthly passes instead of two, 6-month supplies. Greater savings could be achieved when comparing a 12-month order to orders placed every month.

If fare prepayment plans are ordered less frequently, however, more space will have to be found in which to store them. Although the monthly storage costs for tickets and passes are minor in contrast to the other costs incurred in a fare prepayment program, storage can be a problem and expensive in very large programs. The trade-off presented in this section, therefore, concerns the monthly cost of printing versus the monthly cost of storage space.

Since the monthly equivalent cost of printing fare prepayment plans decreases at a decreasing rate as printing orders become less frequent, and since storage costs increase linearly, the printing frequency that yields the least monthly cost to the transit company can be identified by the minimum point on the curve represented by the sum of these two costs. For example, consider the printing and inventory costs for Sacramento's monthly pass program shown in Table 5-23. The monthly equivalent printing costs decrease from $1,332 when passes are printed monthly to less than $300 when passes are printed annually. Inventory costs, however, increase from only $3 to $40 per month. Because the monthly pass program in Sacramento is relatively small, the major savings in monthly printing costs by printing less frequently is not offset by the rising inventory costs. Based on the cost data presented in Table 5-23, Sacramento does not reach a minimum total costs (i.e., printing plus inventory cost) by printing its monthly passes more frequently than once per year. Sacramento is thus better off ordering passes annually or even less often rather than semi-annually or monthly.

Table 5-23

MONTHLY EQUIVALENT PRINTING AND INVENTORY COSTS BY ORDER SIZE FOR A MONTHLY PASS IN SACRAMENTO - 1981

	Printed Monthly	Printed Semi-Annually	Printed Annually
Order Size	16,000	96,000	192,000
Printing Cost Per Order[a]	$1,332	$2,206	$3,506
Monthly Printing Cost	$1,332	$368	$292
Space Required (cubic feet)[b]	56	337	674
Monthly Inventory Cost[c]	$ 3	$20	$40
Total Monthly Cost	$1,335	$388	$332

[a]From Table 4-4, Chapter 4.

[b]Based on an inventory requirement of 285 passes per cubic foot from Table 4-19, Chapter 4.

[c]Based on a value of storage space of $0.06 per cubic foot per month.

In large fare prepayment programs, however, the amount of savings that can be achieved by ordering more instruments less frequently diminishes rapidly. In the Sacramento case cited above, unit printing costs went from $83.25 to $18.26 per thousand by going from an order of 16,000 passes to 192,000 passes. In Los Angeles, where 160,000 passes are ordered each month, the unit printing cost is only $10 per thousand. By printing 960,000 passes semi-annually, Los Angeles can not expect to obtain a rate much below $10 per thousand. Its monthly pass printing costs, therefore, will remain constant no matter how frequently monthly passes are ordered. Storage costs, on the other hand, will continue to increase linearly as space requirements increase.

Based on a monthly requirement of 40,000 passes, monthly equivalent printing and storage costs for various pass order sizes are given in Table 5-24 and illustrated in Figure 5-12. The monthly pass printing costs are based on the standardized costs obtained in Table 4-6 of Chapter 4. Notice that as the size of order increases, the unit printing cost -- and thus monthly equivalent cost -- decreases but at a decreasing rate. The inventory costs were obtained from equation (4.3) of Chapter 4 assuming a normal efficiency of space utilization. Both curves, therefore, reflect the standardized costs of printing and storing monthly passes after observing all 11 transit systems.

The total monthly printing and inventory costs shown in Table 5-24 and Figure 5-12 decrease from $1,611 for passes printed monthly to just below $800 for passes printed every 8 to 12 months. Total costs then begin to rise almost linearly when monthly passes are printed less than once per year. A minimum point on the total cost curve, therefore, lies between the printing periods of 8 to 12 months.

It can be shown that as the monthly pass requirement increases for large programs, the minimum point of the printing and inventory cost curve will occur at more frequent printing orders. This is true because most economies of scale for printing monthly passes are reached at order sizes of around 300,000 passes. In Figure 5-13, four cost curves are presented, each curve representing a different monthly pass program size. The lowest curve is the same curve illustrated in Figure 5-12 and presents a monthly pass printing requirement of 40,000 passes, or essentially what Philadelphia and Portland require. Each ascending curve represents a higher program size. The second curve, for example, represents the costs of printing and storing passes at different printing frequencies based on a monthly pass requirement of 80,000 passes, or approximately what Seattle requires. The top two curves are for programs requiring 120,000 passes per month and 160,000 passes per month. Los Angeles, for example, orders 160,000 passes each month.

As shown in Figure 5-13, the minimum point of each curve moves to the left as the size of the program increases. Thus, a program requiring 40,000 passes each month should place orders every 10 months, a program requiring 80,000 passes each month should place orders semi-annually, and larger programs even more frequently.

Table 5-24

MONTHLY EQUIVALENT PRINTING AND INVENTORY COSTS BY ORDER SIZE -- 1981

Size of Order	Printing Frequency	Unit Printing Cost[a] ($ per thousand)	Monthly Printing Cost	Monthly Inventory Cost[b]	Total Monthly Cost
40,000	1 month	40.0	$1,600	$ 11	$1,611
80,000	2 months	32.0	1,280	22	1,302
160,000	4 months	25.0	1,000	44	1,044
240,000	6 months	21.0	840	65	905
320,000	8 months	18.5	740	87	827
400,000	10 months	17.0	680	109	789
480,000	annually	16.5	660	131	791

[a]Estimated from Table 4-6 of Chapter 4.
[b]Estimated from equation (4.3) of Chapter 4 assuming a normal utilization of space (i.e., 220 passes per cubic foot).

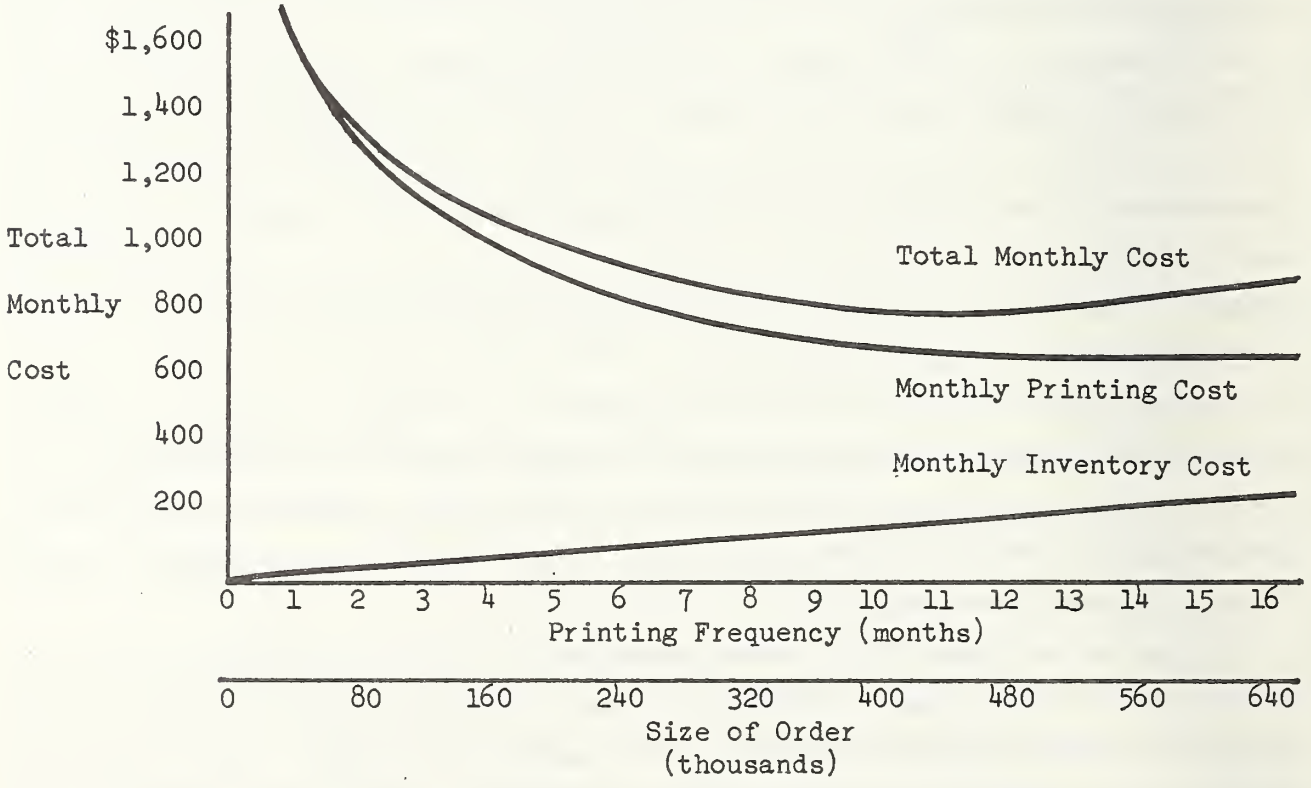

Figure 5-12: MONTHLY EQUIVALENT PRINTING AND INVENTORY COSTS BY ORDER SIZE -- 1981

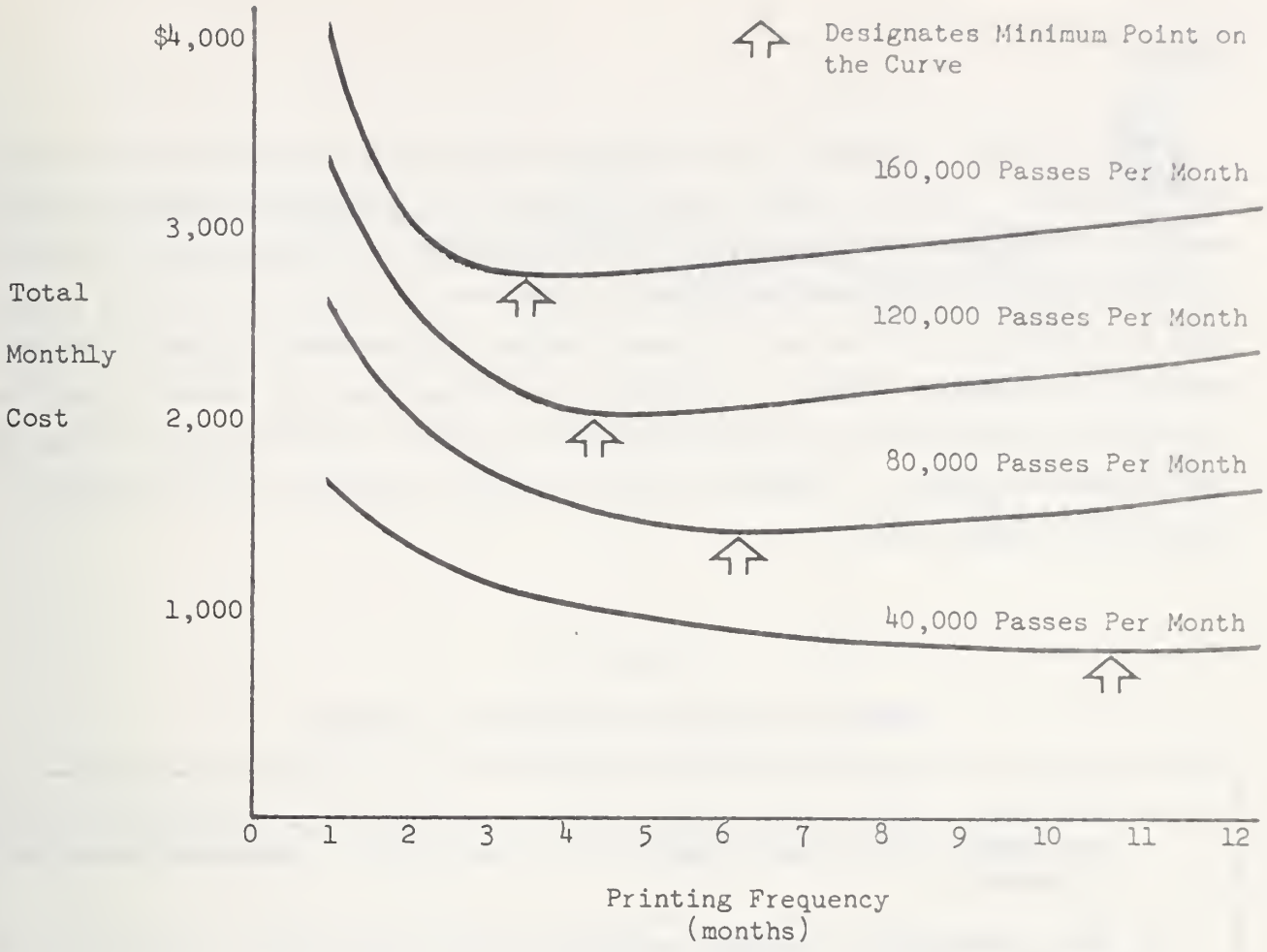

Figure 5-13: MONTHLY EQUIVALENT PRINTING AND INVENTORY COSTS BY PRINTING FREQUENCY FOR FOUR PROGRAM SIZES -- 1981

It is important to remember that the costs represented by these curves are standardized costs based on data obtained from all 11 case sites. The cost of printing may vary from site to site which will affect where the minimum point lies. As already indicated, Los Angeles is ordering its passes on a monthly basis and paying only $10 per thousand.

Other factors may also affect these cost curves. The cost of storage space, estimated at $0.06 per cubic foot per month, will vary by site depending on the location of the storage facility and the security requirements of the program. The type of fare prepayment plan used will also affect the printing cost and the amount of space required for storage.

Summary

This section presented a brief analysis of the cost of printing and storing monthly passes. It was shown that in small fare prepayment programs passes should be printed as infrequently as possible without incurring a greater risk of theft or creating a problem in planning. The minor savings by printing passes less frequently in very large programs, however, is eventually offset by higher storage and inventory costs. In general, the lowest possible monthly cost for printing and storage can be obtained by printing more frequently as the size of the program increases. A summary of the principal findings of this section is presented in Table 5-25.

Table 5-25

SUMMARY FINDINGS OF FREQUENCY OF PRINTING

- Inventory costs, while minor relative to other fare prepayment costs, can offset the savings obtained by printing fare prepayment plans less frequently.
- Fare prepayment programs requiring less than 40,000 instruments per month should have their plans printed annually.
- Larger programs should print plans more frequently according to the guidelines presented below:

Programs Requiring:		Should Print Plans:
40,000 passes/month	--	every 10 months
80,000 passes/month	--	every 6 months
120,000 passes/month	--	every 5 months
160,000 passes/month	--	every 4 months

6

GUIDELINES ON USE OF THIS REPORT

6

GUIDELINES ON USE OF THIS REPORT

The purpose of writing this report is to provide transit managers with a set of working tools that can be used to help improve the cost-effectiveness of fare prepayment programs. The tools presented in this report are in the form of standardized parametric cost equations. In Chapter 3, the principal transaction oriented costs were analyzed and a series of detailed cost equations were presented in four cost categories. Non-transaction oriented costs were analyzed in Chapter 4, again yielding a series of parametric equations in eight cost categories. Taken together, these two chapters provide enough information to analyze almost any fare prepayment program in substantial detail.

The question then arises: why would anyone want to know how much it costs to operate a fare prepayment program? There are perhaps three good reasons for wanting to have operating cost data available. First, by having cost data available, transit managers will be able to identify where their costs are above normal. Specific changes can then be made to the program to reduce operating costs.

For transit managers interested in adding to, subtracting from, or modifying their fare prepayment programs, parametric cost models, such as the equations presented in this report, can be used to forecast the changes in costs to the program. The cost ramifications of introducing a direct mail order and distribution program, for example, can be estimated from the equations and productivity parameters provided in this document.

Finally, since most fare prepayment managers do not know how much is spent each month on a particular aspect of a program, or the program in general, they may not be aware of how program activities actually function. Thus, by knowing more about the factors that drive the costs of operating a fare prepayment program, transit managers should be in a position to better understand the programs they oversee.

This chapter is provided to assist the reader in using this report. Specifically, the chapter is divided into three sections:

- how to compute an existing program's operating costs;
- how to forecast a new program's operating costs, and
- general observations on fare prepayment program costs.

In the first two sections of this chapter, the reader is shown how the parametric equations presented in Chapters 3 and 4 can be used to provide reliable and accurate cost information. Guidelines are presented on computing costs and short examples are provided. In the last section, the authors present some general observations on fare prepayment costs based on the analyses of Chapters 3 and 4, and the cost comparisons of Chapter 5.

HOW TO COMPUTE AN EXISTING PROGRAM'S OPERATING COSTS

General guidelines are presented in this section on how to compute the operating costs of an existing fare prepayment program. Both monthly and average costs are described. An example is presented following the general guidelines to illustrate how these costs can be computed.

General Guidelines

Total monthly costs and average costs can be computed using the equations presented in Chapters 3 and 4. In addition, a transit manager must have available information on the values of three categories of parameters used in the equations. These include:

- resource parameters, which identify existing wages and costs, such as the average hourly wage rate for different types of labor, and the fringe benefit rate for the employees;

- program parameters, which identify the characteristics of the fare prepayment program, such as the number of staff-run sales outlets, number of fare prepayment plans, and the average monthly mileage for staff delivery; and

- productivity parameters, which identify how efficiently the task is performed, such as the delivery time per outlet and the average time required to make a sales transaction at a sales outlet.

Fare prepayment staff should be able to identify values for the first two sets of parameters. The productivity parameters, however, may be difficult to identify or measure. If they cannot be measured or estimated, one of the standardized values presented after the equation in which the parameter is used should be selected. The value selected should correspond as closely as possible to the conditions in the system in question. A complete description of the 24 principal cost equations is presented in Appendix A, along with their parameter definitions.

Five steps are required to compute and analyze total monthly and unit costs. These steps include:

Step 1: Inventory fare prepayment program
Step 2: Identify appropriate cost equations
Step 3: Compute costs for each equation separately and by cost category
Step 4: Compute unit costs by cost category
Step 5: Compare unit costs with costs of companies of similar size

Step 1: Inventory Fare Prepayment Program

A detailed inventory of the fare prepayment program does not have to be made at this time since it is not known which cost equations (and thus which parameters) will be used. It is necessary, however, that a general inventory be conducted with the objective of answering the following questions:

- What sales distribution methods are employed?
- How many plans are delivered to sales outlets?
- What types of fare prepayment plans are sold and how many are sold every month?
- What proportion of monthly sales are made by each distribution method?

The general categories of distribution methods, delivery methods, and fare prepayment plans that are discussed in this report are shown in Table 6-1. As indicated, five methods of sales distribution can be analyzed with the cost equations presented in this report. Transit-operated outlets include all sales outlets that are staffed by transit company personnel. Public and private outlets include all outlets that are not staffed by the transit company. Employer-distributed sales of fare prepayment would be included in this category. They may be commissioned or non-commissioned outlets. Third-party contract distribution and sales, similar to the Seven-Eleven contract discussed in Chapter 5, is not incorporated in any of the cost equations. However, the equation describing monthly commissions paid to sales outlets can be modified to include the terms of the Seven-Eleven contract if the fixed commission rate is changed to a variable rate. Direct mail and telephone order programs are those that do not involve an over-the-counter transaction. Finally, on-board sales include the sales of day passes and weekend passes.

Table 6-1

GENERAL FARE PREPAYMENT PROGRAM CHARACTERISTICS
CAPABLE OF BEING ANALYZED IN THIS REPORT

SALES DISTRIBUTION METHODS

- Over-the-Counter Sales
  - Transit-Operated Outlets
  - Public and Private Outlets (including employer outlets)
- Direct Mail Sales
- Telephone Order Sales
- On-Board Sales of Day Passes

ORDER DELIVERY METHODS

- Staff Delivery
- Courier Delivery
- Certified Mail Delivery

FARE PREPAYMENT PLANS

- Passes
- Permits (ID's)
- Tickets
- Tokens
- Punch Cards

Three types of order delivery methods can be analyzed with the cost equations: deliveries using transit staff and transit-owned vehicles, courier deliveries, and certified mail deliveries.

All of the fare prepayment plans listed in Table 6-1 can be analyzed with the equations presented in this report. It is important to remember, however, that the costs obtained from each of the parametric equations are monthly costs. The parameters related to long-term plans, such as semester and annual passes, must be converted to monthly equivalents in order to be used in the equations.

The last piece of information that should be assembled before proceeding is the distribution of fare prepayment sales by fare prepayment plan and sales method. A simple distribution of sales by fare prepayment plan and sales method should be easy to obtain and will help with the computations that follow. An example of such a distribution is provided in Table 6-2.

Table 6-2

AN EXAMPLE OF FARE PREPAYMENT SALES BY SALES DISTRIBUTION METHOD

Fare Prepayment Plan	Transit-Operated Outlets		Public/ Private Outlets	Direct Mail Program	TOTAL SALES
	At Headquarters	At Outlets			
Monthly Pass	2,000	8,000	19,500	500	30,000
10-Trip Ticket	3,000	7,000	15,000	0	25,000
TOTAL SALES	5,000	15,000	34,500	500	55,000

Step 2: Identify Appropriate Cost Equations

Although more than 40 unique parametric cost equations were developed in this report for describing fare prepayment program costs, only 24 equations are needed to compute total fare prepayment program costs. Moreover, fewer equations are needed if direct mail, telephone order, and on-board pass sales programs are not employed.

Table 6-3 presents a list of the equation numbers organized by cost category taken directly from Chapters 3 and 4. These are the only equations that are required for calculating total monthly program costs. In addition, the five principal distribution methods are identified. The shaded portions of the table indicate which equations are relevant for each method of sales distribution. For example, if one is interested in computing the costs of a direct mail program only, the reader should compute the costs of the ten equations indicated in Table 6-3, starting at equation (3.14) and ending with equation (4.9).

A box is provided next to each equation number to allow the reader to check the equation number that corresponds to the sales distribution method of the program under investigation. These equations will then be used in the next step to compute monthly costs by cost category.

Step 3: Compute Costs For Each Equation Separately and by Cost Category

The equations that were checked in Table 6-3 based on the identifications made in Step 2 should now be used to compute monthly program costs. Appendix A presents all 24 equations along with their parameter definitions. A set of standardized costs developed from the analyses in Chapters 3 and 4 is given for each productivity parameter. In addition, some resource parameters are also given dollar values. It is important to remember that each equation yields monthly costs for that activity. If annual or semi-annual costs are required, the equation results should be adjusted accordingly. Moreover, all costs included in the equations are based on 1981 dollars. Obviously, these costs should be inflated for future years.

As monthly costs are computed for each equation, they can be entered in the form presented in Table 6-4. The costs computed from each equation should be entered in column 1, in the row corresponding to the equation number. Monthly subtotals for each cost category should be entered in column 2. Notice that most of the cost categories from Chapter 4 include only one equation. The subtotal costs in these cases are the costs obtained from the parametric equations. Lines 28 and 35 are provided for costs not covered by the cost equations, such as the miscellaneous handling costs presented in Chapter 4. The total monthly fare prepayment cost is the sum of the costs in column 2.

Table 6-3: PARAMETRIC COST EQUATIONS IDENTIFIED BY SALES DISTRIBUTION METHOD

	Equation Number	Check Column	Over-the-Counter Sales		Sales at Headquarters		
			Transit Operated Outlets	Public/ Private Outlets	Direct Mail Program	Telephone Order Program	On-Board Sales of Day Passes
Order Preparation	3.1		■	■			
	3.2		■	■			
	3.3						■
Order Delivery	3.5		■	■			
	3.6		■	■			
	3.7		■	■			
	3.8		■	■			
Direct Sales	3.11		■				
	3.12a			■			
	3.13a			■			
	3.14				■		
	3.15				■		
	3.16					■	
	3.17					■	
Recording and Accounting	3.21		■		■	■	
	3.22		■	■	■	■	
	3.23						■
Design	4.1		■	■	■	■	
Printing	4.2		■	■	■	■	■
Inventory	4.3		■	■	■	■	■
Advertising	4.4		■	■	■	■	
Administration	4.5		■	■	■	■	
Overhead	4.8		■				
	4.9		■	■	■	■	■

Table 6-4: MONTHLY COST SUMMARY SHEET BY COST CATEGORY

Cost Category	Item Description	Equation Number	Monthly Costs (1)	Monthly Subtotal Costs (2)
A: SALES OUTLETS, DIRECT MAIL, AND TELEPHONE ORDER				
Order Preparation	1. order preparation - labor	3.1		
	2. order preparation - equipment	3.2		
	3. Subtotal: Order Preparation			
Order Delivery	4. staff delivery - labor	3.5		
	5. staff delivery - vehicle	3.6		
	6. courier service	3.7		
	7. certified mail	3.8		
	8. Subtotal: Order Delivery			
Direct Sales	9. transit-operated sales-labor	3.11		
	10. outlet commissions - percentage rate	3.12a		
	11. outlet commissions - fixed rate	3.13a		
	12. direct mail sales - labor	3.14		
	13. direct mail sales - materials	3.15		
	14. telephone sales - labor	3.16		
	15. telephone sales - materials	3.17		
	16. Subtotal: Direct Sales			
Recording and Accounting	17. recording sales - labor	3.21		
	18. accounting sales - labor	3.22		
	19. Subtotal: Recording & Accounting			
Design	20. design - labor and materials	4.1		
Printing	21. printing plans	4.2		
Inventory	22. storage plans	4.3		
Advertising	23. advertising - labor and media	4.4		
Administration	24. administration - labor	4.5		
Overhead	25. transit-operated outlets	4.8		
	26. headquarters operations	4.9		
	27. Subtotal: Overhead			
Miscellaneous	28. costs not covered by equations			
Regular Sales	29. TOTAL MONTHLY COSTS FOR REGULAR SALES			
B: ON-BOARD SALES OF DAY PASSES				
Order Preparation	30. order preparation - labor	3.3		
Accounting	31. accounting sales - labor	3.23		
Printing	32. printing passes	4.2		
Inventory	33. storage of passes	4.3		
Overhead	34. headquarters operations	4.9		
Miscellaneous	35. costs not covered by equations			
On-Board Sales	36. TOTAL COSTS FOR ON-BOARD SALES			
C: ENTIRE FARE PREPAYMENT PROGRAM				
Regular Sales	37. TOTAL COSTS FOR REGUALR SALES (line 29)			
On-Board Sales	38. TOTAL COSTS FOR ON-BOARD SALES (line 36)			
TOTAL	39. TOTAL MONTHLY FARE PREPAYMENT COSTS			

Notice also that the costs associated with regular fare prepayment programs (i.e., programs involving sales through transit-operated and public/private outlets, direct mail programs, and telephone order programs) are separated from the costs incurred in on-board pass sales programs. This is done only to assist in computing average, or unit costs. On-board pass sales are usually very high and their costs are generally low if the added operating cost due to boarding time delays are ignored. If the costs of regular ticket and pass programs were combined with the costs of day pass programs, the resulting unit costs would be artifically low and impossible to compare with other systems. Section C in Table 6-4 provides space for identifying the monthly costs for both regular ticket and pass programs and on-board pass programs.

Step 4: Compute Unit Costs by Cost Category

The costs presented in column 2 of Table 6-4 represent the monthly costs of operating a fare prepayment program by cost category. Lines 29 and 36 represent the total monthly cost for regular sales programs and on-board sales programs respectively. The bottom line (line 39) represents the total monthly fare prepayment program cost. Unit costs can easily be computed for each line item in column 2 by dividing that cost by the number of fare prepayment plans sold each month. The number of plans sold in Section A should include all passes, tickets, and tokens that are sold through outlets and at the transit company headquarters. Total unit transaction costs and unit cost by cost category should be computed. For on-board sales, only the total unit transaction cost (i.e., computed from the cost item indicated in line 36) is relevant.

Step 5: Compare Unit Costs with Costs of Companies of Similar Size

The unit transaction costs computed from the monthly costs presented in Section A of Table 6-4 can be compared with the costs obtained from the different transit companies used in this report. Table 6-5 presents the unit transaction costs for three groups of transit companies. These costs were obtained by averaging the unit costs of systems of similar size. This table was adapted from Table 5-7 in Chapter 5.

Table 6-5: A COMPARISON OF UNIT TRANSACTION COSTS BY COST CATEGORY AND TRANSIT COMPANY SIZE -- 1981[a]

Cost Category	Large Companies		Medium Companies		Small Companies		Your Company	
	Cost Per Instrument	%	Cost Per Instrument	%	Cost Per Instrument	%	Cost Per Instrument	%
Order Preparation	$0.017	2.0	$0.020	4.5	$0.005	3.7		
Order Delivery	0.013	1.5	0.045	10.2	0.020	14.7		
Direct Sales	0.548	63.8	0.158	36.0	0.006	4.4		
Recording & Accounting	0.039	4.6	0.074	16.9	0.035	25.7		
Design	Negl.	0	0.002	0.5	0	0		
Printing	0.088	10.3	0.056	12.8	0.023	16.9		
Inventory	0.001	0.1	0.002	0.5	0.002	1.5		
Advertising	0.075	8.8	0	0	0	0		
Administrative	0.019	2.2	0.008	1.8	0.004	2.9		
Overhead	0.057	6.7	0.064	14.5	0.036	26.5		
Miscellaneous Handling	0	0	0.010	2.3	0.005	3.7		
Total	$0.857	100.0	$0.439	100.0	$0.136	100.0		

[a]Transit Company size is defined by the number of annual revenue passengers
Large Transit Companies: More than 50 million annual revenue passengers
Medium Transit Companies: 10 million to 50 million annual revenue passengers
Small Transit Companies: Less than 10 million annual revenue passengers

The unit transaction costs computed in Step 4 should be entered into the column provided in Table 6-5 opposite the appropriate cost category. The last column should indicate the percentage of the total unit cost for each cost category. Thus, both unit costs and their proportion of the total unit cost can be compared with what was found for the case sites. If the costs differ considerably from those presented in Table 6-5, perhaps adjustments can be made to certain activities of the fare prepayment program to streamline costs. The purpose of this exercise is first to compute costs and then compare these costs with other comparable systems. An example of the steps and calculations just described is provided below.

How to Compute Your Costs: An Example

A relatively simple fare prepayment program is described and analyzed below in order to illustrate the five steps just outlined.

Step 1: Inventory Fare Prepayment Program

The fare prepayment program chosen for this analysis incorporates only the basic activities for simplicity. Only two fare prepayment plans are sold: monthly pass and 10-trip ticket book. Approximately 30,000 passes and 25,000 ticket books are sold each month.

Only two methods of sales distribution are employed. The transit company operates two outlets full time; one outlet is located in the company's office building and the other is located downtown. A network of 20 public and private outlets are also used to sell passes and tickets, and no commissions are charged. Delivery to these outlets is carried out by staff once each month. The transit-operated outlet located downtown, however, is serviced weekly.

Table 6-6 presents a distribution of monthly pass and ticket sales by sales method. Notice that direct mail order, telephone order, and on-board sales of passes are not used in this example.

Step 2: Identify Appropriate Cost Equations

This task is relatively straight forward and involves checking the boxes in Table 6-3 that correspond to the distribution methods used in this example. Table 6-3 reappears as Table 6-7 with the appropriate boxes checked. Only these 18 equations will be analyzed in the next step.

Table 6-6

FARE PREPAYMENT SALES BY SALES DISTRIBUTION METHOD

Fare Prepayment Plan	Transit-Operated Outlets		Public/ Private Outlets	TOTAL SALES
	Headquarters	Downtown		
Monthly Pass	1,000	7,000	22,000	30,000
10-Trip Ticket	1,000	11,000	13,000	25,000
TOTAL SALES	2,000	18,000	35,000	55,000

Step 3: Compute Costs For Each Equation Separately and by Cost Category

The 18 cost equations and their parameter definitions are presented in Appendix A. Each of these equations is used to compute monthly program costs by activity. The parametic values used in each equation are presented below with the calculations.

Equation (3.1): Labor cost for order preparation (L_{op})

N_{op} = 28, or 20 order preparations per month to public and private outlets plus 8 order preparations to the two transit-operated outlets (i.e., weekly to these two outlets)

MH_{op} = 0.25 hours per outlet preparation in normal conditions

W_{op} = $8.25 per hour in wages

F_r = 36.2 percent fringe benefit rate

Therefore:

$$L_{op} = \$79$$

Table 6-7: PARAMETRIC COST EQUATIONS IDENTIFIED BY SALES DISTRIBUTION METHOD

	Equation Number	Check Column	Over-the-Counter Sales		Sales at Headquarters		
			Transit Operated Outlets	Public/ Private Outlets	Direct Mail Program	Telephone Order Program	On-Board Sales of Day Passes
Order Preparation	3.1	X					
	3.2	X					
	3.3						
Order Delivery	3.5	X					
	3.6	X					
	3.7	X					
	3.8	X					
Direct Sales	3.11	X					
	3.12a	X					
	3.13a	X					
	3.14						
	3.15						
	3.16						
	3.17						
Recording and Accounting	3.21	X					
	3.22	X					
	3.23						
Design	4.1	X					
Printing	4.2	X					
Inventory	4.3	X					
Advertising	4.4	X					
Administration	4.5	X					
Overhead	4.8	X					
	4.9	X					

Equation (3.2): Equipment cost for order preparation (E_{op})

E_{op} = 0, since no equipment is used

Equation (3.5): Labor cost for order delivery (L_d)

N_o = 24, or 20 outlet deliveries to public and private outlets each month plus four deliveries to the transit-operated outlet downtown (no deliveries are made to the other transit-operated outlet since it is already located in the company office building)

D_t = 35 minutes of delivery time per outlet in this low density site where the radius of area served is assumed to be 16 miles

W_d = $8.25 per hour in wages

F_r = 36.2 percent fringe benefit rate

N_e = 1 employee per vehicle

Therefore:

$$L_d = \$157$$

Equation (3.6): Vehicle cost for delivery (V_d)

M_d = 150 miles per month for delivery

MR = $0.3531 cents per mile for a standard automobile

Therefore:

$$V_d = \$53$$

Equation (3.7): Cost for courier service (C_c)

C_{cs} = 0, since courier service is not employed

Equation (3.8): Cost for certified mail (C_{cm})

C_{cm} = 0, since certified mail is not employed

Equation (3.11): Labor cost for fare prepayment sales (L_s)

W_s = \$8.25 per hour in wages
F_r = 36.2 percent fringe benefit rate
N_{to} = 2 transit-operated outlets

N_s = { 2,000 monthly transactions at headquarters outlet (see Table 6-6)
18,000 monthly transactions at downtown outlet (see Table 6-6)

R_s = { 2.5 minutes per transaction at the headquarters outlet
1.25 minutes per transaction at the downtown outlet

Therefore:

$$L_s = \$5,150$$

Equation (3.12a): Sales commission for percentage rate commissions (MC_p)

MC_p = 0, since commissions are not charged

Equation (3.13a): Labor cost for recording sales (L_r)

L_{rh} = 0, since direct mail and telephone order programs are not used
W_{rt} = \$8.25 per hour in wages
F_r = 36.2 percent fringe benefit rate
N_{to} = 2 transit-operated outlets

N_i = { 2,000 transactions at the headquarters outlet
18,000 transactions at the downtown outlet

MM_{ri} = { 0.90 minutes per transaction at the headquarters outlet
0.25 minutes per transaction at the downtown outlet

L_{rt} = \$1,180

Therefore:

$$L_r = \$1,180$$

Equation (3.22): Labor cost for accounting sales (L_a)

W_a = \$10.00 per hour in wages
F_r = 36.2 percent fringe benefit rate
NT = 55,000 monthly transactions
N_{ob} = 0, since there are no on-board sales of passes
MM_a = 0.11 minutes per transaction

Therefore:

$$L_a = \$1,373$$

Equation (4.1): Cost for designing pass plans (D)

N_{pd} = 1, since only monthly passes incur design costs
MP_i = 50,000 monthly passes printed per month
DC_i = \$1.80 per thousand passes printed monthly (outside design)

Therefore:

$$D = \$90$$

Equation (4.2): Cost for printing plans (PC)

N_t = 2 types of fare prepayment plans

S_i = { 300,000 monthly passes printed semi-annually
300,000 ticket books printed annually

PR_{ij} = { \$25 per thousand monthly passes printed
\$20 per thousand ticket books printed

PF_i = { 6 months for monthly passes
12 months for ticket books

Therefore:

$$PC = \$1,750$$

Equation (4.3): Cost of storing plans (IC)

SV = \$0.06 per cubic foot per month
N_t = 2 types of fare prepayment plans

IS_i = { 300,000 monthly passes
300,000 ticket books

IR_i = 220 instruments per cubic foot

Therefore:

$$IC = \$164$$

Equation (4.4): Cost of advertising (AC)

Equation (4.4) is not needed since we know that \$15,000 is spent on advertising every six months.

Therefore:

$$AC = \$2,500$$

Equation (4.5): Cost of administering program (L_{ad})

W_{ad} = \$12.00 per hour in wages

F_r = 36.2 percent in fringe benefits
ADR = 30 man hours per month for this medium-size program

Therefore:

$$L_{ad} = \$490$$

Equation (4.8): Overhead cost for transit-operated sales outlets

OR_t = 20 percent overhead rate for the two transit-operated sales outlets
L_s = \$5,150 as computed from equation (3.11)
L_{rt} = \$1,180, as computed from equation (3.21b)

Therefore:

$$OR_t = \$1,266$$

Equation (4.9): Overhead cost for company headquarters (OC_h)

OR_h = 39.5 percent overhead rate for company headquarters
L_h = \$2,599 = $L_{op} + L_d + L_a + L_{ad}$ + \$500 per month of the advertising cost which is labor

Therefore:

$$OC_h = \$1,027$$

Miscellaneous Costs: The fare prepayment program does use a shredding machine for destroying monthly passes and tickets. The labor cost was included in the cost of accounting but the cost of the machine has not been accounted.

Equipment: one shredding machine at \$3,700 with 3-year service life
Monthly Cost: \$128[1]

Miscellaneous Costs: \$128

[1]One-time equipment acquisition cost is converted into an equivalent annual (and subsequently monthly) cost using a capital recovery factor based on a 3-year service life and a discount rate of 12 percent.

Now that all 18 program costs plus the extra unaccounted monthly cost of a shredding machine have been computed, these costs can be entered into the monthly cost summary work sheet that appeared in Table 6-4. This has been done and is presented in Table 6-8. Notice that sections B and C do not appear in this table since pass plans are not sold on-board the buses in this example. The costs by cost category appear in column 2. The total monthly cost of this fare prepayment program is $15,407.

Step 4: Compute Unit Costs by Cost Category

The costs presented in column 2 of Table 6-8 represent the monthly costs of operating a fare prepayment program by cost category. Unit costs can easily be computed for each line item in column 2 (i.e., cost category) by dividing each cost by the number of fare prepayment plans sold. In this example, each cost should be divided by 55,000 fare prepayment plans. This has been done and the results appear in Table 6-9.

Step 5: Compare Unit Costs with Cost of Companies of Similar Size

The transit company being examined in this short analysis is assumed to carry 40 million revenue passengers annually. With respect to the categories presented in Table 6-9, this company would be ranked a medium size transit company. Comparing the costs just computed and shown in the last two columns of Table 6-9 with other medium size companies, this fare prepayment program is operating relatively inexpensively. Order preparation and delivery costs are very low because only 20 public and private outlets are used to complement the two transit-operated outlets. Direct sales, recording and accounting, design, and printing costs are all normal for a fare prepayment program of this size. Inventory costs are slightly higher because the passes are purchased semi-annually and tickets annually. Note that the advertising costs, while lower in absolute terms than the unit advertising costs in large companies, are proportionately high for that cost category. This level of advertising may explain the very high volumes of passes and tickets sold through only 22 outlets. Both administrative and overhead costs are normal for this type of program.

Table 6-8: MONTHLY COST SUMMARY SHEET BY COST CATEGORY

SALES OUTLETS, DIRECT MAIL, AND TELEPHONE ORDER				
Cost Category	Item Description	Equation Number	Monthly Costs (1)	Monthly Subtotal Costs (2)
Order Preparation	1. order preparation - labor	3.1	$ 79	
	2. order preparation - equipment	3.2	0	
	3. Subtotal: Order Preparation			$ 79
Order Delivery	4. staff delivery - labor	3.5	157	
	5. staff delivery - vehicle	3.6	53	
	6. courier service	3.7	0	
	7. certified mail	3.8	0	
	8. Subtotal: Order Delivery			210
Direct Sales	9. transit-operated sales-labor	3.11	5,150	
	10. outlet commissions - percentage rate	3.12a	0	
	11. outlet commissions - fixed rate	3.13a	0	
	12. direct mail sales - labor	3.14	0	
	13. direct mail sales - materials	3.15	0	
	14. telephone sales - labor	3.16	0	
	15. telephone sales - materials	3.17	0	
	16. Subtotal: Direct Sales			5,150
Recording and Accounting	17. recording sales - labor	3.21	1,180	
	18. accounting sales - labor	3.22	1,373	
	19. Subtotal: Recording & Accounting			2,553
Design	20. design - labor and materials	4.1	90	90
Printing	21. printing plans	4.2	1,750	1,750
Inventory	22. storage plans	4.3	164	164
Advertising	23. advertising - labor and media	4.4	2,500	2,500
Administration	24. administration - labor	4.5	490	490
Overhead	25. transit-operated outlets	4.8	1,266	
	26. headquarters operations	4.9	1,027	
	27. Subtotal: Overhead			2,293
Miscellaneous	28. costs not covered by equations		128	128
Regular Sales	29. TOTAL MONTHLY COSTS FOR REGULAR SALES			$15,407

Table 6-9: A COMPARION OF UNIT TRANSACTION COSTS BY COST CATEGORY AND TRANSIT COMPANY SIZE -- 1981[a]

Cost Category	Large Companies		Medium Companies		Small Companies		Your Company	
	Cost Per Instrument	%	Cost Per Instrument	%	Cost Per Instrument	%	Cost Per Instrument	%
Order Preparation	$0.017	2.0	$0.020	4.5	$0.005	3.7	$0.001	0.4
Order Delivery	0.013	1.5	0.045	10.2	0.020	14.7	0.004	1.4
Direct Sales	0.548	63.8	0.158	36.0	0.006	4.4	0.094	33.6
Recording & Accounting	0.039	4.6	0.074	16.9	0.035	25.7	0.046	16.4
Design	Negl.	0	0.002	0.5	0	0	0.002	0.7
Printing	0.088	10.3	0.056	12.8	0.023	16.9	0.032	11.4
Inventory	0.001	0.1	0.002	0.5	0.002	1.5	0.003	1.1
Advertising	0.075	8.8	0	0	0	0	0.045	16.1
Administrative	0.019	2.2	0.008	1.8	0.004	2.9	0.009	3.2
Overhead	0.057	6.7	0.064	14.5	0.036	26.5	0.042	15.0
Miscellaneous Handling	0	0	0.010	2.3	0.005	3.7	0.002	0.7
Total	$0.857	100.0	$0.439	100.0	$0.136	100.0	$0.280	100.0

[a]Transit Company size is defined by the number of annual revenue passengers
Large Transit Companies: More than 50 million annual revenue passengers
Medium Transit Companies: 10 million to 50 million annual revenue passengers
Small Transit Companies: Less than 10 million annual revenue passengers

HOW TO FORECAST A NEW PROGRAM'S OPERATING COSTS

Unlike in the previous section where clear guidelines can be provided for computing fare prepayment costs, it is much more difficult to present a "cookbook" approach to measuring changes in fare prepayment program costs. This is because there are literally an infinite number of changes that can be made to a program.

In general, there are two approaches a transit manager can take in calculating the changes in costs that can be expected from program adjustments. First, total program costs, such as the costs computed in the previous section of this chapter, can be estimated for the program designed for the near future, and subtracted from existing program costs. This requires the analyst to compute total program costs twice.

A second approach that should take much less time and effort is to measure the changes in the parameters that will be affected by the program changes, and then compute costs using these parameters. This process, however, will only be easy to follow and result in accurate estimates if the analyst is aware of how the parameters will change with each program adjustment. Since there is an endless variety of changes that can take place, and since small program changes are relatively easy to analyze, two examples of program changes are presented in this section with the objective of forecasting the changes in program operating costs.

Example One: A Program of Public Outlet Expansion

In this example, a transit manager is interested in knowing how much more it will cost the fare prepayment program to expand the number of public outlets from the current 20 outlets to 40 outlets. The transit manager is not interested at this time in understanding the short-term implementation costs but rather the long-term change in monthly operating costs.

Increasing the number of fare prepayment outlets will have the following effects:

- the number of outlet orders that must be prepared and delivered will increase,
- if commissions are charged by the new outlets, direct sales costs will increase,

- accounting costs will increase,
- printing and inventory costs will increase if more plans are needed,
- program expansion may involve advertising in the short-term, but none in the long-term, and
- overhead costs will increase slightly at company headquarters.

Concerning each of these possible effects, fare prepayment staff have estimated that the following conditions will result:

- the number of outlet orders will expand from 20 to 40 preparations per month,
- average delivery time per outlet will increase from 35 to 50 minutes because the new outlets are located outside of the downtown area; monthly vehicle mileage will increase from 120 to 340 miles,
- commissions will not be charged, and
- sales of monthly passes will jump from the current level of 15,000 passes per month to approximately 24,000 passes per month resulting in a 50 percent increase in printing (i.e., 120,000 passess to 180,000 passes every six months).

With this information available, a fare prepayment manager can now calculate the change that can be expected in the operating costs of the fare prepayment program. This task requires the analyst to move sequentially from the first equation in Appendix A to the last, computing the change in operating costs by equation. These costs are calculated below.

Equation (3.1): Labor cost for order preparation (L_{op})

Parameter Affected: N_{op} (number of outlet preparations per month)
ΔN_{op} = 20 outlet preparations

Therefore:

$$\boxed{\Delta L_{op} = \$56^{1}}$$

---

[1]The values of the parameters used in all of the equations in this example were taken from those used in the example in the last section of this chapter.

Equations (3.2) - (3.3): No change

Equation (3.5): Labor cost for order delivery (L_d)

Parameters Affected: N_o (number of outlet deliveries)
D_t (driving time per outlet)

ΔN_o = 20 outlet deliveries
ΔD_t = 15 minutes per outlet

Therefore:

$$\boxed{\Delta L_d = \$243}$$

Equation (3.6): Vehicle cost for delivery (V_d)

Parameter Affected: M_d (average monthly mileage)
ΔM_d = 220 miles

Therefore:

$$\boxed{\Delta V_d = \$78}$$

Equations (3.7) - (3.21): No change

Equation (3.22): Labor cost for accounting sales (L_a)

Parameters Affected: MM_a (minutes per transaction)
NT (total number of transactions)

ΔMM_a = 0.11 minutes per transaction
ΔNT = 9,000 passes

Therefore:

$$\boxed{\Delta L_a = \$185}$$

Equations (3.23) - (4.1): No change

Equations (4.2): Cost for printing plans (PC)

Parameter Affected: S (size of printing order)
ΔS = 60,000 passes printed semi-annually

Therefore:

$$\boxed{\Delta PC = \$250}$$

Equations (4.3): Cost of storing plans (IC)

Parameter Affected: IS (inventory stock)
$\Delta IS = 60{,}000$ passes

Therefore:

$$\boxed{\Delta IC = \$16}$$

Equations (4.4) - (4.8): No change

Equations (4.9): Overhead cost for company headquarters (OC_h)

Parameter Affected: L_h (total monthly labor cost)
$\Delta L_h = \$484$ of labor

Therefore:

$$\boxed{\Delta OC_h = \$191}$$

The total change in monthly operating cost to this fare prepayment program resulting from the expansion of public outlets is $1,019. If staff calculations are correct and 9,000 additional monthly passes can be sold, the marginal cost to the transit system for selling each new pass is only $0.113 per pass sold.

Example Two: Implementation of a Direct Mail Program

In this second example, the same transit company wishes to introduce a direct mail order and sales distribution program for its monthly pass customers. Although it is known that the introduction of the program will divert some current over-the-counter purchases, it is believed that the long-term effect of this program is to increase monthly pass sales from its current level of 15,000 passes per month to approximately 18,500. In addition to changing the costs of some activities (overhead, for example), the introduction of a new program will involve new costs and new equations must be used to compute these costs. The parameters will be identified for each new equation used in this example. For those costs already incurred, only the changes in the parameters affected are noted.

Once again, the analyst must move sequentially from the first equation in Appendix A to the last, computing the changes in operating cost and computing all new costs by equation. These costs are calculated below.

Equations (3.1) - (3.13a): No change

Equation (3.14): Labor cost for direct mail sales (L_{dm})

W_{dm} = \$8.25 per hour in wages
F_r = 36.2 percent fringe benefit rate
MM_{dm} = 3.0 minutes per transaction
N_{dm} = 3,500 direct mail transactions

Therefore:

$$L_{dm} = \$1,966$$

Equation (3.15): Material cost for direct mail program (MC_{dm})

N_{dm} = 3,500 direct mail transactions
C_{dm} = \$0.0325 per order form
BRM_f = \$3.33 per month
C_p = \$0.18 per mailing
C_{ps} = \$0.05 per mailing
C_e = \$0.065 per envelope
P = \$20 per pass
DR = 0, since credit cards are not accepted

Therefore:

$$MC_{dm} = \$1,780$$

Equations (3.16) - (3.17): No change

Equation (3.21a): Labor cost for recording sales at headquarters (L_{rh})

W_{rh} = \$8.25 per hour in wages
F_r = 36.2 percent fringe benefit rate
MM_r = 0.50 minutes per transaction
N_{dm} = 3,500 direct mail transactions
N_{tel} = 0, since telephone order program is not used

Therefore:

$$L_{rh} = \$328$$

Equation (3.22): Labor cost for accounting sales (L_a)

Parameters Affected: NT (total number of transactions)
ΔNT = 3,500 monthly transactions

Therefore:

$$\boxed{\Delta L_a = \$170}$$

Equations (3.23) - (4.8): No change

Equation (4.9): Overhead cost for company headquarters (OC_h)

Parameter Affected: L_h (total monthly labor cost)
ΔL_h = \$2,464 of labor

Therefore:

$$\boxed{\Delta OC_h = \$973}$$

The total change in monthly operating cost to this hypothetical program resulting from the establishment and operation of a direct mail program is \$5,217. This extremely high operating cost is due to the high cost of labor and materials for direct mail order and sales distribution activities. The very high direct sales costs are due to the optimistic estimates of direct mail transactions. The unit cost of operating a direct mail program at this high level (i.e., 3,500 transactions per month) is \$1.491 per pass sold. Note that this cost estimate is nearly identical to the minimum unit cost estimated for direct mail programs in Chapter 5 (see Figure 5-8).

GENERAL OBSERVATIONS ON FARE PREPAYMENT PROGRAM COSTS

This final section of the report presents a summary of the principal cost figures computed as part of this study. In addition, general observations are presented in how fare prepayment costs are affected and how they can be minimized based on the analyses made in Chapters 3, 4, and 5.

General Cost Summary

The costs of the 11 transit fare prepayment programs included in this study are summarized in Table 6-10 by transit company size and for all 11 sites combined. Costs per fare prepayment instrument sold, per revenue dollar generated, and per prepaid trip taken are shown.

Table 6-10

A SUMMARY OF TRANSIT FARE PREPAYMENT PROGRAM COSTS -- 1981

Transit Company Size[a]	Cost Per Instrument	Cost Per Revenue Dollar	Cost Per Prepaid Trip
Large	$0.857	$0.062	$0.024
Medium	0.439	0.034	0.016
Small	0.136	0.026	0.011
AVERAGE	$0.627	$0.055	$0.022

[a]Transit company size is defined by the number of annual revenue passengers as follows:

- Large transit company: More than 50 million annual revenue passengers
- Medium transit company: 10 million to 50 million annual revenue passengers
- Small transit company: Less than 10 million annual service passengers

The authors have shown in a recently completed paper[1] that the potential benefits of transit fare prepayment programs can be between $0.78 and $1.05 per prepaid instrument sold. At these benefit levels, fare prepayment programs are cost-effective if properly priced to avoid farebox revenue losses since the potential benefits exceed the costs presented in Table 6-10. However, a conscious effort should be made by managers of large fare prepayment programs to

[1]Armando M. Lago and Patrick D. Mayworm. "The Economics of Transit Fare Prepayment Plans." Presented at the 61st Annual Meeting of the Transportation Research Board (TRB), Washington, D.C., January 1982. This paper was sponsored by the TRB Committee on Transit Service Characteristics, Mr. James E. Reading, Chairman.

reduce costs since there is no technical or operating reason why the unit costs of large programs should be greater than the unit costs incurred in medium programs. The opportunities for reducing program costs that were identified in this report are summarized in the section that follows. It is hoped that by presenting these general observations, transit managers will be able to implement more efficient policies to reduce operating costs.

General Observations

A transit fare prepayment program consists of a series of unique activities that involves labor, equipment, and special materials. Some program activities, such as order delivery, can be performed in several ways depending on the characteristics of the program. A transit manager's job when designing a fare prepayment program is to select the method of performing each activity to maximize the operating effectiveness of the program at minimum cost. This report concludes by presenting the following general observations which suggest how trade-offs can be made for specific program activities to reduce fare prepayment program costs.

1. Many activities are transaction oriented and thus program operating costs will increase as sales increase. In addition, most of these activities exhibit economies of scale because staff become more productive as more instruments are processed. Large fare prepayment programs, however, exhibit higher unit costs than medium programs primarily because of the special costs incurred at large sites that do not exist in smaller programs, such as advertising and sales commission costs.

2. The costs of a fare prepayment program are definitely affected by the type of plans selected. For the same number of monthly trips taken, a weekly pass program will cost twice as much to operate as a monthly pass program. Also large quantity ticket books are significantly less expensive to provide than 10-trip ticket books.

3. Staff delivery of fare prepayment plans to sales outlets should only be used when the travel time and distance between outlets is very short. A cost effective alternative to staff delivery for many programs is courier service. Certified mail should be used if less than 50 fare prepayment instruments are sent to a sales outlet.

4. The largest single cost of a fare prepayment program is incurred in the sales of plans to individuals and public and private outlets are the main methods of sales distribution in a community. Every attempt should be made to develop a network of sales outlets without paying a commission on sales. If outlets charge more than two percent of sales revenues, it may be less expensive for a transit company to operate its own outlets where the marginal cost is approximately $0.60 per instrument sold. Direct mail and telephone order programs are very expensive sales distribution methods with marginal costs approaching $1.40 and $2.20 respectively.

5. The savings obtained by printing fare prepayment plans less frequently can be offset by rising inventory costs. This is especially true in large fare prepayment programs. In general, however, programs requiring less than 40,000 instruments per month should have their plans printed semi-annually or annually if possible. Programs requiring more than 80,000 instruments per month should print their plans semi-annually or more frequently.

6. One of the main features of fare prepayment programs is that revenues are collected in advance of services being delivered. This positive cash flow reduces the financing requirements of the transit company and can be a significant amount of money in large fare prepayment programs. Most of this positive cash flow that results in interest accruals to the transit company is not received if revenues are not promptly collected from the sales outlets. In general, monthly pass revenues should be collected during the first week of the month the passes are valid or on a weekly basis if the principal fare prepayment plan is a ticket, token, or punch card.

APPENDICES

APPENDICES

There are two appendices to this report. Appendix A presents the 24 key parametric cost equations that must be used to compute the costs of operating a fare prepayment program as described in Chapter 6. Each equation is followed by the parameter definitions and the standardized costs and values developed in this report.

Appendix B presents a list of all the case sites and the key individuals interviewed as part of this research project.

APPENDIX A

PRINCIPAL PARAMETRIC COST EQUATIONS BY COST CATEGORY

APPENDIX A

PRINCIPAL PARAMETRIC COST EQUATIONS BY COST CATEGORY

ORDER PREPARATION COSTS

(3.1) $L_{op} = (N_{op})(MH_{op})(W_{op})(1 + F_r)$

where:

L_{op} = monthly labor cost (dollars) for preparing orders for delivery to sales outlets

N_{op} = number of outlet preparations per month

$MH_{op} = \begin{cases} 1.00 \text{ hours per outlet preparation where the labor requirements are } \underline{\text{exceptionally high}} \\ 0.45 \text{ hours per outlet preparation where the labor requirements are } \underline{\text{high}} \\ 0.25 \text{ hours per outlet preparation where the labor requirements are } \underline{\text{normal}} \\ 0.15 \text{ hours per outlet preparation where the labor requirements are } \underline{\text{low}} \end{cases}$

W_{op} = average hourly wage rate for fare clerks

F_r = fringe benefit rate

(3.2) $E_{op} = (E_c)(N_c) + (E_w)(N_w)$

where:

E_{op} = monthly equipment cost (dollars) for order preparation

E_c = monthly equivalent cost per pass counter

N_c = number of pass counter machines employed

E_w = monthly equivalent cost per token wrapping machine

N_w = number of token wrapping machines employed

(3.3) $L_{pp} = (N_d)(MH_{pp})(W_{pp})(1 + F_r)$

where:

L_{pp} = monthly labor cost (dollars) for preparing day passes for on-board sales

N_d = number of days per month day passes are sold

$MH_{pp} = \begin{cases} 0.50 \text{ hours per day where the labor requirements are } \underline{\text{high}} \\ 0.33 \text{ hours per day where the labor requirements are } \underline{\text{normal}} \\ 0.15 \text{ hours per day where the labor requirements are } \underline{\text{low}} \end{cases}$

W_{pp} = average hourly wage rate for fare clerk or dispatcher

F_r = fringe benefit rate

ORDER DELIVERY COSTS

(3.5) $L_d = (1/60)(N_o)(D_t)(W_d)(1 + F_r)(N_e)$

where:

L_d = monthly labor cost (dollars) of delivering fare prepayment plans to sales outlets

N_o = number of outlet deliveries per month

$D_t = \begin{cases} 40 \text{ minutes per outlet in } \underline{\text{high density}} \text{ sites where the radius of the area served is greater than 10 miles} \\ 30 \text{ minutes per outlet in } \underline{\text{high density}} \text{ sites where the radius of the area served is between 7 and 10 miles} \\ 20 \text{ minutes per outlet in } \underline{\text{high density}} \text{ sites where the radius of the area served is between 5 and 7 miles} \\ 10 \text{ minutes per outlet in } \underline{\text{high density}} \text{ sites where the radius of the area served is less than 5 miles} \\ 50 \text{ minutes per outlet in } \underline{\text{low density}} \text{ sites where the radius of the area served is greater than 18 miles} \\ 35 \text{ minutes per outlet in } \underline{\text{low density}} \text{ sites where the radius of the area served is between 15 and 18 miles} \\ 25 \text{ minutes per outlet in } \underline{\text{low density}} \text{ sites where the radius of the area served is between 10 and 15 miles} \\ 10 \text{ minutes per outlet in } \underline{\text{low density}} \text{ sites where the radius of the area served is less than 10 miles} \end{cases}$

W_d = average hourly wage rate for the delivery of fare prepayment plans to sales outlets.

F_r = fringe benefit rate

N_e = number of employees per vehicle

(3.6) $V_d = (M_d)(MR)$

where:

V_d = monthly total vehicle cost (dollars) for delivery

M_d = average monthly mileage for delivery

$MR = \begin{cases} 57.82 \text{ cents per mile for a passenger van} \\ 35.31 \text{ cents per mile for a standard automobile} \\ 24.91 \text{ cents per mile for a compact automobile} \\ 19.05 \text{ cents per mile for a subcompact automobile} \end{cases}$

(3.7) $C_{cs} = (N_{cd})(N_s)(CR) + (CI)$

where:

C_{cs} = monthly cost (dollars) for courier service

N_{cd} = number of carrier deliveries per month

N_s = number of outlet stops per delivery

$CR = \begin{cases} \$5.50 \text{ each for 2-5 outlet stops} \\ \$4.37 \text{ each for 6-10 outlet stops} \\ \$3.23 \text{ each for 11-49 outlet stops} \\ \$2.67 \text{ each for over 50 outlet stops} \end{cases}$

CI = monthly equivalent insurance premium for courier service
The 1981 monthly equivalent premium in Portland is $33.46.

(3.8) $$C_{cm} = \sum_{i=1}^{N_{cm}} (C_{ei} + C_{pi} + C_c + C_r)$$

where:

C_{cm} = monthly cost (dollars) to send fare prepayment instruments to sales outlets by U.S. Postal Service

N_{cm} = total number of packages mailed each month

C_{ei} = cost of envelope used in mailing to outlet i

C_{pi} = cost of first class postage to mail package to outlet i

C_c = certified mail rate

C_r = return receipt rate

$$(3.11) \qquad L_s = (1/60)(W_s)(1 + F_r) \sum_{i=1}^{N_{to}} (N_{si})(R_{si})$$

where:

L_s = monthly labor cost (dollars) for selling fare prepayment plans at transit-operated sales outlets

W_s = average hourly wage rate for sales activities at transit-operated outlets

F_r = fringe benefit rate

N_{to} = number of transit-operated sales outlets

N_{si} = number of monthly transactions at outlet i

R_{si} = average time required (minutes) to make each transaction at outlet i following the schedule presented below in Table 3-21

Table 3-21: AVERAGE TIME REQUIRED PER TRANSACTION

Number of Monthly Transactions at Outlet i (N_{si})	MINUTES REQUIRED PER TRANSACTION	
	Normal Range	Standardized Value (R_{si})
less than 5,000	3.0 - 4.0	3.50
5,000 - 10,000	2.3 - 3.0	2.50
10,000 - 20,000	1.8 - 2.3	2.00
more than 20,000	1.5 - 1.8	1.75
Outlets where many photographs are taken	4.0 - 7.0	5.00

$$(3.12a) \qquad SC_p = \sum_{i=1}^{N_{co}} \sum_{j=1}^{N_t} (CMP_j)(P_j)(N_{ij})$$

where:

SC_p = total monthly sales commission (dollars) for percentage rate commissions

N_{co} = number of commissioned sales outlets

N_t = number of different types of fare prepayment plans

CMP_j = commission rate (decimal) for fare prepayment plan j

P_j = price (dollars) of fare prepayment plan j

N_{ij} = number of monthly transactions at outlet i for fare prepayment plan j

$$(3.13a) \qquad SC_r = \sum_{i=1}^{N_{co}} \sum_{j=1}^{N_t} (CMR_j)(N_{ij})$$

where:

SC_r = total monthly sales commission (dollars) for fixed value commissions

N_{co} = number of commissioned sales outlets

N_t = number of different types of fare prepayment plans

CMR_j = commission rate (dollars) per fare prepayment plan j sold

N_{ij} = number of monthly transactions at outlet i for fare prepayment plan j

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$$(3.14) \qquad L_{dm} = (1/60)(W_{dm})(1 + F_r)(MM_{dm})(N_{dm})$$

where:

L_{dm} = monthly labor cost (dollars) for direct mail sales

W_{dm} = average hourly wage rate for direct mail sales

F_r = fringe benefit rate

MM_{dm} = { 5.0 minutes per transaction for systems with high labor requirements
3.0 minutes per transaction for systems with normal labor requirements
1.5 minutes per transaction for systems with low labor requirements

N_{dm} = number of monthly direct mail transactions

(3.15) $$MC_{dm} = (N_{dm})(C_{dm}) + [BRM + (C_p + C_{ps})(N_{dm})] + (C_e)(N_{dm}) + (C_p)(N_{dm}) + (N_{dm})(\overline{P})(DR)$$

where:

MC_{dm} = monthly material cost (dollars) for direct mail program

N_{dm} = number of monthly direct mail transactions

C_{dm} = cost per order form (dollars)

BRM = business reply mail monthly fee, currently at \$40 ÷ 12 = \$3.33

C_p = first class postage cost per mailing

C_{ps} = cost of postage surcharge for business reply mail service currently at \$0.05

C_e = cost per envelope

$\overline{P}$ = weighted average cost of a fare prepayment instrument sold through the direct mail program

DR = financial institution bank card discount rate (service charge according to the schedule presented in Table 3-31

Table 3-31:

APPROXIMATE BANK CARD DISCOUNT RATE SCHEDULE
FOR DRAFTS WITHOUT PLASTIC - 1981[a]

Monthly Volume	SALES DRAFT AVERAGE					
	Under \$20	\$20.01 to \$35	\$35.01 to \$50	\$50.01 to \$75	\$75.01 to \$100	\$101 and over
\$ 1 - \$ 2,500	5.75%	5.50%	5.25%	5.00%	4.25%	4.25%
2,501 - 5,000	5.50	5.25	5.00	4.50	4.25	4.00
5,001 - 7,500	5.25	5.25	4.75	4.25	3.75	3.75
7,501 - 12,500	5.25	5.00	4.75	4.25	3.75	3.50
12,501 - 20,000	5.25	5.00	4.50	3.75	3.50	3.50
20,001 - 25,000[b]	5.25	4.75	4.50	3.75	3.50	3.50

[a]Without plastic refers to those transactions where credit card imprints are not taken. Two percent is added to original rate schedule for drafts with plastic quoted by the Bank of America for the Sacramento Regional Transit.

[b]Monthly volume above this figure is subject to individual contract negotiation.

Source: Ecosometrics, Inc. A Comprehensive Demonstration of Distribution Systems For Transit Fare Prepayment: The Sacramento Regional Transit Project. Prepared for the Office of Service and Methods Demonstrations, Urban Mass Transportation Administration, February 1981.

(3.16) $L_{tel} = (1/60)(W_{tel})(1 + F_r)(MM_{tel})(N_{tel})$

where:

L_{tel} = monthly labor cost (dollars) for telephone sales

W_{tel} = average hourly wage rate for telephone sales

F_r = fringe benefit rate

MM_{tel} = { 5.0 minutes per transaction for systems with high labor requirements; 3.0 minutes per transaction for systems with normal labor requirements; 1.5 minutes per transaction for systems with low labor requirements }

N_{tel} = number of monthly telephone transactions

(3.17) $MC_{tel} = (TC) + (N_{tel})(\overline{P}_t)(DR) + (C_e)(N_{tel}) + (C_p)(N_{tel})$

where:

MC_{tel} = monthly material cost (dollars) for telephone order program

TC = monthly equivalent telephone installation and service charge

N_{tel} = number of monthly telephone orders

$\overline{P}_t$ = weighted average cost of a fare prepayment instrument sold by telephone

DR = financial institution bank card discount rate based on schedule presented in Table 3-31

C_e = cost per envelope

C_p = first class postage cost per mailing

(3.21) $L_r = L_{rh} + L_{rt}$

where:

(3.21a) $L_{rh} = (1/60)(W_{rh})(1 + F_r)(MM_r)(N_{dm} + N_{tel})$

(3.21b) $L_{rt} = (1/60)(W_{rt})(1 + F_r)\sum_{i=1}^{N_{to}} (N_i)(MM_{ri})$

where:

L_r = total monthly labor cost (dollars) for recording fare prepayment sales at transit-operated outlets and at headquarters

L_{rh} = monthly labor cost (dollars) for recording fare prepayment sales at headquarters

L_{rt} = monthly labor cost (dollars) for recording fare prepayment sales at transit-operated outlets

W_{rh} = average hourly wage rate for recording fare prepayment sales at headquarters

W_{rt} = average hourly wage rate for recording fare prepayment sales at transit-operated outlets

F_r = fringe benefit rate

N_{dm} = number of monthly direct mail transactions

N_{tel} = number of monthly telephone transactions

N_{to} = number of transit-operated sales outlets

N_i = number of monthly transactions at outlet i

$MM_{r(i)} =$
- 3.10 minutes per transaction when there are less than 500 monthly transactions at headquarters (or at outlet i)
- 1.70 minutes per transaction when there are 500-1,000 monthly transactions at headquarters (or at outlet i)
- 0.90 minutes per transaction when there are 1,000-2,000 monthly transactions at headquarters (or at outlet i)
- 0.50 minutes per transaction when there are 2,000-5,000 monthly transactions at headquarters (or at outlet i)
- 0.33 minutes per transaction when there are 5,000-10,000 monthly transactions at headquarters (or at outlet i)
- 0.25 minutes per transaction when there are more than 10,000 monthly transactions at headquarters (or at outlet i)

(3.22) $L_a = (1/60)(W_a)(1 + F_r)(NT - N_{ob})(MM_a)$

where:

L_a = monthly labor cost (dollars) for accounting and reconciling fare prepayment sales

W_a = average hourly wage rate for accounting and reconciling fare prepayment sales

F_r = fringe benefit rate

N_{ob} = number of monthly on-board transactions

NT = total number of monthly transactions

MM_a =
- 0.45 minutes per transaction when there are less than 5,000 monthly transactions
- 0.35 minutes per transaction when there are 5,000-10,000 monthly transactions
- 0.26 minutes per transaction when there are 10,000-20,000 monthly transactions
- 0.15 minutes per transaction when there are 20,000-50,000 monthly transactions
- 0.11 minutes per transaction when there are 50,000-100,000 monthly transactions
- 0.09 minutes per transaction when there are 100,000-200,000 monthly transactions
- 0.09 minutes per transaction when there are more than 200,000 monthly transactions

---

(3.23) $L_{ap} = (W_{ap})(1 + F_r)(N_d)(MH_{ap})$

where:

L_{ap} = monthly labor cost (dollars) for accounting and reconciling on-board sales of weekend day passes

W_{ap} = average hourly wage rate for accounting and reconciling on-board pass sales

F_r = fringe benefit rate

N_d = number of days per month passes are sold on-board transit vehicles

MM_{ap} =
- 1.00 hours per day when there are less than 5,000 passes sold per month
- 2.25 hours per day when there are 5,000-24,000 passes sold per month
- 3.50 hours per day when there are more than 24,000 passes sold per month

---

DESIGN COSTS

$$(4.1) \qquad D = (1/1000) \sum_{i=1}^{N_{pd}} (NP_i)(DC_i)$$

where:

D = average monthly cost (dollars) for designing pass plans

N_{pd} = number of prepayment plans that incur significant design costs

NP_i = average monthly volume printed of prepayment plan i

DC_i = standardized design cost per thousand instruments printed of prepayment plan i following the schedule presented in Table 4-2

Table 4-2

STANDARDIZED DESIGN COSTS PER THOUSAND PRINTED
FOR IN-HOUSE AND OUTSIDE DESIGNS - 1981

IN-HOUSE DESIGNS		OUTSIDE DESIGNS	
Average Monthly Volume Printed	Standardized Cost (DC_i)	Average Monthly Volume Printed	Standardized Cost (DC_i)
Less than 10,000	$2.70	Less than 10,000	$4.60
10,000 - 30,000	1.90	10,000 - 30,000	2.90
30,000 - 60,000	1.10	30,000 - 60,000	1.80
60,000 - 100,000	0.60	60,000 - 100,000	1.10
100,000 - 200,000	0.20	100,000 - 200,000	0.60
More than 200,000	0.10	More than 200,000	0.40

PRINTING COSTS

$$(4.2) \qquad PC = (1/1000) \sum_{i=1}^{N_t} (S_i)(PR_{ij})/(PF_i)$$

where:

PC = total average monthly cost (dollars) for printing all fare prepayment plans

N_t = total number of different fare prepayment plans

S_i = size of printing order for fare prepayment plan i

PR_{ij} = standardized printing cost per thousand instruments of fare prepayment plan i at printing volume j as given in Table 4-17

PF_i = number of months between printing orders for fare prepayment plan i

Table 4-17: STANDARDIZED COSTS FOR PRINTING DIFFERENT FARE PREPAYMENT PLANS - 1981

STANDARDIZED COSTS BASED ON ORDER SIZE (PR_{ij})
(cost per thousand printed)

Size of Order	Monthly, Weekly, Semester Passes	Day and Weekend Passes	Ticket Books	Punch Cards	Tokens[a]
Less than 10,000	$120	$90	$250	$62	$96
10,000 - 30,000	60	90	87	38	92
30,000 - 50,000	40	90	50	22	90
50,000 - 100,000	32	40	30	12	82
100,000 - 200,000	25	24	20	7	75
200,000 - 500,000	25	14	20	7	75
500,000 - 1,000,000	25	9	20	7	75
1,000,000 - 2,000,000	25	5	20	7	75
More than 2,000,000	25	2	20	7	75

STANDARDIZED COSTS NOT BASED ON ORDER SIZE (PR_i)

Printed Item		Cost Per Thousand Printed
Multiple-Trip Strip Tickets		$25
Tickets Sold in Rolls		3
Sticker & Stamps:	High Cost	34
	Medium Cost	20
	Low Cost	6
Identity Cards		20
Tourist Passes		10

[a]Costs are for 0.984 inch diameter brass tokens only. See Table 4-13 for costs for other token sizes.

$$(4.3) \qquad IC = (SV) \sum_{i=1}^{N_t} (IS_i)/(IR_i)$$

where:

IC = monthly inventory cost (dollars) for storing fare prepayment plans

SV = value of storing fare prepayment (dollars per cubic foot per month). In this study, SV = $0.06/cu ft./month

N_t = total number of different fare prepayment plans

IS_i = inventory stock defined as the maximum number of fare prepayment instruments on hand at any one time, where:

$$IS_i = \begin{cases} S_i, \text{ or the size of the printing order of fare prepayment plan i for conventional plans excluding tokens, tickets in rolls, and stamps;} \\ 0.25\ S_i, \text{ or a quarter of the size of the printing order of fare prepayment i for tickets in rolls and stamps} \\ N_{ts}, \text{ or the actual number of tokens in stock} \end{cases}$$

IR_i = inventory space requirement computed in instruments per cubic foot using the standardized values presented below in Table 4-20

Table 4-20: STANDARDIZED INVENTORY REQUIREMENTS

Fare Prepayment Plan and Efficiency of Space Utilization	NUMBER OF INSTRUMENTS PER CUBIC FOOT	
	Normal Range	Standardized Value (IR_i)
CONVENTIONAL PLANS		
High Efficiency	240 - 290	265
Normal Efficiency	200 - 240	220
Low Efficiency	100 - 200	150
DAY PASSES	N.A.	7,000
TOKENS	N.A.	14,000

ADVERTISING COSTS

$$(4.4) \qquad AC = \sum_{i=1}^{N_a} (N_i)(AR_i)$$

where:

AC = total monthly advertising cost (dollars)

N_a = number of different fare prepayment plans being advertised each month

N_i = number of monthly sales of fare prepayment plan i

AR_i = standardized advertising cost as given in Table 4-24

Table 4-24: STANDARDIZED COSTS FOR ADVERTISING FARE PREPAYMENT PROGRAMS - 1981

Monthly Sales Volume	MONTHLY COST PER INSTRUMENT SOLD	
	Normal Range	Standardized Cost (AR_i)
Less than 10,000	More than $0.60	$0.80
10,000 - 30,000	0.40 - 0.60	0.50
30,000 - 50,000	0.33 - 0.40	0.37
50,000 - 100,000	0.20 - 0.33	0.24
100,000 - 200,000	0.12 - 0.20	0.15
More than 200,000	Less than 0.12	0.10

ADMINISTRATIVE COSTS

$$(4.5) \qquad L_{ad} = (W_{ad})(1 + F_r)(ADR)$$

where:

L_{ad} = monthly labor cost (dollars) for administering a fare prepayment program

W_{ad} = average hourly wage rate for program administration

F_r = fringe benefit rate

ADR = monthly labor requirement in man-hours based on standardized values presented in Table 4-27

Table 4-27

STANDARDIZED VALUES OF LABOR REQUIRED FOR
FARE PREPAYMENT PROGRAM ADMINISTRATION

Fare Prepayment Program Size and Characteristics	MONTHLY MAN HOURS	
	Normal Range	Standardized Value (ADR)
Companies With Program Expansion		
Large Programs	200 - 300	250
Medium Programs	100 - 200	150
Small Programs	50 - 100	75
Companies Without Program Expansion		
Large Programs	40 - 60	50
Medium Programs	20 - 40	30
Small Programs	1 - 20	10

GENERAL OVERHEAD COSTS

(4.8) $OC_t = (OR_t)(L_s + L_{rt})$

where:

OC_t = monthly overhead cost (dollars) for operating all transit-operated sales outlets

OR_t = overhead rate for transit-operated sales outlets defined as the ratio of overhead costs to labor costs, (a standardized value of 0.20 is applied in this study)

L_s = monthly labor cost (dollars) for selling fare prepayment plans at transit-operated sales outlets as defined in equation (3.11)

L_{rt} = monthly labor cost (dollars) for recording fare prepayment sales at transit-operated sales outlets as defined in equation (3.21b)

(4.9) $OC_h = (OR_h)(L_h)$

where:

OC_h = monthly overhead cost (dollars) for operating a fare prepayment program at transit company headquarters.

OR_h = overhead rate for transit company headquarters defined as the ratio of total administrative materials, supplies, and other expenses, to total non-operating administrative labor

L_h = total monthly labor cost (dollars) for operating a fare prepayment program at transit company headquarters, including the labor cost of order preparation for public outlets and on-board sales, staff delivery, direct mail and telephone programs, recording and accounting, plan design, advertising, administration, and other miscellaneous labor activities.

APPENDIX B

CASE SITES PARTICIPATING IN STUDY

APPENDIX B

CASE SITES PARTICIPATING IN STUDY
(Listed Alphabetically)

CINCINNATI, OHIO

Queen City Metro
6 East 4th Street
Cincinnati, Ohio 45202
(513) 621-9450

DATE OF INTERVIEW: May 19, 1981
PERSONS INTERVIEWED:
- Ms. Rita Potts - Director of Marketing
- Mr. John Lorah - Director of Finance
- Mr. Paul Rauf - Fare Systems Manager

LOS ANGELES, CALIFORNIA

Southern California Rapid Transit District
425 South Main Street
Los Angeles, California 90013
(213) 972-6000

DATES OF INTERVIEW: June 10, 15-16, 1981
PERSONS INTERVIEWED:
- Mr. Ron Johnson - Marketing Analyst
- Mr. Boyd Emrick - Acting Prepaid Program Manager
- Mr. Cornelia Ward - Advertising Manager
- Ms. JoAnn Grant - Marketing & Communications Representative
- Ms. Isabelle Paskas - Production Coordinator

NORFOLK, VIRGINIA

Tidewater Regional Transit
P.O. Box 660
Norfolk, Virginia 23501
(804) 627-9291

DATE OF INTERVIEW: May 15, 1981
PERSONS INTERVIEWED:
- Mr. Lee Carlson - Finance Manager
- Mr. Rod Ghearing - Director of Marketing

PHILADELPHIA, PENNSYLVANIA

Southeastern Pennsylvania Transportation Authority
200 West Wyoming
Philadelphia, Pennsylvania 19140
(215) 574-7300

DATE OF INTERVIEW: July 14, 1981
PERSONS INVERVIEWED:
- Mr. William Boone - Manager of Rates and Ridership
- Mr. Jules Cook - Operating Analyst
- Mr. Joseph Thompson - Manager of Passenger Receipts
- Mr. Wayne Smith - Senior Accountant

PORTLAND, OREGON

Tri-County Metropolitan Transportation District of Oregon
4012 S.E. 17th
Portland, Oregon 97202
(503) 238-4915

DATE OF INTERVIEW: June 24, 1981
PERSONS INTERVIEWED:
- Ms. Lana Nelson - Senior Manager of Customer Analysis
- Mr. Douglas Wentworth - Director of Management Information and Analysis
- Mr. Gerald Fox - Manager of Self-Service Fare Project

RICHMOND, VIRGINIA

Greater Richmond Transit Company
101 S. Davis Avenue
P. O. Box 27323
Richmond, Virginia 23261
(804) 358-3871

DATE OF INTERVIEW: April 2, 1981
PERSON INTERVIEWED:
Mr. Jack Henderson Jr. - Director of Finance

SACRAMENTO, CALIFORNIA (Demonstration Site)

Sacramento Regional Transit District
P. O. Box 2110
Sacramento, California 95810
(916) 444-7591

Data from the UMTA/SMD demonstration described in Systan, Inc. Sacramento Transit Fare Prepayment Demonstration, 1980. The Systan data was augmented with information from communications with Ms. Beth F. Beach, Fare Prepayment Manager, and Ms. Delana James, Assistant Fare Prepayment Manger.

ST. PAUL, MINNESOTA

Metropolitan Transit Commission
160 E. Kellogg Blvd.
St. Paul, Minnesota 55101
(612) 221-0939

DATES OF INTERVIEW: May 8, 1981; June 30, 1981
PERSONS INTERVIEWED:
Mr. Ralph Allison - Director of Marketing
Mr. George Powell - Supervisor of Convenience Fares
Ms. Claire Lewis - Senior Graphic Designer

SEATTLE, WASHINGTON

Municipality of Metropolitan Seattle
821 2nd Avenue
Seattle, Washington 98104
(206) 447-6666

DATE OF INTERVIEW: June 26, 1981
PERSONS INTERVIEWED:
Mr. Raymond Shea - Supervisor of Market Planning
Ms. Jane Dye - Marketing Research Analyst
Ms. B.J. Carol - Supervisor Customer Assistance Office
Mr. James Munson - Senior Accountant

TUCSON, ARIZONA (Demonstration Site)

SunTran
P.O. Box 27210
Tucson, Arizona 85736
(602) 623-4301

Data from the UMTA/SMD demonstration described in numerous technical memoranda prepared by Systan, Inc. The Systan data was augmented with information from communications with Mr. Gayland Simpson, Demonstration Project Manager

WILMINGTON, DELAWARE

Delaware Authority for Regional Transit
1 South Monroe Street
Wilmington, Delaware 19801
(302) 658-8960

DATE OF INTERVIEW: July 17, 1981
PERSONS INTERVIEWED:
Mr. Stephen Welch - Manager of Market Development
Ms. Elsie Stant - Manager of Customer Relations

U.S. Department
of Transportation

**Urban Mass
Transportation
Administration**

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