

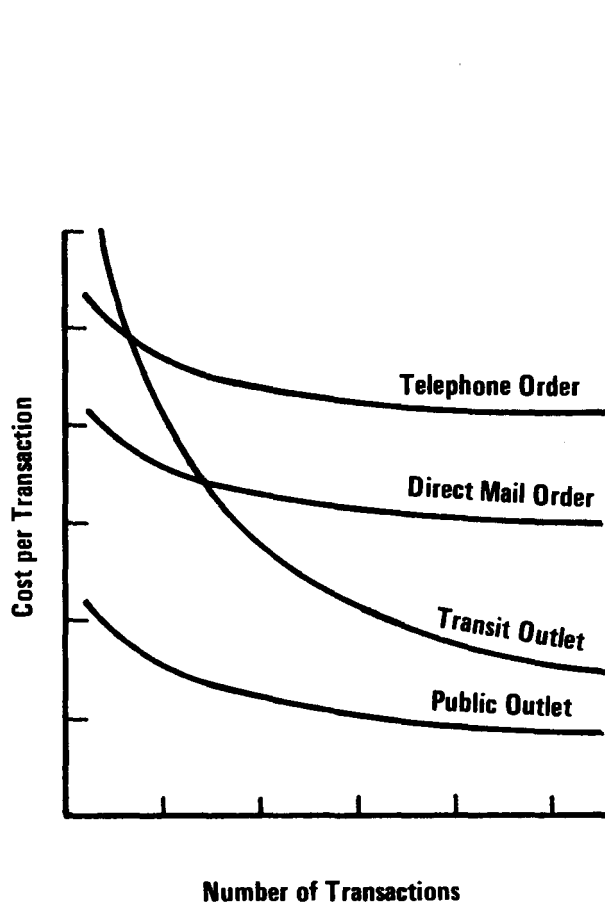


U.S. Department of Transportation

Urban Mass Transportation Administration

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

## Executive Summary



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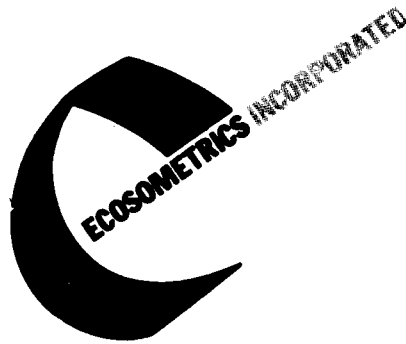
Office of Service and Management Demonstrations

Prepared by Ecosometrics, Incorporated

Transit Services Division

Washington, D.C. 20590





Research Report 125-7

THE COSTS OF TRANSIT FARE PREPAYMENT PROGRAMS:  
A PARAMETRIC COST ANALYSIS

EXECUTIVE SUMMARY

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by

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Prepared for

Office of Service and Methods Demonstrations  
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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 study was performed to provide 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 developed for this purpose are in the form of parametric equations using standardized costs.

The results of this study are presented in two documents: an executive summary and a technical report. This executive summary complements the technical report by providing an overview of the analyses of 11 transit fare prepayment programs and presenting a summary of the general findings.

The technical report presents the cost analysis in detail in six chapters. 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 the technical report.

This study has shown 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.





## EXECUTIVE SUMMARY

### 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 study was performed 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 the technical report for estimating their own program costs. In addition, the 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 the technical report and this executive summary. 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 of the technical report, 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, the technical 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 of the technical report 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 of the technical report.

Although the parametric cost equations in the technical 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 study did not focus on a discussion of the costs associated with lost revenue due to improper pricing.

Finally, the technical report was 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.

#### 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.<sup>1</sup> Consequently, data from a total of 11 transit companies were used in the cost analysis. Table S-1 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.

All five criteria were met by the 11 case sites finally selected. Not only were a wide range of fare prepayment plans, delivery methods, sales distribution methods, and program sizes represented in the sample, but every region of the country is also included. Concerning the last criterion, this study has shown that, with the exception of some activities in a few of the programs analyzed, the case sites do operate relatively efficient fare prepayment programs.

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<sup>1</sup>See Ecosometrics, Inc. "Demonstration Plan for the Student Transit Fare Prepayment Demonstration: Tucson, Arizona." Prepared for the Office of Service and Methods Demonstrations, Urban Mass Transportation Administration, Washington, D.C. 1980, and Systan, Inc. "Sacramento Transit Fare Prepayment Demonstration." Prepared for the Transportation Systems Center, U.S. Department of Transportation, 1980.

Table S-1

## 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 Transportation 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.

## SUMMARY OF THE PARAMETRIC COST ANALYSIS MODEL

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 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.

## FUNCTIONAL ACTIVITIES AND COST CATEGORIES

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 S-2 along with the 12 overall cost categories in which each of the functional activities is classified.

Table S-2

## OVERALL COST CATEGORIES AND FUNCTIONAL ACTIVITIES

Overall Cost Category	Functional Activity
Order Preparation Costs	<ul style="list-style-type: none"> <li>● Order preparation for delivery to sales outlets</li> <li>● Order preparation for on-board pass sales</li> </ul>
Order Delivery Costs	<ul style="list-style-type: none"> <li>● Order delivery by transit staff</li> <li>● Order delivery by courier service</li> <li>● Order delivery by certified mail</li> </ul>
Direct Sales Costs	<ul style="list-style-type: none"> <li>● Direct sales at transit-operated sales outlets</li> <li>● Direct sales at public and private sales outlets</li> <li>● Direct mail sales and distribution</li> <li>● Telephone order sales and distribution</li> </ul>
Recording and Accounting Costs	<ul style="list-style-type: none"> <li>● Recording sales at transit-operated outlets and headquarters</li> <li>● Accounting for sales at all outlets and headquarters</li> <li>● Accounting for on-board pass sales</li> </ul>
Design Costs	<ul style="list-style-type: none"> <li>● Designing plans for printing</li> </ul>
Printing Costs	<ul style="list-style-type: none"> <li>● Printing fare prepayment plans</li> </ul>
Inventory Costs	<ul style="list-style-type: none"> <li>● Storing fare prepayment plans</li> </ul>
Miscellaneous Handling Costs	<ul style="list-style-type: none"> <li>● Sorting and shredding tickets and other miscellaneous activities</li> </ul>
Advertising Costs	<ul style="list-style-type: none"> <li>● Advertising fare prepayment program</li> </ul>
Administrative Costs	<ul style="list-style-type: none"> <li>● Supervising and administering fare prepayment program</li> </ul>
General Overhead Costs	<ul style="list-style-type: none"> <li>● Overhead at transit-operated sales outlets</li> <li>● Overhead at headquarters</li> </ul>
Cost of Funds	<ul style="list-style-type: none"> <li>● Interest lost due to delays in revenue deposit</li> </ul>

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 S-2 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 the companion document. The four cost categories that comprise all transaction oriented costs are discussed first in Chapter 3 of the technical report. The eight non-transaction oriented costs are discussed and analyzed in Chapter 4.

#### SUMMARY RESULTS OF THE COST ANALYSIS

The costs incurred at each of the 11 case sites were analyzed in detail in order to develop the parametric cost equations that appear in the technical report. A summary of the results of this analysis is presented here.

#### Aggregate Fare Prepayment Program Costs by Program Size

Three indicators of efficiency were used to compare the costs incurred at each transit company. These indicators include: cost per instrument sold, cost per prepaid revenue dollar, and cost per prepaid 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 S-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 S-3

A SUMMARY OF TRANSIT FARE PREPAYMENT PROGRAM COSTS -- 1981

Transit Company Size <sup>a</sup>	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

<sup>a</sup>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

As shown in Table S-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.

The second indicator also presented in Table S-3, cost per revenue dollar, represents the amount spent to earn a dollar of prepaid revenue. 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 S-3 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.

#### Fare Prepayment Program Costs by Cost Category and Program Size

The costs per instrument that are presented in Table S-3 reappear in Table S-4. This time, however, the unit costs are subdivided by cost category in order to provide an opportunity to compare the costs of individual fare prepayment activities by program size.

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.

#### SUMMARY RESULTS OF THE PRINCIPAL COST COMPARISONS

As with most transit operations, a fare prepayment program must be designed to meet the needs of its users based on the characteristics of the urban area in which the transit company operates. Consequently, no clear recipe on designing a fare prepayment program can be given that will result in maximum sales and minimum costs for all transit companies. Some of the major trade-offs that have to be made when designing a fare prepayment program are discussed in detail in Chapter 5 of the technical report. A summary of results of the trade-off analyses made in four areas is presented here.

Table S-4

## 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

## Normalized Fare Prepayment Plan Costs

One of the first decisions that must be made when designing a fare prepayment program is identifying which fare prepayment plan(s) will be offered to the general public. Although several criteria should be used in selecting fare prepayment plans, it is interesting to note how each plan will affect the cost of the program. Since actual program costs cannot be used to make valid comparisons of the costs of different fare prepayment plans, a set of normalized costs were computed in order to make this cost comparison. The costs of six different plans were computed using the cost equations and standardized values presented in Chapters 3 and 4 of the technical report. The values of the parameters were chosen based on a review of the actual values at each site in an attempt to portray a "typical" fare prepayment program. The results of this cost analysis are presented in Table S-5.

Table S-5

### MONTHLY NORMALIZED COSTS BY FARE PREPAYMENT PLAN -- 1981

	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. Thus, when decisions are made on the selection of an appropriate fare prepayment plan, the relative costs presented in Table S-5 should provide an indication of the monthly and unit costs that will be incurred.

A summary of the principal findings of the actual fare prepayment plan costs and the normalized costs as reported in the technical report is presented in Table S-6.

Table S-6

SUMMARY FINDINGS OF ACTUAL AND  
NORMALIZED FARE PREPAYMENT PLAN COSTS - 1981

- 
- The actual 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 and the per trip costs will decrease as the quantity of tickets or time duration increases.
- 

Normalized Delivery Costs by Delivery Method

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 of the technical report, the three principal delivery methods include:

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

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, 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 S-1 presents the costs of servicing each outlet in a medium density environment. All three methods of fare prepayment delivery are represented. Certified mail costs increase as the number of passes sent per outlet increases. Courier delivery costs are not affected by the volume of passes sent to each outlet but rather by the number of outlets served. It is assumed that more than 50 sales outlets are served during each delivery period. Transit staff delivery costs depend on the distance (and time) between outlets. The delivery costs per outlet for one and two mile average distances between outlets are shown in Figure S-1.

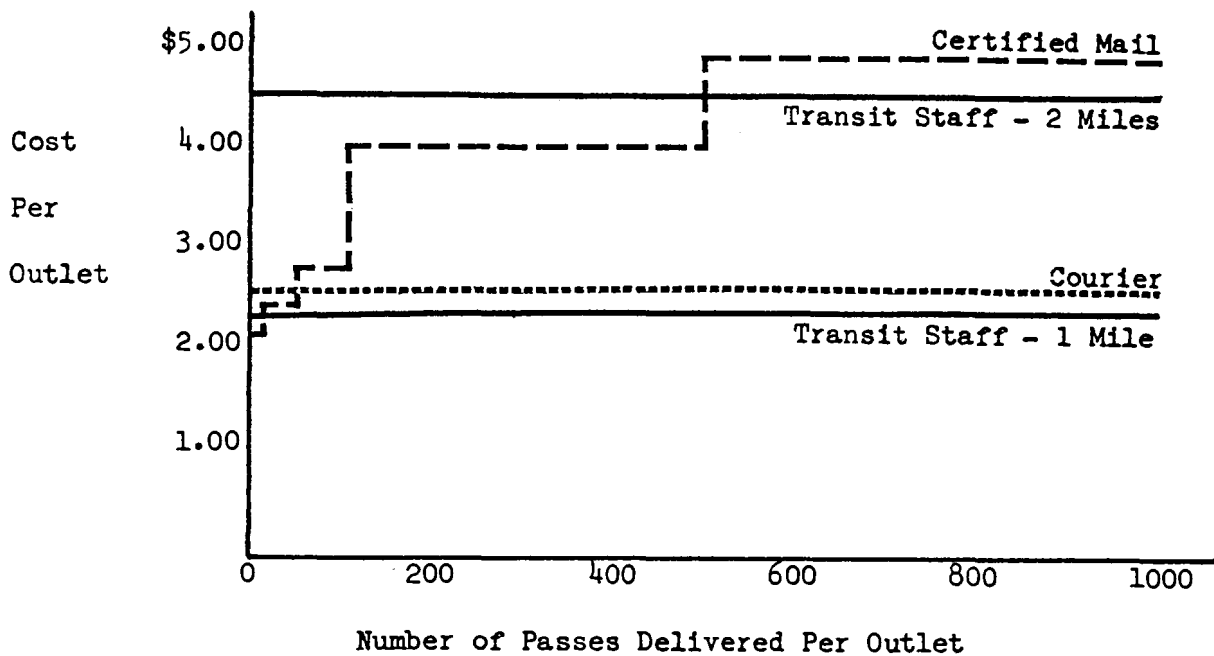


Figure S-1: COMPARISON OF DELIVERY METHOD COSTS IN A MEDIUM DENSITY ENVIRONMENT - 1981

With the costs of the three delivery methods superimposed on Figure S-1, it is possible to determine which method results in the least cost to the transit company at different volumes of passes delivered. Certified mail is the least costly method at volumes below approximately 50 passes per outlet. Beyond that volume, transit staff delivery is the most economical method if outlets are spaced one mile apart on average. If the distances between outlets are greater than one mile, courier service is less costly.

The analysis presented in the technical report shows in more detail 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, 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 fare prepayment delivery costs is presented in Table S-7.

Table S-7: SUMMARY FINDINGS OF FARE PREPAYMENT DELIVERY COSTS

- 
- Staff delivery costs are directly related to the time spent delivering fare prepayment plans and the distance between outlets.
  - Courier delivery costs per outlet will generally decline as the number of outlets serviced increases, while 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.
-

## Normalized Sales Costs by Sales Method

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.<sup>1</sup> 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 the technical report. These include:

- transit-operated sales outlets,
- public and private sales outlets,
- public outlets with sales contract,
- direct mail programs, and
- telephone order programs.

The analysis presented in the technical report and summarized in Figure S-2, shows 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 the 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.

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<sup>1</sup>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.



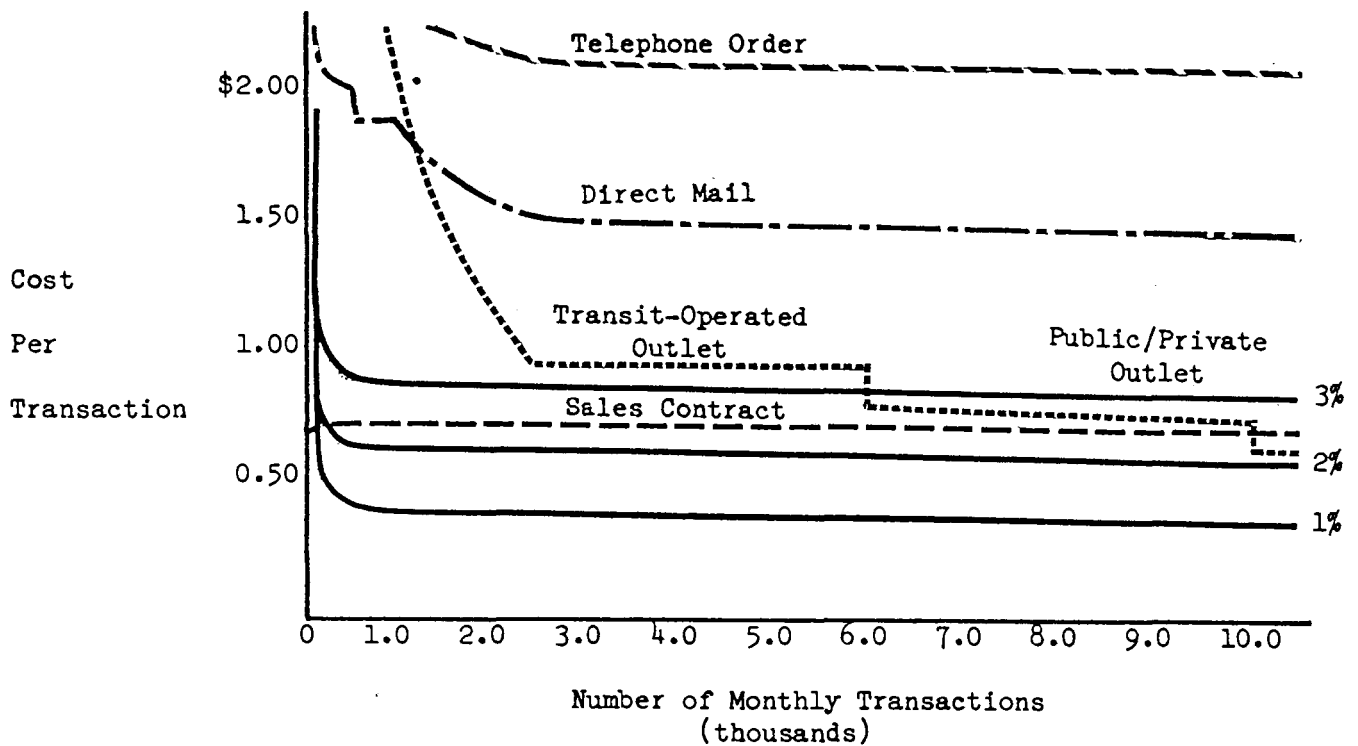


Figure S-2: A COMPARISON OF AVERAGE COSTS FOR FIVE DISTRIBUTION METHODS AT HIGH SALES VOLUME - 1981

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 on the costs of alternative sales distribution methods is presented in Table S-8.

Table S-8: SUMMARY FINDINGS OF ALTERNATIVE SALES DISTRIBUTION COSTS

- With the exception of the sales contracts that provide progressive variable commission rates, 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 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 sales outlets.

## Normalized Printing and Inventory Costs by Printing Volume

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 shown in Chapter 4 of the technical report, 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 illustrates how 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 summarized below, 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. It can be shown that as the size of the printing order increases, 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, say monthly passes, are reached at order sizes of around 300,000 passes. In Figure S-3, four cost curves are presented, each curve representing a different monthly pass program size. The lowest curve 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 S-3, 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.

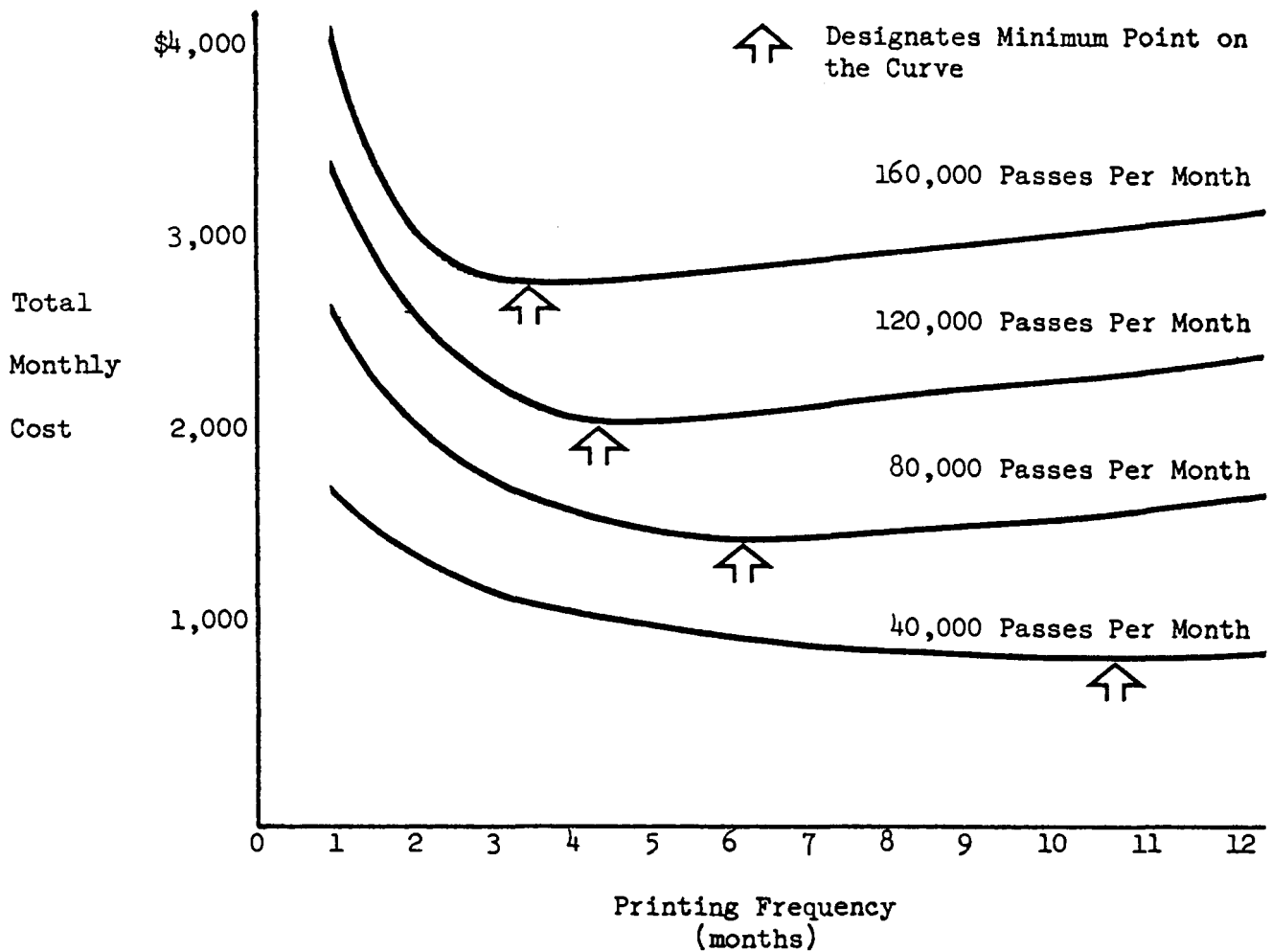


Figure S-3: MONTHLY EQUIVALENT PRINTING AND INVENTORY COSTS BY PRINTING FREQUENCY FOR FOUR PROGRAM SIZES - 1981

Table S-9

SUMMARY FINDINGS OF FREQUENCY OF PRINTING AND INVENTORY COSTS

- 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:

<u>Programs Requiring:</u>	---	<u>Should Print Plans:</u>
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

GUIDELINES ON USE OF THE TECHNICAL REPORT

The purpose of writing the technical 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 the report are in the form of standardized parametric cost equations. In Chapter 3 of the technical report, the principal transaction oriented costs are analyzed and a series of detailed cost equations are presented in four cost categories. Non-transaction oriented costs are 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.

For transit managers interested in adding to, subtracting from, or modifying their fare prepayment programs, parametric cost models, such as the equations presented in the technical 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.

Chapter 6 of the technical report is provided to assist the reader in using the equations developed in this study. 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 an existing program's operating costs and on how to forecast a new program's operating costs. In addition, short examples are presented to assist the reader.

#### GENERAL OBSERVATIONS

The unit costs for the 11 transit fare prepayment programs included in this study are summarized in Table S-10 by transit company size and for all 11 sites combined. As shown, large fare prepayment programs incur proportionally higher unit costs than small programs. The average cost incurred per prepaid instrument sold is \$0.63.

Table S-10

#### SUMMARY FARE PREPAYMENT PROGRAM COSTS - 1981

Transit Company Size	Cost Per Instrument
Large	\$0.857
Medium	0.439
Small	0.136
Average	\$0.627

The authors have shown in a recently completed paper<sup>1</sup> 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 S-10. However, a conscious effort should be made by managers of large fare prepayment programs to 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.

As described in the technical report, 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. The opportunities for reducing program costs that are identified in the technical report are summarized below. It is hoped that by presenting these general observations, transit managers will be able to implement more efficient policies to reduce operating 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.

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<sup>1</sup>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.

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.







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