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Foreword

Most transit properties continue to improve marketing programs to increase ridership, promote public awareness, and provide better service information to the rider. They are also striving to improve internal management of the transit system through performance monitoring of all aspects of operations. The papers in this Record describe current management techniques used by various transit agencies.

Furth and McCollom discuss cost reductions for collecting transit data. The procedure of collecting only one data item and applying a multiplication factor estimated from a small joint sample results in cost savings as large as 75 percent. White and Edner surveyed 178 transit agencies and found that the problem of retention of managers on the job may be more pronounced than previously believed.

Scott et al. describe a survey on the attitudes of transit employees toward merit pay. Although merit pay programs are the most widely used type of financial incentive program in mass transit systems, employees' attitudes toward such programs are mixed. In general, employees' perceptions of the accuracy of the performance evaluation were quite negative. Lyons presents a study of nine European public transit data bases. Usefulness of the data bases is examined to identify items for which Section 15 could be improved or could be used as a valuable standard. This study provides a critical guide to data sources for analysis of international transit performance.

Capo' and Messmer examine the effects on ridership of distributing route-specific service information only, or information with free-ride coupons, to residential areas bordering three high-ridership urban bus routes. Neither the information alone nor the coupons caused significant increase in ridership. Rhine and Flynn describe a one-stop ticket and pass clearinghouse that provides a simple method for employers to sell transit tickets and passes to their employees at the work site.

Spielberg et al. report on a method to determine ridership, probable level of demand, proper fare, and service frequency for new transit services. A market survey of all households in the proposed service areas was conducted. Questions were designed to permit analysis using a screening process that projected ridership quite closely to the actual number found when the new line was put in service. Markowitz describes a program underway since 1980 to improve the integration of fares among the three largest public transit operators in the San Francisco Bay Area. Improvements have recently been made to add convenience attractive to regular riders and to promote new ridership.

Muncey and Sinha describe a simple elasticity model developed to define the sizes of either fare increases or service decreases required to offset possible reductions in federal operating subsidies. This model was part of a larger study that examined alternative strategies for the distribution of state transit funds. Cutler presents the results of a demonstration project that evaluated the effectiveness of using outside experts to teach local transit managers how to market their services, and of specific marketing actions to increase ridership and improve the image of transit in the community.

Hitlin et al. compare the costs, findings, advantages, and disadvantages of two types of surveys used to estimate ridership demand for new transit service. The telephone survey was approximately three and one-half times as expensive per interview as the door-to-door survey, but the results of the two surveys in each location were virtually identical. A self-administered door-to-door survey is a cost-effective and viable option. Larwin reports on the coordination of public transportation development in San Diego, describing the way the San Diego Metropolitan Development Board has evolved into an umbrella organization with broad transit development, planning, programming, and financial powers.

Using Conversion Factors to Lower Transit Data Collection Costs

PETER G. FURTH AND BRIAN MCCOLLOM

Monitoring passenger use measures such as boardings, revenue, passenger-miles, and load can be an expensive task for transit systems. One way to reduce data collection costs is to measure only one of these items, the auxiliary item, and then apply multiplicative factors that are estimated from a small joint sample to its estimated mean to estimate the means of the other items. Statistical aspects of the conversion factor approach are presented, including sample size estimation and determination of the accuracy of both the conversion factors and the inferred estimates. An optimal sampling plan that minimizes the combined cost of estimating the conversion factors and estimating the mean of the auxiliary item is determined. Cost savings between 0 and 75 percent of the cost of direct estimation are obtained for various situations.

Collection of passenger use data (e.g., boardings, peak load, revenue) at both the route and system level constitutes a significant expense for transit systems. With the exception of system-level revenue, few transit systems collect these data on every trip. For cost reasons, sampling is used at most systems. Different sampling techniques are available, entailing different measurement techniques, sample sizes, sampling plans, and costs. One especially suitable technique for estimating passenger use measures is conversion factors. Although the informal use of conversion factors is widespread throughout the transit industry, the research effort reported in this paper represents the first treatment, to the authors' knowledge, of statistical issues, such as sample size and accuracy, related to the use of conversion factors in transit.

Although sampling has been done in the transit industry for decades—in bus systems, the abolition of tickets made it necessary—the subject of statistical determination of sample size and accuracy for transit has scarcely been started. A data collection manual published in 1947 by the American Transit Association *(1)*, recommends sample sizes but does not suggest the resultant level of precision. A more recent report *(2)* describes current data collection techniques but says nothing about sample size or accuracy.

In 1979, UMTA began the Bus Transit Monitoring Study to improve the state of the art in transit data collection and service monitoring practices. As part of that study, the first *Bus Transit Monitoring Manual (3)* was completed in 1981. A later edition of this manual was published in 1985 under the title *Transit Data Collection Design Manual* (TDCDM) *(4)*. In these manuals, procedures are offered for determining accuracy and sample size. The later edition includes procedures for using conversion factors under certain conditions that are described later. This paper draws on the results of the Bus Transit Monitoring Study and describes the statistical theory of conversion factors and their application to transit more fully.

A conversion factor expresses a relationship between two variables: Y, called the inferred item, and X, the auxiliary item. The conversion factor is estimated from a paired sample of X and Y. The following notation is used in this paper:

N = population size,
Y_i = value of Y for population element i,
$Y_T = \sum_{i=1}^{N} Y_i$ = population total of Y,
$\bar{Y} = Y_T/N$ = population mean of Y,
n = size of paired sample,
y_i = value of Y for sample observation i,
$y_t = \sum_{i=1}^{n} y_i$ = sample total of Y,
$\bar{y} = y_T/n$ = sample mean of Y,
$S_y^2 = \frac{1}{N-1} \sum_{i=1}^{N} (Y_i - \bar{Y})^2$ = variance of Y,
$v_y = \frac{S_y}{\bar{Y}}$ = coefficient of variation (COV) of Y,
and
$r_{xy} = \frac{\sum_{i=1}^{N} (Y_i - \bar{Y})(X_i - \bar{X})}{(N-1)S_y S_x}$ = correlation coefficient of X and Y.

Corresponding terms for X are similarly defined.

The conversion factor R is the ratio of population means. Its estimator $\hat{R}$ is the ratio of sample means. Thus,

$$R = \bar{Y}/\bar{X} = Y_T/X_T \quad (1)$$

$$\hat{R} = \bar{y}/\bar{x} = y_T/x_T \quad (2)$$

If the mean $(\bar{X})$ or total (X_T) of the auxiliary item is known, the mean or total of the inferred item can be estimated using the estimated conversion factor:

$$\hat{\bar{Y}} = \hat{R}\,\bar{X} \quad (3)$$

$$\hat{Y}_T = \hat{R}X_T \quad (4)$$

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where $\hat{\bar{Y}}$ and $\hat{Y}_T$ are estimates of $\bar{Y}$ and Y_T. If $\bar{X}$ and X_T are not known but are estimates, the following estimates are used:

$$\hat{\bar{Y}} = \hat{R}\bar{x} \quad (5)$$

$$\hat{Y}_T = \hat{R}\, N\bar{x} \quad (6)$$

Examples of conversion factors in the transit industry abound. Average fare is used to estimate route revenue from route boardings or vice versa. Average trip length is the conversion factor (average passenger-miles divided by average boardings) used to estimate passenger-miles from boardings data. Peak-load counts could be used to estimate route boardings. Evidence of the value of using ratio estimates is found in a recent study *(5)* of San Diego bus routes in which the ratio of maximum load to total boardings on a route showed far less variation over the day than the absolute values of either measure.

Because of the close relationship between such passenger use measures, a relatively small sample size is typically required for estimating conversion ratios. Armed with a set of ratios based on a single auxiliary item X, a transit system may be able to estimate all passenger use items by directly collecting data only on the variable X. This approach can be especially cost-effective when data on X can be collected much more cheaply than other passenger use measures.

Basic statistical theory is used in this paper and is therefore presented without proof. The theory can be found in several statistical texts; for example, Cochran *(6)*.

BIAS AND VARIANCE OF A CONVERSION FACTOR

The true model can be assumed as

$$Y_i = RX_i + \varepsilon_i \quad (7)$$

where ε_i is independently distributed with mean 0. Then $\hat{R}$ is a slightly biased estimator of R. Following Cochran *(6)*, this bias is of the order of $1/n$ and so is negligible for large samples. For sample sizes in the range of 10 to 30, terms of order $1/n^3$ and higher may be neglected, and so the relative mean squared error (mse) is approximately the expectation

$$\text{mse}(\hat{R}) = \text{E}\left[\frac{\hat{R} - R}{R}\right]^2$$

$$\cong v_R^2\left[1 + \frac{3v_x^2}{n} + \frac{6v_x^2}{n}\left(\frac{r_{xy}^2\, v_y^2 + v_x^2 - 2r_{xy}v_xv_y}{v_y^2 + v_x^2 - 2r_{xy}v_xv_y}\right)\right] \quad (8)$$

where

$$v_R^2 = \frac{v_x^2 + v_y^2 - 2r_{xy}v_xv_y}{n} \quad (9)$$

is a first-order approximation of the relative variance (squared COV) of $\hat{R}$, derived from

$$v_R^2 \cong v_Y^2 \cong \frac{1}{n\bar{x}^2R^2}\;\frac{\sum_{i=1}^{n}(y_i - \hat{R}x_i)^2}{n-1} \quad (10)$$

For many applications, X and Y have approximately equal coefficients of variation, so that Equation 7 reduces to

$$\text{mse}(\hat{R}) \cong v_R^2\left[1 + \frac{v_x^2}{n}(6 - 3r_{xy})\right] \quad (11)$$

By using values of $v_x = 0.6$ and $r_{xy} = 0.85$, worse than average values for route level applications observed in the UMTA Bus Transit Monitoring Study, v_R^2 underestimates the mse by a factor of about $(1 + 1.2/n)$.

The relative bias of $\hat{R}$, $b/\hat{R}$, where b = bias, can be expressed as

$$\frac{b}{R} = \left[\text{mse}\,(\hat{R}) - v_R^2\right]^{1/2} \quad (12)$$

When the assumed values of v_x and r_{xy} are used, the relative bias is approximately $0.36/n$. To keep the relative bias small, then, sample sizes below 10 should not be used.

Another problem with small samples is the fact that the approximations used become less exact because of nonnormality and the greater importance of neglected higher-order terms. Cochran *(6)* reports, based on empirical studies, that v_R^2 underestimates the true value by about 20 percent when the sample size is 10, and by about 6 percent when the sample size is 30. Accordingly multiplying the right-hand side of Equation 9 by the factor $n/(n - 1.7)$ yields

$$v_R^2 = \frac{1}{n - 1.7}(v_x^2 + v_y^2 - 2r_{xy}v_xv_y) \quad (13)$$

ACCURACY AND SAMPLE SIZE

Accuracy is defined by two components, a relative tolerance and a confidence level. For example, the federal Section 15 requirements call for estimates of systemwide boardings and passenger-miles to within ±10 percent at a 95 percent confidence level. If an estimate $\hat{\theta}$ is normally distributed, then

$$d = z_c v(\hat{\theta}) \quad (14)$$

where

- d = tolerance (e.g., $d = 0.2$ means ±20 percent tolerance);
- c = specified confidence level in percent (e.g., c = 95 means 95 percent confidence level);
- z_c = $(c + 100)/2$ percentile value of the standard normal distribution (e.g., $z_{95} = 1.96 \cong 2$); and
- $v(\hat{\theta})$ = coefficient of variation of $\hat{\theta}$.

Although ratio estimates are not normally distributed, they are close enough to normal for practical purposes. Extreme nonnormality is avoided by prohibiting small sample sizes.

Because $v(\hat{\theta})$ depends on the sample size used to calculate $\hat{\theta}$, the sample size required to achieve a specified accuracy level can be determined from Equation 14. It is the sample size for which

$$v(\hat{\theta}) = d/z_c \qquad (15)$$

It is assumed that N is known, so that the expansion from a mean to the population total does not alter the COV of an estimate, making the sample size formulas for means and totals identical. For simplicity, our exposition will deal with estimation of the population mean of Y.

Three different cases will be covered: when $\bar{X}$ the mean of the auxiliary item is known; when $\bar{X}$ is unknown and estimated by using data that are also used to estimate the conversion ratio; and when $\bar{X}$ is unknown and is estimated independent of the data used to estimate the conversion ratio.

INFERRING WITH A KNOWN AUXILIARY VARIABLE

The simplest case of using a conversion factor is when the total or mean of the auxiliary variable is known. An example is estimating systemwide boardings or passenger-miles from systemwide farebox revenue, which is universally measured for accounting purposes. Another transportation example might be estimating regional vehicle-miles of travel (VMT) from total regional gasoline sales.

When $\bar{X}$ is known, estimation of $\hat{\bar{Y}}$ follows Equation 3, and therefore

$$v^2(\hat{\bar{Y}}) = v^2(\hat{R}) = \frac{1}{n - 1.7}(v_x^2 + v_y^2 - 2r_{xy}v_xv_y) \qquad (16)$$

Necessary sample size, applying Equation 15, is

$$n = \frac{z_c^2}{d^2}(v_x^2 + v_y^2 - 2r_{xy}v_xv_y) + 1.7 \qquad (17)$$

The results of evaluating Equation 17 are always rounded upward to the next integer, with the smallest value for n of 10.

This approach was used to analyze the potential of using a systemwide revenue-to-boardings conversion in the collection of Section 15 data for the Port Authority of Allegheny County (PAT), Pittsburgh's regional transit system. The population was all the vehicle trips in a year including all routes; Y_i = boardings on Trip i and X_i = revenue on Trip i. Analysis of data from PAT yielded the following estimates:

$$v_x = 0.786, \quad v_y = 0.587, \quad r_{xy} = 0.647$$

When these parameters were used to obtain systemwide boardings with the specified ±10 percent tolerance at the 95 percent confidence level, $n = 149$.

This result indicates that, in the case of PAT, 149 trips must be randomly sampled over the year, with trip level boardings and revenue observed on each trip. This procedure might be done by using on-board checkers to count boarding passengers and to take farebox readings at the start and end of each trip.

An estimate of total passenger-miles at the same level of accuracy is also required in Section 15. An analysis was made of the potential of using a conversion factor of systemwide revenue (X) to passenger-miles (Y) to estimate total passenger-miles. An analysis of sample PAT data yielded the estimates $v_y = 0.816$ and $r_{xy} = 0.739$, resulting in a required sample size of $n = 129$. Data on both revenue and passenger-miles can be collected by having an on-board checker record ons and offs at each stop, from which passenger-miles may be derived directly, as well as the beginning and ending farebox reading. If on-board checks are used for estimating conversion factors for both passenger-miles and boardings, PAT could meet its Section 15 requirements for service consumed by performing annually 149 (the larger of the two n-values) on-board checks chosen at random, or about 3 per week.

In contrast, if boardings or passenger-miles are estimated directly without conversion for a sample of n trips, the COV of the sample mean would be $v_y/n^{1/2}$. Applying Equation 15, the necessary sample size would be

$$n = \frac{z_c^2}{d^2}v_y^2 \qquad (18)$$

For the PAT example, Equation 18 yields $n = 235$ for boardings and $n = 326$ for passenger-miles. Assuming that data on both of these items can be measured concurrently with on-board checks, the larger sample size ($n = 326$) governs. In comparison with the 149 on-board checks needed under the conversion factor approach, use of revenue-based conversion factors saves, for this example, 56 percent of the data collection cost.

On the basis of the analysis of the PAT data described here and of a similar analysis of data from VIA (San Antonio's transit system), UMTA has authorized this revenue-based approach for meeting its Section 15 requirements for boardings and passenger-miles *(7)*. The approved sampling plan calls for 208 observations per year, in contrast with the 600 or so observations required in the previously authorized sampling plan that does not involve conversion factors *(8)*.

Some transit systems are fortunate in that route level boardings are counted routinely on every trip. This makes boardings an ideal auxiliary variable from which to estimate other desired route level measures such as average revenue per trip, average peak load, and average boardings on a segment of the route. For example, average peak load for a certain route/direction/time period (*R/D/TP*) combination (an example time period might be 6:30 to 9:00 a.m.) might be a desired statistic. Then the population is all trips in that *R/D/TP*, X_i = boardings on Trip i, and Y_i = peak load on Trip i. The boardings-to-peak-load conversion factor is estimated from a sample of n joint observations as $\hat{R} = \bar{y}/\bar{x}$. A joint observation is made by positioning a checker at the peak-load point to count the number of passengers on board. If the checker records the bus and trip number, this count can be matched to the boarding count taken on that trip. Analysis of data from a large number of routes in Pittsburgh, San Francisco, and Minneapolis yielded typical values as follows:

$$v_x = 0.5, \quad v_y = 0.4, \quad r_{xy} = 0.94$$

For a desired accuracy of ±10 percent tolerance at the 95 percent confidence level, the necessary sample size applying Equation 17 is $n = 16$.

In contrast, if peak load were estimated directly, the required number of observations of peak load, from Equation 18, would be $n = 64$. This four-fold difference illustrates the potential savings of using a known measure (e.g. boardings) that is being collected routinely to estimate other passenger-use measures by using conversion factors.

SAMPLING FOR THE CONVERSION FACTOR AND THE AUXILIARY ITEM IN THE SAME TIME FRAME

When there is no perfectly known auxiliary item, the mean of Y is estimated by using Equation 5, and both the conversion factor and the mean of the auxiliary item must be estimated by sampling. The case in which sampling for both items occurs in the same time frame is discussed in this section.

A random sample of n' observations of X are made. On a randomly selected subset of n of the observations, Y is observed as well. The following notation is used in this discussion:

$\bar{y}_{n'}, \bar{x}_n$ = sample means of Y and X from the subset of size n; and
$\bar{x}_{n'}$ = sample mean of X from the entire set of n' observations.

For example, if X is peak load for a particular $R/D/TP$, and Y is boardings for that $R/D/TP$, both X and Y might be observed by using on-board checks on n trips, whereas point checks are used to measure peak load on $n' - n$ additional trips. From Equation 2, the estimate of the peak load-to-boardings conversion factor is $\hat{R} = \bar{y}_n/\bar{x}_n$. The estimate of $\bar{X}$ is $\bar{x}_{n'}$. The estimate of $\bar{y}$ is

$$\hat{\bar{y}} = \bar{x}_{n'} \frac{\bar{y}_n}{\bar{x}_n} \tag{19}$$

Its squared COV, following Cochran and using the small-sample adjustment, is

$$v^2(\hat{\bar{Y}}) = \frac{v_x^2 + v_y^2 - 2r_{xy}v_xv_y}{n - 1.7} + \frac{2r_{xy}v_xv_y - v_x^2}{n'} \tag{20}$$

In determining the necessary sample size to achieve a desired accuracy, there is a trade-off between n and n'. The optimal choice depends on their relative costs. If the unit sampling cost for a paired observation is c, and the cost for a separate observation of X is c', the total cost is $cn + c'(n' - n)$.

If the following substitutions are made,

$$c_1 = c - c' \tag{21}$$

$$c_2 = c' \tag{22}$$

$$k_1 = v_x^2 + v_y^2 - 2r_{xy}v_xv_y \tag{23}$$

$$k_2 = 2r_{xy}v_xv_y - v_x^2 \tag{24}$$

the optimization problem is the following:

$$\text{Minimize } c_1n + c_2n' \tag{25}$$

subject to

$$k_1/(n - 1.7) + k_2/n' \le d^2/z^2 \tag{26}$$

$$n \ge 10 \tag{27}$$

and

$$n' > n. \tag{28}$$

The solution, ignoring Equation 28, is

$$n = 1.7 + \frac{z^2}{d^2}k_1\left[1 + \left(\frac{k_2c_2}{k_1c_1}\right)^{1/2}\right] \tag{29}$$

$$n' = k_2\left(\frac{d^2}{z^2} - \frac{k_1}{n - 1.7}\right)^{-1} \tag{30}$$

Results of Equation 29 are again to be rounded upwards, with the smallest allowed value for n of 10.

If $n' \le n$, Equation 28 is violated, implying that the direct estimation of $\bar{Y}$ without using a conversion factor will be less costly. Even if $n' > n$, there still may be cases where direct estimation of $\bar{Y}$ is the less costly alternative. Therefore the direct and indirect approaches must be compared.

An example of this approach can be shown using the data from the last example. The problem is to estimate mean boardings for a particular $R/D/TP$ to a tolerance of ±20 percent at a 95 percent confidence level through the use of a conversion factor with peak load as the auxiliary variate. The COV and correlation estimates are the same as for the last example, except that load is now the independent variable X and mean boardings is the dependent variable Y. The correlation coefficient is unchanged, because of the identity $r_{xy} = r_{yx}$. Joint observations of peak load and boardings are made using an on-board checker. If this checker will be collecting useful data in both directions, then the time required for one joint observation is $t/2$, where t = cycle time for the route. Observations of peak load alone are made with checkers stationed at the peak-load point. If the headway is h, one observation in each direction can usually be made in an interval h, so the time spent per observation is $h/2$. If $t = 60$ min and $h = 10$ min, then

$c_2 = h/2 = 5$ min

$c_1 = (t - h)/2 = 25$ min

$k_1 = 0.03$

$k_2 = 0.22$

$(z/d)^2 = 100$

$n = 8.33$, which is increased to 10,

$n' = 34$

The cost is $[cn + c'(n' - n)]/60 = 7$ checker-hr. For comparison, boardings could be estimated directly using on-board checkers. The unit sampling cost is $t/2 = 30$ min. The necessary sample size is, from Equation 18, $n = 25$. The resulting cost is 12.5 checker-hr. These results are summarized as follows:

	Using Conversion Factor (checker-hr)	*Direct Estimation (checker-hr)*
On-board checks	10	25
Point checks	24	0
Total	7	12.5

The conversion factor approach is not always the least costly alternative. Because a less strict accuracy for route boardings of ±30 percent at a 90 percent confidence level (z =1.65) is recommended in the TDCDM, it is illustrative to look at the results for this case. Applying Equation 29 yields n = 3.6, which must be rounded up to n = 10 on-board checks. Applying Equation 30 yields n' = 7.5, which is less than n, indicating that no point checks should be taken and that direct estimation will be less costly. When Equation 18 is applied, it is found that direct estimation calls for only n = 8 ride checks in this case. This example illustrates how the requirement of having at least 10 joint observations makes the conversion factor approach less desirable when only small sample sizes are needed.

SAMPLING FOR THE CONVERSION FACTOR AND THE AUXILIARY ITEM INDEPENDENTLY

In some cases the conversion factor and the mean of the auxiliary item can be estimated from independent samples. For example, the peak load-to-boardings conversion factor might be estimated in the fall and used with an estimate of peak load in the spring to estimate spring mean boardings. In this case, the conversion factor is estimated from a set of n joint observations of X and Y with unit sampling cost c, yielding the conversion factor estimate $\hat{R} = \bar{y}_n/\bar{x}_n$ as before. An independent sample of n' observations of X with unit sampling cost c' yields the estimate of $\bar{x}_{n'}$. The product of $\hat{R}$ and $\bar{x}_{n'}$ is an estimate of $\bar{Y}$, whose squared COV, following Cochran *(6)*, is approximately

$$v^2(\hat{\bar{Y}}) = \frac{v_y^2 + v_x^2 - 2r_{xy}v_xv_y}{n - 1.7} + \frac{v_x^2}{n'} \quad (31)$$

If a conversion factor has already been estimated by using a sample size n, it follows that the required size of the sample of the auxiliary item is

$$n' = v_x^2 \left(\frac{d^2}{z^2} - \frac{v_x^2 + v_y^2 - 2r_{xy}v_xv_y}{n - 1.7} \right)^{-1} \quad (32)$$

provided that the denominator is greater than zero. If the denominator is negative, the desired accuracy level is unattainable regardless of n', because there is too much uncertainty in the estimate of the conversion factor.

A program for route level monitoring in which conversion factors are estimated during a baseline phase and are assumed to remain stable during a monitoring phase of a few years is recommended in the TDCDM. During the monitoring phase, $\bar{X}$ is estimated periodically (e.g., every quarter) and is multiplied by the conversion factor to yield periodic estimates of $\bar{Y}$.

Cost minimization should be considered in the selection of the sample sizes for the auxiliary item that will be taken during the monitoring phase and for the one conversion factor sample taken in the baseline phase. If f = number of times a sample of $\bar{X}$ will be measured during the monitoring phase, then the problem of minimizing the total data collection cost of both baseline and monitoring phases is determined from the following problem:

$$\text{minimize } cn + fc'n' \quad (33)$$

subject to

$$\frac{v_y^2 + v_x^2 - 2r_{xy}v_xv_y}{n - 1.7} + \frac{v_x^2}{n'} \le \frac{d^2}{z^2} \quad (34)$$

$$n \ge 10 \quad (35)$$

This problem is of the same form as Equations 25–27. Therefore, the solutions for n (Equation 29) and n' (Equation 30) can be used by making the following substitutions:

$$c_1 = c \quad (36)$$

$$c_2 = fc' \quad (37)$$

$$k_1 = v_x^2 + v_y^2 - 2r_{xy}v_xv_y \quad (38)$$

$$k_2 = v_x^2 \quad (39)$$

This approach can be applied to the previously used example, in which the problem is to estimate mean boardings Y for a particular *R/D/TD* from mean peak load X. The desired tolerance for mean boardings is ±20 percent at the 95 percent confidence level. If the monitoring phase lasts 3 years and a quarterly estimate of $\bar{Y}$ is needed, then f = 12. Using the same values for v_x, v_y, and r_{xy} as before, n and n' are estimated as follows:

c_1 = 30 min

c_2 = 60 min

k_1 = 0.03

$v_x^2 = k_2$ = 0.25

$(z/d)^2$ = 100

n = 17

n' = 31

Using Equation 33, the cost for both the baseline and monitoring phases is estimated to be 39.5 checker-hr. In comparison, direct estimation of boardings, using ride checks, during the monitoring phase requires (as before) 25 observations for each estimate of Y, for a cost of 150 checker-hr. This cost is in addition to any cost of sampling in the baseline year.

If the same example is repeated with a ±30 percent tolerance at the 90 percent confidence level required, the results are

	Using Conversion Factors (checker-hr)	*Direct Estimation (checker-hr)*
n	10	8
n'	9	–
Total cost	14	48

In both cases, conversion factors offer a 70 to 75 percent reduction in data collection costs over direct estimation.

USING AN AUXILIARY ITEM TO INFER SEVERAL ITEMS

In the transit context, a single auxiliary item may be used with different conversion factors to yield estimates of several items, such as route boardings, segment boardings, peak load, and revenue. For each estimated item there is a different set of values for v_y, r_{xy}, and d. What, then, is the least-cost sampling plan?

Expanding the optimization framework is straightforward if all of the conversion factors are estimated using the same data collection technique, typically ride checks. If the auxiliary item is known without sampling, the estimated variable that demands the largest paired sample size will control the sample size.

When the auxiliary item as well as several conversion factors must be estimated by sampling, the general solution is cumbersome to apply because several optimality conditions must be checked. One simple approach is to do a one-dimensional search over n, the number of ride checks. The lower bound for n is 10. If the conversion factor sample is independent of the auxiliary item sample, each inferred item will supply another lower bound for n, which is the integer greater than the value at which the denominator of Equation 32 equals 0. Then, for a given value of n, the required n' for each inferred item is given by Equation 30 or 32. The highest n' governs. With the given n and corresponding governing n', the cost can easily be calculated. Searching over n will reveal a value that minimizes overall cost. Although not proven, the cost as a function of n is almost certain to be convex. This implies that a local optimum will be a global optimum.

CONCLUSIONS

In this paper, formulas for sample size and accuracy determination are presented with the use of conversion factors in three situations: (a) when the mean $\bar{X}$ of the auxiliary item is known; (b) when it is estimated using the conversion factor sample plus a supplemental sample of X; and (c) when $\bar{X}$ is estimated independently of the conversion factor sample. In the latter cases, the trade-off between the costs of the conversion factor sample and of the sample for X is explored, and cost-minimizing formulas are presented. Examples are presented that demonstrate how using conversion factors can dramatically reduce data collection costs in comparison with direct estimation.

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REFERENCES

1. W. S. Rainville, Jr. *Traffic Checking and Schedule Preparation.* American Transit Association, 1947. (Reprinted by U.S. Department of Transportation, as Report DOT–I–88–23, 1982).
2. *Review of Transit Data Collection Techniques.* Report DOT–I–85–26, UMTA, U.S. Department of Transportation, 1985.
3. J. P. Attanucci, I. Burns, and N. H. Wilson. *Bus Transit Monitoring Manual.* Report DOT–I–81–30, U.S. Department of Transportation, 1981.
4. J. H. Banks. Analysis of Maximum Load Data for an Urban Bus System. In *Transportation Research Record 1011,* TRB, National Research Council, Washington, D.C., 1985, pp. 1–8.
5. P. G. Furth, J. P. Attanucci, I. Burns, and N. H. Wilson. *Transit Data Collection Design Manual.* U.S. Department of Transportation, 1985.
6. W. G. Cochran, *Sampling Techniques.* 3rd edition. John Wiley and Sons, Inc., New York, 1977.
7. *Revenue Based Sampling Procedures for Obtaining Fixed Route Bus Operating Data Required Under the Section 15 Reporting System.* Circular UMTA–C–2710.4, UMTA, U.S. Department of Transportation, 1985.
8. *Sampling Procedures for Obtaining Fixed Route Bus Operating Data Required Under the Section 15 Reporting System.* Circular UMTA–C–2710.1, UMTA, U.S. Department of Transportation, 1978.

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Manager Retention and Job Change in the Transit Industry: A Survey of Manager Attitudes

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Issues related to the retention of management personnel in the transit industry are examined. The results are based on survey responses of 1,301 managers from 178 transit agencies and indicate that turnover may be substantially higher than previous reports have suggested. Specifically, 42.6 percent state that they will leave their present agency and 21.3 percent expect to leave the industry altogether. Analysis of these findings suggests that the problem of retention may be more pronounced for managers who are 5 to 10 years into their careers or whose positions are outside core transit areas (i.e., operations and maintenance). From the analysis of factors that might be related to the problem of retention, three explanatory factors are suggested: (a) absence of commitment to a career in transit, (b) lack of a clear career ladder within the industry, and (c) the end of the period of rapid transit growth. The major implication of these findings is that the managerial recruitment needs of the industry may be greater than previously indicated and will be especially pronounced for managers in the areas of marketing, personnel, and finance.

In this study, issues related to the managerial personnel needs of the transit industry over the next 5 years are examined. Specifically, career expectations reported by 1,301 managers from 178 agencies are explored. The responses are grouped on the basis of whether the managers will be with the same transit agency, a different agency, retire, or leave the transit industry. The extent to which these stated intentions are related to agency characteristics, individual demographics, professional experience, and evaluations of personal career development and opportunities is examined.

The findings suggest that the industry will experience substantial change in its managerial cadre over the next 5 years and that the recruitment needs may be greater than previously forecast *(1)*. Further, results indicate that recruitment needs will be more pronounced for some management categories than for others. Finally, though respondents are generally satisfied with their current positions and with the development of their careers, they are not optimistic about the opportunities for advancement in their present agencies or in the industry. This general pessimism about future opportunities is a major factor related to the potential loss of current managers to other industries and does, therefore, pose a major concern for the industry.

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BACKGROUND

The 1985 Transportation Research Board report on transportation professionals indicated that

> . . . approximately 11.4 percent (2.3 percent per year) of the current transit work force can be expected to retire by 1990. This means that approximately 3,000 executive, professional, and supervisory job openings will be created during the next 5 years to replace those who retire.
>
> . . . transit agencies anticipate that total attrition due to retirement and other causes will amount to about 18.7 percent of the professional work force in the next 5 years. After retirements have been deducted, . . . , this leaves *7.3 percent of the professionals—2,000 transit professionals—who will change jobs or drop out of the work force during the next 5 years.* Although some of these professionals will leave the transit industry, many will probably remain working in transit but simply change agencies to advance their careers (*1*, p. 118). (Emphasis added.)

The conclusions of this TRB report *(1)* are based on the assumption that three primary factors influence the human resource requirements of the industry: (a) changes in service, ridership, and funding; (b) retirement rates; and (c) attrition due to long-term leave, disability, or job change. There are additional, possibly more subtle, factors that may also be important for the retention and recruitment of qualified transit managers. In general, these factors appear to be related to individual manager commitment to transit as an occupational setting that offers opportunities for personal development and advancement.

In 1973, Mundy and Spychalski found transit managers to be largely made up of an up-from-the-ranks professional cadre. Although this still may be an accurate depiction for some of the current managers, the past 13 years have produced significant changes both in the sources of management personnel and the types of managers sought by the industry. The 1970s saw many agencies adding new types of positions or creating new departments to respond to changing service demands, new technologies, and organizational settings. Marketing, planning, and personnel tasks expanded, resulting in the recruitment of managerial personnel with an increasingly diverse array of training, prior experience, and career expectations.

It is not clear that there ever were well-defined career ladders for transit managers. These career paths are even more ambiguous today because management has diversified away from the core aspects of transit in operations and maintenance toward new skills and disciplinary orientations. To the extent that clear opportunities for career advancement are related to commitment to a career in transit, retention of qualified managers may have become more problematic.

In a previous paper *(3)*, the authors explored whether difficulties attracting new management personnel were related to the size, organizational setting, organizational structure, or degree of change that characterized transit agencies. Analysis revealed no discernible trends, implying that recruitment difficulties were more of an industry problem than specific to any particular class of transit agency. Consequently, the recruitment problems experienced by the industry may be related to some more generic factor, such as the attractiveness of transit as a setting for long-term career development. This factor could also impair the ability of transit to retain qualified managers.

For the purposes of this study, four general factors that may be related to anticipated career moves were identified: (a) agency characteristics, (b) individual demographic characteristics, (c) professional experience, and (d) evaluation of personal career development and advancement opportunities. The analysis of the effects of these factors permits isolation of classes of transit managers that may be more or less prone to make job changes.

SURVEY METHODOLOGY

Between late 1984 and early 1985, surveys were sent to 3,050 managers in 207 transit agencies. The individuals receiving these questionnaires had been previously identified by personnel lists or organization charts supplied by each of these agencies. The characteristics of these agencies in terms of fleet size, organizational structure, institutional setting, and fiscal characteristics are reported in *Transit Agency Characteristics: An Industry Profile (4)*. Managers were sent individually addressed questionnaires, with one follow-up mailing sent to those who did not respond initially. Completed responses were received from 1,301 managers for a return rate of 43 percent. The respondents did not comprise a scientifically drawn random sample of managers in the transit industry. However, responses were received from persons in 178 agencies, representing the range of agency size and institutional and locational characteristics. Further, the sample included a broad array of managerial functions. Thus the sample was deemed a good cross section of industry management personnel.

The questionnaire requested information on a number of topics, including career experience, training, educational background, attitudes toward the industry, perceptions of career development opportunities, training needs, short-term career plans, and assessments about the future of transit. This information is applied to our examination of issues related to the problem of managerial retention. First, the characteristics of the sample are described with respect to career experience, agency characteristics, and individual demographics. Then the short-term career plans of the managers are examined, and finally factors are explored that may be related to those plans, particularly with respect to those who indicated that they expected to leave the industry during the next 5 years.

SAMPLE CHARACTERISTICS

Two important trends were established by the results summarized in Table 1. First, the overwhelming majority of respondents had fewer than 20 years' service not only with their current agencies, but also in the transit industry. This tenure is distinctly shorter than the managerial tenure reported in 1973 by Mundy and Spychalski (2, p. 11), who stated: "The vast majority of transit managerial personnel have 20 or more years in transit operations—most of this in a single system." For the present sample, the median number of years in the industry is 12.1, with median tenure at the present agency of 8.4 years.

TABLE 1 PROFESSIONAL EXPERIENCE

	N	Percent
Experience Prior to Current Position		
This agency	618	50.2
Other transit	140	11.4
Other transportation	88	7.1
Other public sector	90	7.3
Private sector (nontransportation)	190	15.4
Military	58	4.7
School	18	1.5
Other	29	2.4
Total	1,231	100.0
Years in Transit		
Less than 5	222	17.1
5–9	290	22.4
10–14	326	25.2
15–19	167	12.9
20–29	172	13.2
30 or more	118	9.1
Total	1,295	99.9
Years at Current Agency		
Less than 1	51	3.9
1–2	136	10.5
3–5	303	23.3
6–10	334	25.7
11–20	318	24.5
21–29	98	7.5
30 or more	59	4.5
Total	1,299	99.9
Present Position		
General manager/executive director	139	10.7
Other administration	130	10.0
Planning	174	13.4
Personnel	102	7.9
Operations director	110	8.5
Maintenance supervisor	130	10.0
Other operations	244	18.8
Marketing	52	4.0
Finance	124	9.6
Other management	91	7.0
Total	1,296	99.9

Second, only slightly more than half (50.2 percent) of respondents indicated that their primary experience prior to their current position had been with their present agency. Further, only 11.4 percent came to their present position from another transit agency. Thus the present cadre of transit managers tends to have less experience in transit. Further, there does not appear to be a pattern by which individuals shift from one agency to another as they pursue their careers.

TABLE 2 SAMPLE DISTRIBUTION AND AGENCY CHARACTERISTICS

	N	Percent
Number of Full-Time Employees		
Less than 25	40	3.1
25–99	170	13.3
100–499	287	22.4
500–999	113	8.8
1,000–1,999	160	12.5
2,000 and more	513	40.0
Total	1,283	100.1
Number of Vehicles		
Less than 50	168	13.2
50–99	154	12.1
100–249	164	12.8
250–499	125	9.8
500–999	215	16.8
1,000–1,999	258	20.2
2,000 and more	193	15.1
Total	1,277	100.0
Institutional Type		
City/county	331	25.4
Multipurpose	148	11.4
Special district	513	39.4
Nonprofit	168	12.9
Private	56	4.3
Other	85	6.5
Total	1,301	99.9

Most of the respondents are from agencies with more than 500 vehicles and more than 1,000 employees (see Table 2). Managers from larger agencies are expected to be less likely to express dissatisfaction with career advancement opportunities because of the greater number of promotional opportunities. Managers in smaller agencies are expected to indicate a desire to transfer to larger operations as a means of advancing their careers.

The educational background of the sample shown in Figure 1 illustrates the diversity of the current managerial cadre. Some 63.5 percent have at least a 4-year college degree. This figure represents a significant increase over the 14.8 percent who held 4-year college or university degrees in 1973 (Table 3) (*2*, p. 16). The data indicate that those without a college degree tend to be older, suggesting that the managerial core will increasingly include college graduates.

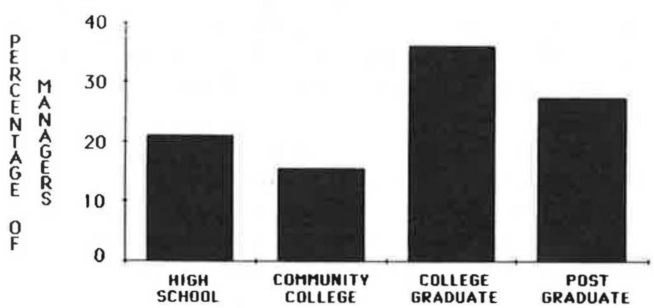

FIGURE 1 Education of transit industry managers.

TABLE 3 DEMOGRAPHIC CHARACTERISTICS

	N	Percent
Education		
High school degree	272	21.0
Community college	201	15.5
College graduate	468	36.1
Postgraduate work/other	356	27.4
Total	1,297	100.0
Educational Specialty		
General/liberal arts	96	9.0
Social science	101	9.0
Engineering	115	11.0
Business	362	34.0
Public administration	77	7.0
Education	27	2.0
Law	23	2.0
Transit	42	4.0
Planning	34	3.0
Other	102	9.0
None	105	10.0
Total	1,084	100.0
Age (years)		
20–30	110	8.5
31–40	555	43.1
41–50	330	25.6
51–60	237	18.4
61+	57	4.4
Total	1,289	100.0
Sex		
Female	195	15.7
Male	1,047	84.3
Total	1,242	100.0
Race		
American Indian	12	0.9
Hispanic	37	2.9
Asian	19	1.5
Black	93	7.3
White	1,106	86.7
Other	8	0.6
Total	1,275	99.9

Among those who indicate an educational specialty, business is the predominant discipline (33 percent). The presence of the large number of individuals who trained for a profession outside of core transit areas (operations or maintenance) raises the issue of whether the industry offers sufficient career opportunities to retain persons whose professional training is not directly related to transit.

Related to this issue is the finding that the median age of the sample is 40.6 years. In 1973, Mundy and Spychalski (*2*, p. 10) reported that the average age of different categories of managers ranged between 49 and 55 years. The managers in the present sample still have the bulk of their careers ahead of them, as shown in Figure 2, and will presumably evaluate their commitment to transit in terms of perceived opportunities to meet career goals. Should those opportunities be perceived to be limited, many will seek to transfer their professional skills to other industries.

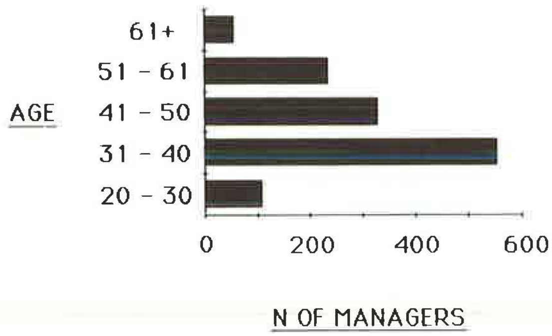

FIGURE 2 Manager responses by age group.

FIGURE 3 Where will you be in 5 years?

SHORT-TERM CAREER PLANS

To measure and estimate the degree to which retention of managers might be a problem for the industry, the survey asked the question: "Where do you see yourself in 5 years?" The responses to this question are shown in Figure 3.

Although these results describe anticipated rather than actual change, it is clear that should our respondents act on these expectations, transit will experience substantial movement by its managerial personnel during the next 5 years. Some 42.6 percent reported that they anticipated leaving their present agency. Further, more expected to leave transit and obtain employment in other industries (21.3 percent) than expected to move to positions in other transit agencies (13.2 percent). This finding conforms with the earlier indication that relatively few managers came to their present position from another transit agency. It further supports the notion that clear paths for career development within transit may be a problem for the industry.

The absence of comparative data makes it difficult to draw conclusions about the implications of these results for the industry. Nonetheless, they do suggest that the industry may be confronted with the need to replace a substantial proportion of its current managerial core, particularly with respect to the loss of over 20 percent to other industries. The next 5 years may see a significant loss of talent within the transit industry.

AGENCY CHARACTERISTICS AND CAREER PLANS

Table 4 presents the relationships between measure of agency size and organizational setting with career expectations. These results indicate that managers in small-to-moderate-sized agencies tend to be more likely than those in larger agencies to plan to leave their present place of employment and move to another agency. Those managers in larger agencies who plan to move are more likely to indicate that they will leave transit, as opposed to seeking a position in another agency. With respect to organizational setting, city and county agencies appear to have a somewhat greater retention problem, with a higher proportion anticipating a move to another transit agency.

INDIVIDUAL CHARACTERISTICS AND CAREER PLANS

Table 5 presents the relationships between individual characteristics and short-term career plans. A significant finding is that women are substantially more likely than men to indicate that they expect to leave the industry. Equally pronounced are the differences between managers with a 4-year college degree or graduate education and those with less formal education. Those with more education are less committed to continuing with their current agency and appear more likely to leave the industry. This trend is particularly striking among those who have continued their education past their baccalaureate degree. Over the next 5 years, the industry may lose many of its best-trained current managers and may have to take specific steps to address the concerns of this group. Finally, the ages of the respondents are significantly related to their career expectations. Those under the age of 40 are more likely to expect to leave their current agency and to leave the transit industry than are older respondents.

To some extent it was anticipated that those who were part of the baby-boom generation, defined here as the present 31–40 age group who had entered the transit industry during the period of expansion of the 1970s would be the most likely to feel the pressure of the current decline of promotional opportunities and therefore express a desire to leave their current agencies or the industry. However, the data indicate that the youngest age group is the most likely to expect to leave the industry.

CAREER PLANS AND PROFESSIONAL EXPERIENCE

Each of the measures of length of professional experience is significantly related to career expectations, with newer managers indicating that they are more likely to leave their present agency or leave the transit industry than those with longer seniority.

In general, these associations indicate that a substantial proportion of those who have been managers for 10 or fewer years are likely to leave the transit industry during the next 5 years. More of this group plans to leave the transit industry rather than pursue opportunities in a different transit agency. Even though many of these managers expect to continue with their current agencies, the results suggest that the industry may be confronted with substantial leakage to other industries of its managerial talent, particularly those who received their initial professional experience in transit and are only 5 to 10 years into their careers.

The relationship between managerial category and career plans also indicates some important distinctions among transit

TABLE 4 CAREER PLANS AND AGENCY CHARACTERISTICS

	Same Agency (percent)	Different Agency (percent)	Leave Transit (percent)	Retired (percent)	N
Number of Employees					
Less than 25	54.1	10.8	32.4	2.7	37
25–99	59.2	21.0	15.3	4.5	157
100–499	49.3	19.2	22.5	9.1	276
500–999	63.6	12.1	17.2	7.1	99
1,000–1,999	55.3	8.7	30.0	6.0	150
2,000 or more	61.6	8.0	20.3	10.1	474
Total					1,193
($p < 0.01$; $v = 0.12$)					
Number of Vehicles					
Less than 50	51.3	24.0	19.5	5.2	154
50–99	56.8	18.9	20.3	4.1	148
100–249	49.7	17.6	20.3	12.4	153
250–499	63.5	11.3	19.1	6.1	115
500–999	55.6	11.6	25.8	7.1	198
1,000–1,999	62.2	5.8	19.9	12.0	241
2,000 or more	62.9	7.4	22.3	7.4	175
Total					1,184
($p < 0.01$; $v = 0.11$)					
Organizational Type					
City/county	53.5	20.5	18.7	7.7	310
Multipurpose	58.7	6.5	24.6	10.1	138
Special district	56.4	11.7	23.5	8.5	472
Nonprofit	65.4	9.6	16.7	8.3	156
Private	79.6	7.4	9.3	3.7	54
Other	56.2	17.9	29.5	6.4	78
Total					1,208
($p < 0.01$; $v = 0.11$)					

TABLE 5 CAREER PLANS AND INDIVIDUAL DEMOGRAPHICS

	Same Agency (percent)	Different Agency (percent)	Leave Transit (percent)	Retired (percent)	N
Education					
High school degree	69.4	7.5	6.7	16.3	252
Community college	70.7	12.0	8.9	8.4	191
College graduate	54.9	12.9	27.1	5.1	435
Postgraduate work/other	43.9	18.7	31.9	5.8	326
Total					1,204
($p < 0.01$; $v = 0.19$)					
Age					
20–30	44.8	22.9	32.4	–	105
31–40	54.9	17.2	27.9	–	512
41–50	68.	11.4	18.2	2.3	307
51–60	62.8	5.4	8.5	23.3	223
61 or over	22.0	–	8.0	70.0	98
Total					1,245
($p < 0.01$; $v = 0.35$)					
Sex					
Female	50.3	13.3	34.8	1.7	181
Male	58.7	13.2	18.9	9.2	975
Total					1,156
($p < 0.01$; $v = 0.16$)					
Race					
American Indian	70.0	10.0	20.0	–	10
Hispanic	65.7	17.1	11.4	5.7	35
Asian	35.3	23.5	23.5	17.6	17
Black	69.2	13.2	14.3	3.3	91
White	56.6	12.8	22.0	8.7	1,027
Other	71.4	14.3	14.3	–	7
Total					1,187
($p < 0.05$; $v = 0.07$)					

TABLE 6 CAREER PLANS AND WORK EXPERIENCE

	Same Agency (percent)	Different Agency (percent)	Leave Transit (percent)	Retired (percent)	N
Experience Prior to Current Position					
This agency	61.7	11.0	18.5	8.9	574
Other transit	49.2	23.5	18.9	8.3	132
Other transportation	52.6	24.4	16.7	6.4	78
Other public sector	57.0	14.0	25.6	3.5	86
Private sector (nontransportation)	53.7	9.1	31.4	5.7	175
Military	63.6	3.6	20.0	12.7	55
School	38.9	16.7	27.8	16.7	18
Other	52.0	12.0	28.0	8.0	25
Total					1,143
($p < 0.01$; $v = 0.12$)					
Years in Transit					
Less than 5	45.5	13.9	36.6	3.9	202
5–9	52.0	16.5	29.3	2.2	273
10–14	60.8	16.0	19.0	4.2	306
15–19	67.9	13.5	14.1	4.5	156
20–29	71.1	7.5	10.7	10.7	159
30 or more	47.2	2.8	5.7	44.3	106
Total					1,202
($p < 0.01$; $v = 0.28$)					
Years at Current Agency					
Less than 1	53.2	17.0	27.7	2.1	47
1–2	46.0	21.8	31.5	0.8	124
3–5	43.4	20.4	33.2	2.9	274
6–10	61.8	12.9	21.5	3.8	317
11–20	68.7	8.0	13.7	9.7	300
21–30	80.5	2.3	3.4	13.8	87
30 or more	35.1	–	3.5	61.4	57
Total					1,206
($p < 0.01$; $v = 0.32$)					
Present Position					
General manager	38.5	27.0	24.6	9.8	122
Other administration	49.2	13.1	28.7	9.0	122
Planning	49.4	17.9	27.8	4.9	162
Personnel	61.1	4.2	26.3	8.4	95
Operations director	61.2	19.4	9.7	9.7	103
Maintenance supervisor	72.5	11.7	6.7	9.2	120
Other operations	71.1	8.2	11.2	9.5	232
Marketing	36.7	12.2	42.9	8.2	49
Finance	53.0	9.6	35.7	1.7	115
Other management	62.7	6.0	19.3	12.0	83
Total					1,203
($p < 0.01$; $v = 0.20$)					

managers. First, those who hold core transit positions in operations and maintenance are the least likely to indicate that they will be leaving the industry. Conversely, marketing and finance administrators are the most likely to indicate that they anticipate leaving the transit industry. General managers or executive directors seem to anticipate shorter tenures with their present agencies, but they generally appear to plan to continue their careers in the industry.

Overall, with the exception of core transit positions, nearly 35 percent of current managers expect to either leave transit or retire during the next 5 years. The distinctions among managerial categories also lend support to the earlier contention that the changes experienced by the industry have resulted in the development of an increasingly diverse managerial cadre. This cadre is better educated, younger, and trained in a broader array of professional disciplines than were their counterparts of 15 years ago. These differences have also made the problem of retention a more complex issue for the industry.

CAREER PLANS AND CAREER ADVANCEMENT

Eighty-four percent of the managers indicated that they did not plan a career in transit. This group was also asked to identify what their initial career plans had been and to indicate why they took a job with the transit industry. The questions asked and the responses given follow.

Did You Plan Career in Transit?

	N	*Percent*
Yes	205	16.0
No	1,079	84.0
Total	1,284	100.0

What Were Your Career Plans?

	N	*Percent*
No plans	118	12.0
Public transportation	27	2.7
Public nontransportation	265	26.9
Private transportation	38	3.9
Private nontransportation	500	50.8
Any job	37	3.8
Total	985	100.1

Why Did You Take a Job in Transit?

	N	*Percent of Responses*	*Percent of Cases*
Needed a job	188	17.9	21.4
Position relevant to training	308	29.3	35.1
Lack of opportunity to apply skills elsewhere	132	12.6	15.1
Pay/benefits	98	9.3	11.2
More responsibility	164	15.6	18.7
Like transit	86	8.2	9.8
Other	74	7.0	8.4
Total	1,050	100.0	119.7

The total number of respondents was 877; multiple responses occurred.

Not only did most not plan a career in transit, nearly the same proportion (77.7 percent) did not plan a career in any part of the transportation industry. Further, most planned to pursue a career in the private sector. These results indicate that commitment to the industry is not an attitude that is instilled as part of the education and training experience of those who became transit managers. The diversification of the management cadre has meant that many if not most do not train for transit or do not work up through the ranks of a transit agency. Rather, many train for a profession and find transit to be one of many possible industries to apply that training.

The reasons given for taking a job in transit amplify the problem. Slightly more than half of those responding indicated that they entered the industry because the position provided an opportunity relevant to their professional training. By implication, retention of these individuals will be affected by their perceptions of the opportunities offered by transit to develop and advance the skills for which they have trained. As is shown in Tables 7 and 8 the perceptions of the sample about development and advancement opportunities are not very positive.

Most of the respondents indicate that they are satisfied with their present positions. The major variations are found in the somewhat lower proportions of those in the new professional positions of planning, personnel, marketing, and finance indicating that they are satisfied or very satisfied with their present positions. From the perspective of managerial retention, it is encouraging that in none of these categories do more than 15 percent express dissatisfaction with their current positions.

However, perceptions of career development and advancement opportunities are much less positive and, perhaps, begin to define at least one of the central dimensions of the retention problem. Only in the cases of general managers and operations personnel did majorities indicate that they were satisfied or very satisfied with career opportunities in transit. The new management groups were to a significant degree more likely to express dissatisfaction with opportunities in the industry.

The evaluations of the advancement opportunities offered by present agencies and the industry lend further support to this assessment. None of the different manager classes is particularly optimistic about future advancement in their present agencies. With the exception of operations directors and maintenance supervisors, more rate advancement opportunities in their current agency as poor to very poor than good to very good. The respondents are somewhat more optimistic about advancement opportunities offered by the industry. However, with the exception of operations directors, fewer than half of those in each group rated these opportunities as good to excellent.

To further refine the issue of career advancement, the managers were asked to state how they could advance their careers more rapidly. The results given Table 9 suggest two conclusions. First, the most frequent response was the need for more education given by 37.3 percent of the respondents (see also Figure 4). Open-ended comments from the sample indicated a desire for either more education or more training in transit or management. Second, some 23.1 percent indicate that moving from their present agency would be the best way to advance their careers (11.8 percent leaving transit, 11.3 percent going to a different agency).

TABLE 7 ATTITUDES AND PERCEPTIONS

Position	Very Satisfied	2	3	4	Very Unsatisfied	*N*
Managerial Position and Career Attitudes						
General manager	46.0	36.0	10.8	5.8	1.4	139
Other Administrator	31.5	42.3	18.5	4.6	3.1	130
Planning	20.1	46.6	17.2	11.5	4.6	174
Personnel	23.5	39.2	23.5	10.8	2.9	102
Operations director	36.7	42.2	13.8	5.5	1.8	109
Maintenance supervisor	27.9	41.9	19.4	7.0	3.9	129
Other operations	27.9	38.9	18.9	7.0	7.4	244
Marketing	17.3	51.9	28.8	–	1.9	52
Finance	21.8	45.2	25.8	5.6	1.6	124
Other management	28.6	50.5	17.6	2.2	1.1	91
Total						1,294
($p < 0.01$; $v = 0.12$)						
Satisfaction with Career Opportunities in Transit						
General manager	22.6	36.5	24.8	11.7	4.4	137
Other Administrator	18.5	30.0	30.8	14.6	6.2	130
Planning	13.2	33.9	28.7	21.3	2.9	174
Personnel	19.8	24.8	32.7	12.9	9.9	101
Operations director	32.7	39.1	16.4	16.0	1.8	110
Maintenance supervisor	27.7	40.0	20.0	8.5	3.8	130
Other operations	24.6	31.1	25.5	11.5	7.0	244
Marketing	9.6	34.6	26.9	19.2	9.6	52
Finance	10.5	26.6	45.2	19.5	3.2	124
Other management	16.5	35.2	31.9	14.3	2.2	91
Total						1,293
($p < 0.01$; $v = 0.13$)						

TABLE 8 ADVANCEMENT OPPORTUNITIES

Position	Excellent	2	3	4	Very Poor	*N*
Advancement Opportunities in Current Agency						
General manager	4.3	26.1	35.5	21.0	13.0	138
Other Administrator	7.7	26.2	33.1	22.3	16.8	130
Planning	3.5	23.7	37.6	20.8	14.5	173
Personnel	4.9	18.6	34.3	23.5	18.6	102
Operations director	12.7	26.4	26.4	20.9	13.7	110
Maintenance supervisor	7.7	24.6	42.3	17.7	7.7	130
Other operations	7.4	24.8	33.5	19.4	14.9	242
Marketing	–	17.3	30.8	36.5	15.4	52
Finance	5.8	21.1	40.7	18.7	13.8	123
Other management	4.4	24.2	37.4	25.3	8.8	91
Total						1,291
($p > 0.05$; $v = 0.09$)						
Advancement Opportunities in Transit						
General manager	6.5	41.0	38.8	12.2	1.4	139
Other Administrator	7.9	39.7	38.9	11.1	2.4	126
Planning	6.4	33.1	44.8	14.0	1.7	172
Personnel	8.2	26.8	47.4	15.5	2.1	97
Operations director	11.0	40.4	40.4	8.3	–	109
Maintenance supervisor	10.6	35.8	44.7	8.9	–	123
Other operations	11.4	38.0	37.6	8.9	4.2	237
Marketing	–	24.5	57.1	16.3	2.0	49
Finance	5.0	32.5	49.2	12.5	0.8	120
Other management	2.2	35.6	47.8	11.1	3.3	90
Total						1,262
($p > 0.05$; $v = 0.10$)						

TABLE 9 WAYS TO RAPIDLY ADVANCE CAREER

	N^a	Percent of Responses	Percent of Cases
Nothing	105	11.9	14.1
More experience	258	29.2	34.6
More education	278	31.4	37.3
Leave transit	88	9.9	11.8
Different agency	84	9.5	11.3
Not sure	24	2.7	3.2
Other	48	5.4	6.4
Total	885	100.0	118.7

[a]Total number of response was 746; multiple responses occurred.

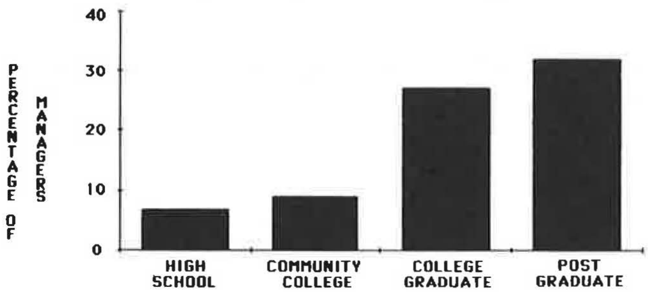

FIGURE 4 Future educational plans.

The generally negative perceptions of career development and advancement opportunities offered by the industry would seem to be a major component of the retention problem, particularly with respect to the new professionals. Although most are satisfied with their present position, this path of career development is perceived as being either unclear or nonexistent. Many see further education as a vehicle for future development, but a substantial proportion believe that movement from their present agency or from the industry offers the best prospects. This point is consistent with the earlier finding that over the next 5 years, more managers expect to leave the industry (21.3 percent) than shift to a different transit agency (13.2 percent).

SUMMARY

To the extent that the sample is representative of industry managers, there have been some significant changes in the character of the management cadre since Mundy and Spychalski *(2)* reported their findings in 1973. Current managers are younger, more highly educated, and more diverse in terms of training specialization and current function. Further, most did not plan to pursue a career in transit, and nearly half came to their present position from outside their current agency. These changes reflect the dynamic character of the industry resulting from a period of expansion and increased utilization of new management specialties.

The findings also indicate that with the changing character of the management core there has developed at least the potential of a serious problem in managerial retention. This problem was found to be particularly true for the new professionals, as opposed to those in core transit positions. Should the respondents follow through on their stated intentions, the industry will experience substantial managerial turnover during the next 5 years, not just in terms of switching from one agency to another but also in terms of qualified, trained individuals leaving the industry altogether.

A central dimension of the problem lies in the lack of positive views about the opportunities for future career development and advancement opportunities offered by individual agencies and by the industry. Although most of the respondents express satisfaction with their present positions, many, particularly newer managers, appear negative about transit as an industry offering opportunities for professional growth. These individuals are simply more likely to indicate that they plan to leave not only their present agencies but also the industry.

Three factors may be related to this trend: (a) the training and experience of new managers as these are related to commitment to the industry, (b) the possible lack of a clear career ladder within the industry, and (c) the end of the period of rapid expansion, decreasing the availability of promotional opportunities. With respect to the first factor, the findings indicate that concomitant with the changing character of the management core is the increasing specialization within professional disciplines. Nearly half of the sample came from outside their present agency and most did not plan a career in transit. The most common reason given for entering the industry was that it provided an opportunity to practice the profession for which these managers had trained. The change from the up-from-the-ranks character of managers has resulted in a lesser degree of commitment to the industry and a greater willingness to pursue opportunities elsewhere.

The lack of a clear path for career development in the industry is suggested by two findings. First, only some 11.4 percent of the respondents came to their present position from another transit agency. Second, only 13.2 percent plan to shift to another agency during the next 5 years. This contrasts with the 21.3 percent who plan to leave the industry. In general, little evidence exists that career development in transit includes shifts from one agency to another. Rather, the respondents indicate that they will either stay with their present agency or leave the industry. Whether those staying with their current agency will find significant promotional opportunities is unclear. Our respondents are generally positive. The changing character of the industry, however, suggests that time spent with a given agency is no longer a guarantee of advancement.

The third factor, decline in promotional opportunities, is not directly gleaned from the data. Rather, it is a more general factor resulting from the end of the period of rapid industry growth and changing federal policy. Additionally, Douglas Hall *(5)* has observed:

> . . . in today's leaner, flatter organizations, senior leadership is more critical than ever. Also, with fewer senior slots available, the consequences of a poor fit in any one position are quite serious. And with large numbers of talented, educated "baby boomers" from which to choose, there is more need for good methods of identifying high-potential candidates (*5*, p. 7).

As the industry has entered a period of slow growth, the promotional opportunities for managers hired in the last 10 to

15 years have declined. Many of these individuals are trained in particular disciplines that are not directly dependent upon transit (e.g., marketing and planning). Further, the data indicate that many do not see promotional or even lateral moves within the industry as a central part of their career planning. Thus many entry- and middle-level managers plan to take their skills elsewhere.

These three factors affect the perceptions of the current managerial core regarding future opportunities in the industry. The generally pessimistic attitude expressed by the sample raises the possibility of substantial losses of managerial talent for the industry over the next 5 years. With the exception of the directly transit-related managerial functions of operations and maintenance, many current managers anticipated acting on their perceived mobility, with the result that the industry may face future problems not only retaining current talent but also recruiting replacements for those who in fact follow through on their stated intentions.

REFERENCES

1. *Special Report 207: Transportation Professionals: Future Needs and Opportunities*. TRB, National Research Council, Washington, D.C., 1985.
2. R. A. Mundy and J. C. Spychalski. *Managerial Resources and Personnel Practices in Urban Mass Transit*. Pennsylvania State University, University Park, 1973.
3. C. White, S. M. Edner, and K. Ketcheson. Management Recruitment in the Transit Industry. In *Transportation Research Record 1077*. TRB, National Research Council, Washington, D.C., 1986, pp. 39–47.
4. C. White and S. M. Edner. *Transit Agency Characteristics: An Industry Profile*. UMTA–OR–11–0002–86–2). UMTA, U.S. Department of Transportation, June 1986.
5. D. T. Hall. An Overview of Current Career Development Theory, Research and Practice. In *Career Development in Organizations* (Douglas T. Hall and Associates, eds.), Jossey-Bass, San Francisco, 1986.

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Attitudes of Transit Employees Toward Merit Pay

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Merit pay programs are the most widely used financial incentive program among urban mass transit systems. An attitude survey was conducted at a large transit system to determine how employees perceived the merit pay program in which they participated. Employee attitudes toward the merit pay system were mixed. Their perceptions of the accuracy of the performance evaluation were quite negative. However, employees as a whole favored a system in which pay increases are not based on seniority and are not general increases.

The declining growth rate of productivity in the United States relative to other nations is a matter of increasing concern in both the private and public sectors. Productivity, or the efficiency with which goods and services are produced, represents a means of maintaining economic growth, retaining foreign markets, reducing unemployment, and controlling inflation. Because the cost of labor is a major factor in the production of goods and services, increasing the output of human resources is a major element in reversing productivity decline. In view of the economic realities of our times, Americans are finding that a commitment to quality in addition to quantity is essential. To be unresponsive to this issue will ensure further erosion of the marketplace and even tighter resource constraints. Because urban mass transit provides direct service to the public and because it represents a major cost to state, local, and federal governments, it receives close public scrutiny when scarce resources are allocated.

In response to these pressures for increased productivity and better quality of service, private and public sector organizations are reexamining the use of financial incentive programs. A financial incentive in the generic sense is any program in which pay is contingent on individual or group performance. Unlike wages and salaries that are payment for satisfactorily performing a particular job (termed "position pay"), incentive pay is determined by how well the employee does on one or more performance criteria, usually judged in terms of quality and quantity of performance. These performance criteria may include supervisor appraisal of employee behavior or goal accomplishment, overall unit profits and earnings, realized labor cost savings, number of units produced, growth in sales, and so forth. Incentive pay is designed so that an individual's pay may increase or decrease over time on the basis of that person's performance or contribution to the organization's productivity.

A survey conducted by the Conference Board *(1)* found that over 90 percent of the responding companies used a merit pay program. A survey of the transit industry by Scott and Deadrick *(2)* found that merit pay was the most popular financial incentive program among transit authorities, with 30 percent of respondents reporting they had a merit pay program. There were numerous variations of merit pay plans, each of which evolved as organizations tailored the program for their own use. This wide adaptability of the plan has contributed to its popularity.

Financial incentive programs are not as common in the public sector, generally because of political barriers and such limiting factors as civil service policies and procedures. Much of the public sector employment policies are controlled by legislation and regulation, and thus the freedom to institute innovative employment programs has been limited. However, recent public sector interest in such programs may be attributed to the belief that the use of financial incentive programs such as merit pay plans represents an innovative strategy that can help contain costs and show taxpayers that high performance and productivity are of value to government.

Merit pay programs award pay increases to employees on the basis of their level of performance for a specified time period. Merit pay programs are designed to pay different amounts to individuals, depending on the degree of performance. In a typical merit pay program, the overall merit budget is established by top management and is based on either the past financial performance of the organization, expected future performance, or ability to pay. The merit budget is designed to reward only those employees who have performed at a high level during the past period. This is not a general increase that enables the organization to maintain competitive wages relative to the labor market or a cost-of-living adjustment to protect employees from inflationary pressures.

The overall merit budget is then divided among the organization's various departments, usually on the basis of a percentage of each unit's labor costs in wages and salaries. For example, if one department had 15 employees whose wages and salaries totaled $400,000 annually, a merit budget of 5 percent would be $20,000. Thus this department head would receive $20,000 to distribute among deserving and eligible employees through the individual supervisors. Under most merit pay plans, the merit reward represents a permanent increase in the employee's salary and thus represents a permanent increase in the organization's total labor costs.

Some method of measuring individual performance is required for merit increases. Performance evaluations or appraisals are conducted periodically and are usually supervisory judgments as to the level of employee performance. Behaviorally anchored rating scales (BARS), management by

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objectives (MBO), and graphic rating scales represent methods of measuring individual performance *(3)*.

Because an employee's merit increase becomes a permanent part of the employee's pay, distortion in the compensation system may occur. To retain an equitable relationship among the jobs and the employees holding those jobs, the compensation structure usually specifies pay ranges for each position. Once the person reaches the top of the pay range, he or she cannot receive another merit pay increase unless the pay structure is adjusted upward *(4)*. The midpoint of the pay range reflects the level at which an average, fully trained employee should perform *(2)*.

RESEARCH ON MERIT PAY

An extensive review of the theoretical and empirical literature on merit pay was conducted. Although space limitations preclude a detailed treatment of this large body of literature, a brief review of representative articles is provided to identify employee attitudes critical to successful merit pay programs and thus establish a basis for the scales used in this study.

A review of the literature uncovered 94 articles on merit pay. A majority of these articles were simply descriptive or conceptual in nature. At best, these descriptive articles suggest rules of thumb that outline certain conditions that must be present if merit pay is to elicit improved job performance. In these articles, it is suggested that for money to motivate improved job performance:

- Money must be a reward valued by employees *(5, 6)*.
- Money must be valued highly relative to other rewards *(7)*. [Although money may be important to an individual, it may not be the primary motivating force. For example, an individual may be more highly motivated by the nature of the work itself or need for affiliation then by money *(8)*.]
- Workers must perceive that pay is tied to performance *(9, 10)*.
- Employees must believe that effort will lead to successful job performance *(5, 11)*.
- Pay increases must be large enough to be meaningful *(11–13)*.
- Employees must perceive that performance can be and is accurately measured *(11, 14)*.
- High levels of trust are necessary if merit pay programs are to be accepted by employees and have the intended motivational effects *(6, 12)*.
- Good communication is essential to successful merit pay programs *(9, 15)*.

Only 16 articles empirically evaluated the effects of merit pay programs in use. Selected empirical studies are discussed in the following paragraphs. One important study by Marriott *(16)* focused on employee attitudes about merit pay plans. The most important finding was that the firm's performance appraisal system did not distinguish among workers' levels of performance, and most employees were dissatisfied with the pay program.

In a study of 31 engineers and 33 nonprofessional workers, Giles and Barrett *(17)* investigated the relationship between merit increases and individual satisfaction. Their findings indicated that each additional dollar increase in merit pay had additional value to employees. Greene and Podsakoff *(18)* conducted a field study in which a merit system was discontinued in a plant. The satisfaction of the higher performers greatly decreased, whereas the low performers became more satisfied and more productive. In a study of 1,165 nonsupervisory, white collar employees, Kopelman et al. *(19)* examined the linkage between performance and rewards for various merit pay programs. It was found that having a wide range of available rewards increases overall performance. Strong linkage between performance and rewards resulted in high achievement.

The literature reviewed suggests that pay must be linked to performance if money is to motivate improved job performance. However, the fact that pay is linked to performance is no guarantee that employees will perceive this to be the case. Employee perceptions of performance appraisal fairness and accuracy should be positively related to employee perceptions that pay is linked to performance, a precondition for successful merit pay programs. In this study, employee perceptions of the performance evaluation system and the merit pay plan are examined.

RESEARCH METHODOLOGY

Research Location

A large number of transit authorities were considered for the current research project. Site selection criteria included (a) a merit pay program that had been functioning 2 years or more, (b) a large organization that would yield sufficient sample size to perform the required statistical analyses, (c) a performance appraisal system that quantified individual performance scores, (d) the availability of pay and performance data for a 2-year period, and (e) the transit authority's expression of strong support for the research study and willingness to commit employee time to the study.

On the basis of the evaluation of a number of potential candidates, a large transit authority located on the West Coast was chosen as the research site for this project. This transit authority has over 3,000 employees, approximately 1,000 of which participate in the merit pay plan. During Fiscal Year 1984–1985, this transit authority maintained a fleet of over 1,000 buses and carried in excess of 200,000,000 passengers.

Performance Appraisal System

This transit authority has a merit pay policy that requires that a performance evaluation be completed annually for every nonunion employee. By policy, these annual evaluations are to be completed by supervisors during the month of June each year. The evaluation requires the supervisor to examine the work habits of employees (i.e., attendance and punctuality, safety, and observance of rules and regulations) and employee performance on job-related tasks. The supervisor is required to combine this information into an overall judgment of performance. Individuals are awarded a performance evaluation along a five-point continuum including (a) unsatisfactory, (b) needs improvement, (c) competent, (d) superior, and (e) outstanding.

Merit Pay System

The merit pay system used in this research is similar to the general merit pay systems described previously. Merit pay increases at this transit authority were based on an individual's performance evaluation score and position in the wage structure. No general pay increases were given, and in only a few cases were structural adjustments made to an individual's pay. There were structural changes in the pay ranges associated with the pay structure. Pay ranges were adjusted upward 8.5 percent in 1983, 3.5 percent in 1984, and 4.0 percent in 1985. It is again pointed out these were not general increases given to employees but were simply changes in the pay range, that is, changes in the amount an individual could potentially earn. To move up in the pay range, an individual must still get merit increases based on performance. The merit increases averaged 7.8 percent for 1983, 5.5 percent for 1984, and 5.2 percent for 1985. Employees receive the merit increase on July 1 each year.

Data Collection

On the basis of the review of the merit pay literature, a questionnaire was designed to measure employee perceptions of the merit pay process, the performance appraisal process, and other work-related issues critical to successful merit pay programs. This questionnaire was administered to nonunion employees who were eligible for merit pay increases. The Likert-type questions and responses are listed in Tables 1–6. Employees were presented with a statement with which they could strongly agree (SA), moderately agree (MA), somewhat agree (?A), somewhat disagree (?D), moderately disagree (MD), or strongly disagree (SD).

The questionnaires were pilot tested at a transit authority located on the East Coast. Following the pilot questionnaire administration, a debriefing was held in which participants were asked to comment on any potential problems with the questionnaires. On the basis of information obtained in the pilot study, several small changes were made in the questionnaires to improve clarity and employee understanding.

A research team from Virginia Polytechnic Institute and State University administered the questionnaires. Employees were notified by memoranda from the personnel department of the transit authority and were requested to attend one of the scheduled sessions to fill out the questionnaires. Eighteen 1-hr sessions were scheduled; although participation was not mandatory, it was strongly encouraged.

Sample Characteristics

Of the 1,425 employees eligible to participate in the study, 842 completed the employee questionnaire for a participation rate of 59 percent. The sample consisted of white collar and supervisory nonunion employees who were eligible to participate in the merit pay program. The age of respondents ranged from 26 to 67, with a mean of 44.8 years. Length of service of respondents ranged from 1 to 44 years, with an average tenure of 13.5 years. Some 78 percent of the respondents were male, and 22 percent were female. A wide variety of ethnic backgrounds was represented in the sample. Some 26 percent were black, 55 percent were Caucasian, 7 percent were Asian or Pacific islanders, and 13 percent were Hispanic. Respondents also exhibited a varied educational background, with 8 percent having high school diplomas, 43 percent having some college, 21 percent having a college degree, 11 percent having some graduate work, and 15 percent having a master's degree or higher. Only 1 percent of the respondents had less than a high school diploma.

Importance of Pay

To assess the value that respondents attached to pay, individuals were asked to rank the importance of seven different job characteristics. The average rank assigned to the seven job characteristics in order of importance (1 was most important) was 2.4 for wages or salary, 3.2 for type of work, 3.3 for job security, 3.4 for opportunity for promotion, 3.9 for recognition for good work, 4.3 for working conditions, and 5.3 for friendly coworkers. Of the seven job characteristics investigated, money was on average the most valued reward among study participants.

Attitudes Toward Performance Evaluation

Performance evaluations are a vital part of merit pay systems because it is the performance evaluation that drives the recommendation for a merit increase for an employee. A series of questions was asked to try to understand how employees feel about the performance evaluation process. One of these questions asked the employee to indicate how satisfied they were with their last performance appraisal (Table 1, Question 1).

The most startling observation about the results of this question is that employees appear to fall into two extreme groups. There is a substantial proportion (21 percent) who are highly satisfied with their last performance evaluation; however, there is also a substantial proportion (28 percent) who are highly dissatisfied with their performance evaluation. Clearly, employees are sharply divided in their attitudes toward satisfaction with their performance evaluations.

Further insight into employees' attitudes about the performance evaluation process can be gleaned from two additional questions that were asked. One of these questions asked if employees felt their last performance review was consistent with actual job performance (Table 1, Question 2). As with satisfaction with the performance evaluation, employees are strongly divided in their attitudes toward the accuracy of the evaluation process. Some 21 percent strongly agree that their last review is consistent with actual performance, whereas 28 percent strongly disagree with the statement.

A second way to ask the same question is to ask employees to react to whether their evaluation was too high or too low (Table 2, Question 3). Consistent with earlier questions, it is again apparent that employees are about equally split between those who think their performance evaluations were about right

TABLE 1 SATISFACTION WITH PERFORMANCE APPRAISAL

Question	Frequency of Responses[a]						
	SA	MA	?A	?D	MD	SD	NA
1. I am very satisfied with the last performance evaluation I received.	174 (21%)	144 (17%)	103 (12%)	72 (9%)	78 (9%)	228 (28%)	30 (4%)
2. My last performance evaluation was consistent with my job performance.	172 (21%)	143 (17%)	105 (13%)	80 (10%)	72 (9%)	229 (28%)	32 (4%)

[a]Percentages do not add to 100% because of roundoff error.

TABLE 2 ACCURACY OF PERFORMANCE APPRAISAL

Question	Much Too High	Too High	About Right	Too Low	Much Too Low
3. Compared to your actual level of performance, do you believe your performance rating was:	5 (1%)	10 (1%)	363 (45%)	348 (43%)	75 (9%)

[a]Percentages do not add to 100% because of roundoff error.

TABLE 3 FEEDBACK

Question	Frequency of Responses[a]						
	SA	MA	?A	?D	MD	SD	NA
4. I received enough feedback concerning the quantity of my output on the job.	148 (18%)	158 (19%)	163 (20%)	134 (16%)	100 (12%)	121 (15%)	10 (1%)
5. I am provided with sufficient feedback on the quality of my work.	154 (18%)	167 (20%)	163 (20%)	145 (17%)	88 (11%)	113 (14%)	6 (1%)

[a]Percentages do not add to 100% because of roundoff error.

TABLE 4 MERIT PAY

Question	Frequency of Responses[a]						
	SA	MA	?A	?D	MD	SD	NA
6. Merit increases accurately reflect an individual's job performance.	58 (7%)	63 (8%)	107 (13%)	131 (16%)	111 (13%)	356 (43%)	10 (1%)
7. This organization gives pay increases on the basis of job performance.	53 (6%)	79 (10%)	151 (18%)	116 (14%)	117 (14%)	302 (36%)	12 (1%)
8. My last pay increase was consistent with my job performance.	77 (9%)	99 (12%)	107 (13%)	118 (14%)	108 (13%)	296 (35%)	34 (4%)
9. I was very disappointed with the size of my last pay increase when I think about what other employees received.	190 (23%)	82 (10%)	125 (15%)	133 (16%)	112 (13%)	125 (15%)	69 (8%)
10. I am very satisfied with the last merit increase I received.	63 (8%)	114 (14%)	124 (15%)	115 (14%)	105 (13%)	274 (33%)	43 (5%)

[a]Percentages do not add to 100% because of roundoff error.

TABLE 5 SUPERVISOR ALLOCATION OF PAY INCREASES

Question	Pay Increase Factor	Average Rank
11. The purpose of this question is to find out what you think were the most important factors determining your last pay increase. Please rank the five items listed below according to how important you think they were to your supervisor in determining your last individual pay increase. Place a 1 by the item you feel was most important, a 2 by the item you consider the second most important, and so on.	My friendship with the supervisor.	3.3
	My length of time with the supervisor.	2.6
	My length of time with the organization.	2.6
	My performance.	1.7
	My economic need.	4.2

TABLE 6 EMPLOYEE PREFERENCE FOR ALLOCATION OF PAY INCREASES

	Frequency of Responses[a]						
Question	SA	MA	?A	?D	MD	SD	NA
12. In my job, all employees should get the the same percentage pay increase.	205 (25%)	58 (7%)	76 (9%)	132 (16%)	95 (11%)	262 (31%)	10 (1%)
13. To be fair, everyone in my job should get the same percentage pay increase.	167 (20%)	50 (6%)	74 (9%)	135 (16%)	98 (12%)	297 (36%)	10 (1%)
14. Pay increases should be based primarily on length of service.	51 (6%)	63 (8%)	105 (13%)	165 (20%)	118 (14%)	331 (40%)	3 (0%)
15. In my job, the largest pay increases should go to the most senior employees.	37 (4%)	41 (5%)	66 (8%)	176 (21%)	120 (14%)	387 (46%)	9 (1%)

[a]Percentages do not add to 100% because of roundoff error.

(45 percent) and those who think that their performance evaluations were too low (43 percent).

Still another way to obtain insight into employees' attitudes toward the performance evaluation process, in general, is to ask employees if they receive enough feedback from their supervisor. Two such questions were asked; one dealing with quantity of output, and another dealing with quality of output (Table 3, Questions 4 and 5). Employees are also strongly split over the amount of feedback they received about both the quantity and quality of their output. Over half of the employees tend to agree that they receive enough feedback, but a substantial minority (over 40 percent) tend to disagree that they receive adequate feedback.

The information on employee attitudes toward the performance evaluation process suggests that a sizable minority is dissatisfied with the appraisal system. Further, that sizable minority appears to believe that they do not receive adequate feedback in terms of quantity or quality of output.

Attitudes Toward Merit Increases

Employees were asked whether or not merit increases, in general, were linked to performance level. This question was asked of employees in two different ways, as indicated in Table 4, Questions 6 and 7. The responses to these two questions provide startling results: 72 percent of the employees disagreed with the statement that merit increases accurately reflect an individual's job performance. Further, 43 percent strongly disagreed. Employee responses to Question 7 in Table 4 reflect similar patterns of responses, indicating that employees strongly disagree with the assertion that merit raises reflect job performance.

Employees were also asked if their last pay increase was consistent with their performance (Table 4, Question 8). On the basis of the responses, it is clear that most employees disagree with the statement that their last increase was reflective of job performance. Some 62 percent disagreed to one degree or another with the statement. Further, 35 percent strongly disagreed with the statement, whereas only 9 percent strongly agreed with the statement.

The questions discussed so far have asked the employees to give their opinions about merit increases and performance. Yet another way for employees to assess their merit increase is to ask them to think about their merit increase relative to other employees (Table 4, Question 9). Interestingly, there is not the same kind of consistency of results when employees compare their own raises to those of other employees. In fact, employees are highly dispersed all the way from strongly agree (those who are disappointed with their raises) to strongly disagree.

Finally, employees were asked to share their attitudes about satisfaction with their last merit increase without specifying a relationship to performance or how other employees came out in the pay increase process (Table 4, Question 10). Some 59 percent of the employees expressed a degree of dissatisfaction with their last merit increase and one-third of the employees strongly disagreed that they were satisfied with their pay raise. These responses suggest that something may be wrong with the merit pay system because such a large proportion of employees are so dissatisfied with the merit pay increases they received.

Supervisor Decision Rules for Pay Raises

Earlier employee opinions indicate that there is considerable dissatisfaction with their last pay raises. The responses also indicate that employees do not feel their last performance evaluation reflected their true performance level. It is therefore worth exploring what criteria employees felt their supervisors used in making pay increase decisions. Question 11 in Table 5 poses this issue to employees. The results in Table 5 are surprising, considering that employees are so dissatisfied with their performance appraisals an pay increases. Respondents were asked to rank which factors were most important for determining pay increases (the smaller the number, the higher the ranking). The data suggest that employees do believe that supervisors used performance as the most important criterion in making pay increase recommendations.

Employees' Criteria for Pay Increases

One of the most important questions that needs to be answered when auditing merit pay systems is the following: "Do employees want pay to be based on individual merit?" Unfortunately, obtaining the answer to such a question is not easy because to disagree with the concept of merit is about as popular as disagreeing with motherhood and apple pie. Therefore, the method used was to ask a series of other questions, which appear in Table 6 along with employee responses. Questions 12 and 13 in Table 6 ask if all employees should get the same pay increase. Most employees strongly disagree with this statement. Questions 14 and 15 in Table 6 ask employees if they would like to have pay increases based on seniority. Again, the data indicate there is strong disagreement with using seniority for granting pay increases. Further, employees believe that supervisors use performance to make pay increase decisions (Table 5, Question 11). However, they apparently think the supervisors' evaluations are biased because they do not agree that their performance is reflected in their performance evaluation (Table 1, Question 2; Table 2, Question 3) or their merit pay increases (Table 4, Questions 6–8). These data suggest the need to train supervisors in performance evaluation and the need to better articulate how the merit pay program is administered.

CONCLUSIONS

The employee attitudes reported here suggest some interesting, albeit paradoxical, conclusions. First, employees at this transit authority definitely believe in merit pay as a concept. This attitude is reflected in the fact that they want their performance to be the basis for their pay increases. The strength of this association is also reflected in their rejection of both equal pay raises and seniority as possible pay increase criteria.

Second, these employees for the most part believe that their supervisor used past performance as a criterion for making pay increases. In other words, in the employee's mind it was performance, and not favoritism or other criterion, that their supervisor used in allocating pay increases.

However, this merit pay system is not functioning as effectively as it might because there is extreme dissatisfaction overall with the merit pay system, indicated by the 60 percent who express some degree of dissatisfaction with their merit increase. Several possible causes may be contributing to this dissatisfaction. A most probable cause is that employees disagree with their supervisor's assessment of their performance. This disagreement is reflected in the fact that the supervisor's rating of an employee's performance is frequently not consistent with the employee's own perceptions of his or her performance. It is also reflected in the fact that a sizable group of employees do not think that feedback from their supervisors is adequate. Furthermore, a strong correlation existed between satisfaction with merit increase and satisfaction with performance evaluation ($r = 0.675$, $p < 0.0001$). Thus, although employees believe in the merit pay concept, the merit pay program at this property is breaking down because of what the employees perceive as an inaccurate performance evaluation system.

A second possible explanation for the paradoxical nature of these data is simply that the size of the pay increase was so small that employees did not see it as reflective of their true performance. In any event, employees did not believe that the system rewards their performance. This fact undermines the entire concept of a merit pay system.

Finally, these data suggest that more work needs to go into training supervisors in conducting performance evaluations. The data suggest that supervisors need to do a better job of providing feedback to employees on the quantity and quality of their work. Frequent and accurate feedback allows the employee to know how he or she stands in the eyes of the supervisor at all times. Further, if the employee and supervisor then come to see the employee's performance in the same way,the satisfaction level with the performance evaluation process should increase. Such training will therefore result in a more effective merit pay program that should in turn result in higher employee and transit property productivity.

The results obtained in this research are generalizable to a variety of organizations. The research site involved in this study has a merit pay and performance appraisal system similar to those found in other public and private sector organizations. In fact, the research site was selected to ensure that the merit pay and performance appraisal systems were representative not only of other transit authorities but of industry in general.

Furthermore, numerous researchers have compared public and private sector employees with respect to reward preferences. Nowlin *(20)* compared factors that motivate public and private sector managers and concluded that money is a reward highly valued by both public and private sector managers. Newstrom et al. *(21)* compared reward preferences in a sample of 354 employees from business organizations and a city government. Results indicated that both public and private sector employees attached equal importance to pay as a reward. As such, in general, there is a great deal of similarity in reward preferences among public and private sector employees.

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REFERENCES

1. *Compensatory Employees—Lessons of the 1970's.* Conference Board, New York, 1976.
2. K. D. Scott and D. L. Deadrick. *The Influence of Financial Incentive Programs on Employee Performance and Organizational Productivity Within the Mass Transit Industry.* Report UMTA-VA-11-0013, UMTA, U.S. Department of Transportation, 1984, p. 23.
3. G. T. Milkovich and W. F. Glueck. *Personnel/Human Resource Management: A Diagnostic Approach.* 4th ed., Business Publications, Inc., Plano, Tex., 1985, p. 372.
4. G. T. Milkovich and J. Newman. *Compensation.* Business Publications, Inc., Plano, Tex., 1984, pp. 342–344.
5. E. E. Lawler. *Pay And Organizational Effectiveness: A Psychological View.* McGraw-Hill, New York, 1971, pp. 157–177.
6. R. Collins. Incentive Programs: Pros and Cons. *Personnel Journal,* July 1981, pp. 571–575.
7. F. S. Hills. The Pay-for-Performance Dilemma. *Personnel,* Sept.-Oct. 1979, pp. 23–31.
8. F. S. Hills. *Compensation Decision Making.* Dryden Press, Hinsdale, Ill., 1987.
9. E. E. Lawler. Merit Pay: Fact or Fiction? *Management Review,* April 1981, pp. 50–53.
10. W. C. Hamner. How to Ruin Motivation with Pay. *Compensation Review,* 3rd quarter 1975, pp. 17–27.
11. W. J. Kearney. Pay for Performance? Not Always. *MSU Business Topics,* Spring 1979, pp. 5–16.
12. E. J. Brennan. The Merits of Merit Pay for Teachers. *Personnel Journal,* Feb. 1984, pp. 16–17.
13. R. E. Kopelman and L. Reinharth. Research Results: The Effect of Merit Pay Practices on White-Collar Performance. *Compensation Review,* 4th quarter 1982, pp. 30–40.
14. R. A. Katzell and D. Yankovich. Pay vs. Work Motivation and Job Satisfaction. *Compensation Review,* 1st quarter 1976, pp. 54–65.

15. B. Dwortzan. The ABC's of Incentive Programs. *Personnel Journal*, Vol. 61, No. 6, June 1982, pp. 436–442.
16. R. Marriott. An Exploratory Study of Merit Rating Payment Systems in Three Factories. *Occupational Psychology*, Vol. 36, 1962, pp. 175–214.
17. B. A. Giles and G. V. Barrett. Utility of Merit Increases. *Journal of Applied Psychology*, Vol. 55, No. 2, 1971, pp. 103–109.
18. C. N. Greene and P. M. Podsakoff. Effects of Removal of a Pay Incentive: A Field Experiment. *Academy of Management National Proceedings*, 1975, pp. 206–210.
19. R. E. Kopelman, L. Rienharth, and A. Beer. The Link Between Judgmental Rewards and Performance. *Personnel Administrator*, April 1984, pp. 78–80.
20. W. A. Nowlin. Factors that Motivate Public and Private Sector Managers: A Comparison. *Public Personnel Management*, Vol. 11, No. 33, 1982, pp. 224–227.
21. J. W. Newstrom, W. E. Reif, and R. M. Monczka. Motivating the Public Employee: Fact vs. Fiction. *Public Personnel Management*, Vol. 5, No. 1, 1976, pp. 67–72.

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Analysis of Nine European Public Transit Databases: Insights for the Urban Mass Transportation Administration Section 15 Program

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A study of nine European public transit databases is presented and insights into the debate over what to report under the UMTA Section 15 program are provided. The content and usefulness of the databases are compared to identify cases either where Section 15 could be improved or where it provides a valuable standard. These comparisons are used to evaluate the merits of proposals to modify Section 15. This report provides a critical guide to data sources for analysis of international transit performance. Access to these resources has been limited because of language barriers, lack of information on availability, and different definitions of key concepts. The analysis also provides insights into the difficulties of compiling and using comparative transit data. Section 15 includes financial and operating statistics from 438 U.S. urban public transit operators. In its seventh year, Section 15 provides standardized data for policy and management analysis, and for the UMTA Section 9 apportionment formula. In response to recommendations from the UMTA and American Public Transit Association advisory committees, UMTA has begun to overhaul Section 15. In the current debate, collection costs are balanced against the value of data to analysts. Although some recommendations add information, most require deletions. Relative to Section 15, the European databases (a) use similar output and ridership measures, including capacity and passenger miles (both proposed for elimination); (b) use similar expense and revenue structures but with fewer details; (c) distinguish public from private sector involvement less successfully; (d) do not clearly estimate capital costs; and (e) fail to estimate service area population accurately.

This report presents a critical analysis of nine European transit databases and provides insights into the debate in the U.S. transit community over what data should be reported under the Section 15 program of UMTA. This report also is a comprehensive guide to European and U.S. data sources for comparison and analysis of international transit performance. Access to these resources has been restricted by language barriers, lack of information on availability, and different definitions of key concepts.

Criteria to use in comparing the databases and in evaluating their value to international analysts are proposed. By focusing on definitions and selection of statistics to measure supply, demand, revenues, expenses, and other key data items, this report encourages informed use of these resources for international analysis. This review of strengths, weaknesses, and compatibilities is of particular value to analysts familiar with Section 15, which is the frame of reference for evaluation of the nine less complex databases. This review also identifies issues in development of transit databases that should be resolved if these resources are to be of maximum value.

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On the basis of comparative analysis, this study provides insights into the debate in the United States over what to report under the Section 15 program. Numerous recommendations have been made over the last 3 years by a Section 15 advisory committee appointed by the Secretary of Transportation *(1)*; a committee of the American Public Transit Association (APTA), representing operators; TRB, representing the research community; and industry sources. The APTA proposal discussed in this paper was submitted to the UMTA Section 15 Advisory Committee meeting on March 13, 1986, but APTA continues to develop its recommendations. In response to these recommendations, UMTA has begun a program to simplify and improve the data quality of Section 15. Although some recommendations require additional information, most require deletions. In the current debate over what to report, collection costs to reporters are contrasted with the benefits gained from use of the data for analysis *(2)*.

Proposals to modify Section 15 are evaluated on the basis of how other countries resolve common issues, including measurement of supply, demand, fleets, and workforces; distinction of capital from operating expenses; allocation of costs and fares by mode; level of expense detail; and identification of private contractors. The objectives are to identify ways in which Section 15 could be improved, often through simplification, and its comparative strengths as a valuable standard.

CRITERIA FOR EVALUATION OF COMPARATIVE DATABASES

A clear statement of intended objectives for the databases should precede development of evaluation criteria. Criteria should assist in answering the question "Do these databases successfully provide required information?" For this paper, the objectives are not those of the individual databases, which often are not explicit and differ among themselves.

It would be arbitrary to apply the objectives of one database in evaluation of other databases because of apparent differences in what each was designed to accomplish. Intended uses of Section 15, the most detailed of the databases, include provision of information for national and state analysis, local decision making, and academic research. The European databases are more modest undertakings, with fewer categories of information, and less detail in categories shared with Section 15. The databases from Belgium, the Federal Republic of Germany (FRG), and the International Union of Public Transport (UITP) contain ridership and output measures required for analysis of national and local historical trends but lack the financial data required for economic analysis using unit costs.

The 10 databases are evaluated for their ability to provide information for international performance evaluation and policy analysis. This is consistent with the intent of this report—to provide a guide to data sources for international analysis and insights into what to report under Section 15. Although performance evaluation and policy analysis are inclusive, they exclude local management and other applications that require additional details on routes, costs, and characteristics of riders. None of the databases are intended for this type of use. The evaluation criteria follow.

Usefulness in Performance Evaluation

Performance evaluation uses financial and operational data to analyze trends in and relationships among costs and services supplied and demanded, and to explain differences in transit system performance. Evaluation answers the questions, "How are the databases doing?" and "Where can they improve, and how?" Comparisons can determine whether performance is improving or deteriorating and can identify candidate items for cost reduction or service improvement.

Performance evaluation requires benchmarks of exemplary, acceptable, and unacceptable performance. Evaluation can be based on historical performance of a single operator or on comparisons with individual or group peer standards. International databases extend the range of transit experience and provide a broader universe of peers.

Fundamental data required for performance evaluation are operating expenses, revenues, service outputs, and ridership. Modal disaggregations by multimodal systems are required to analyze modal performance.

Usefulness in Productivity Analysis

Productivity analysis attempts to maximize transit benefits relative to resource input costs (labor, capital, and materials). Analysts disagree over whether to measure benefits in supply units (vehicle-miles) or demand units (trips), possibly with fares as a surrogate, or to include social benefits, including environmental effects, as used in the social cost benefit model or similar techniques mandated by the British Department of Transport for planning and investment decisions *(3)*.

Productivity is often viewed as having efficiency and effectiveness components. In economic theory, efficiency contrasts marginal costs and benefits to determine optimal resource use. In transit analysis, efficiency is often simplified to focus on ratios of costs to services supplied (in units of vehicle-miles or vehicle-hours), often within different managerial divisions. Effectiveness focuses on the extent to which outputs are consumed *(4)*.

Usefulness in Policy Analysis

The databases are evaluated for ability to provide information required to answer key policy questions, including whether public agencies should subsidize transit, how subsidies might best be provided, whether public investments should encourage particular modes or technologies, and whether public transit services should be deregulated or privatized. International data sources extend the information available to answer national policy questions.

Complete System-Wide Costs

Analysts are particularly interested in cost comparisons between operators, often expressed in costs per service output unit, rider, or passenger-mile, and in historical cost trends of operators individually or in modal, national, or other categories.

The appropriate level of operating expense detail is controversial and is the subject of the APTA proposals. Basic disaggregations include costs of operators, maintenance, administration, labor, and possibly contracts. Many policy questions and comparisons of interest involve modal costs or comparisons, which require cost allocations by mode. Comparisons between modes or operators with different degrees of labor and capital intensity require both operating and capital costs.

Complete Revenues

Revenues can be used to contrast earnings with operating and capital expenses by using farebox returns (fares divided by operating expenses) or other measures. Basic revenue categories include modal or system fares, amounts of public funds, identification of funding agency, tax or other source, and all other revenues.

Service Outputs

Products of a transit system are typically measured in units of service produced or supplied, including vehicle-miles or vehicle-hours, in modal disaggregations. Capacity-miles (seating and standing capacity multiplied by vehicle-miles) and distinctions between deadhead and revenue vehicle-miles and vehicle-hours are also useful.

Ridership

Ridership or service consumed data provide measures of the benefits derived from transit service and are required for analysis of productivity. Typical measures are number of unlinked trips (boardings), number of linked trips (completed origins to destinations), and passenger-miles (sums of distances traveled by all passengers).

Integrated Structure

The different elements of a database should fit together. Modal expense categories can parallel those used for revenues, outputs, ridership, and labor. For example, parallel distinctions between modes or publicly operated and contracted service can be made throughout the database.

Consistent Definitions

Without clear definitions, particularly for international data, consistency should not be assumed among different modes and operators. For example, it should be specified whether trips are origins to destinations or boardings, whether operating expenses include depreciation, interest, or lease costs, and whether vehicle-miles include deadhead (return trip without load).

COMPARATIVE ANALYSIS OF SECTION 15 AND NINE EUROPEAN DATABASES

In this report, Section 15 and nine European databases are analyzed to determine differences and similarities in data and definitions. Of the 10 databases, 8 are national, published by government ministries or associations of operators, and the 2 produced by UITP are international (Table 1). All the databases contain operating statistics for urban operators, and most contain financial information.

Section 15 is the most detailed and complex database surveyed, and the only one except for the Swiss with statistics on vehicle failures, pensions, and accidents. However, basic categories for financial and operating statistics are similar to those used by the other databases. Of the 10 databases, 7 contain operating expenses and revenues, all 10 report service outputs and ridership, and 9 (all but Belgium) publish performance ratios.

Section 15 consolidates statistics in fleet-sized peer groups and presents graphics on national and historical trends. The other data sets do not sort by peer groups, although the British and UITP rail sets could be considered peer groupings. The FRG and UITP rail databases also provide graphics.

The Section 15 database, compiled by UMTA, contains data on commuter rail, light rail, rapid rail, motor bus, and other modes. In its seventh year, Section 15 includes financial and operating statistics on over 430 primarily urban U.S. public transit operators *(5–7)*. Although most operators are publicly owned and operated, information from private operators, mostly under public contract, has increased significantly.

The UITP handbook *(8)* includes urban rail and motor bus data for over 1,000 worldwide reporters. UITP contains detailed engineering descriptions of equipment and networks, but no operating expenses.

The UITP Rail Committee produced two sets of financial and operating statistics for its study of rapid rail performance (UITP–RR) *(9)*. The first version contains rapid rail information on 26 operators, including 20 from Europe, 3 from the

TABLE 1 BASIC INFORMATION AND DEMOGRAPHICS[1]

	Published By	Modes	Reporters	Data From	Information on Ownership	Population/ Density
USA	US Dept of Transport	CR,MB, RR,TB	438	1978-	Yes	Yes/Yes
UITP	Operators' association	LR,MB, RR,TB	1000 +	1964-	Yes	Yes/Yes
UITP Rail	Operators' association	RR	26	1981 & 1985	Yes	No/No
Great Britain	Operators' association	CR,MB RR	8	1977	All public	Yes/Yes
FRG	Operators' association	LR,MB, RR,TB	166	NAV	No	Yes/No
France	Transport Ministry	LR,MB, RR,TB	101	1975-1984	Yes	Yes/Yes
Holland	Operators' association	LR,MB, RR,TB	9	NAV	All public	No/No
Belgium	Communicat Ministry	CR,LR, MB,RR	7	1949-	All public	No/No
Italy	Transport Ministry	LR,MB, RR	1272	1981-1983	All public	Yes/Yes
Switzerland	Federal Statistics Office	LR,MB, TB	19	1948 -	All public	No/No

[1] Abbreviations follow Table 5.

United States, and 3 others. The more extensive second version is limited to data on 10 European rapid rail systems.

The Passenger Transport Executive Group (PTE), an association of British urban transit operators, publishes *Inter P.T.E. Comparisons (10)*, financial and operational statistics for motor bus, commuter rail, and rapid rail for London and seven major urban centers. Recommended accounting and record-keeping structures are described in a Department of Transport publication *(11)*.

The Association of Public Transit Operators, FRG, publishes *Statistik '85 (12)*. In its 15th edition, the database includes operating statistics for motor bus, rapid rail, light rail, and other modes for 166 operators. Financial information is collected but not published.

The French National Research Institute of the Transport Ministry (INRETS) publishes *101 Réseaux de transport urbain (13)*, with historical data (1975–1984) for motor bus, rapid rail, light rail, and other modes for 101 operators, excluding Paris. INRETS reports revenues and operating expenses in system and not modal totals and also describes involvement of different public agencies and private contractors in management and other functions.

In the Netherlands, the Committee of Economic Affairs of the association of nine major urban public transport companies (including Amsterdam) publishes *Bedrijfsvergelijking (14)*, an annual report with extensive motor bus, trolley bus, rapid rail, and light rail data. The report is used by the Dutch Transport Ministry for policy and financial analysis, but it is not publicly distributed.

Les Transports en Belgique (15) is a biannual statistical report on urban transit in Belgium, published in French and Flemish by the Belgian Ministry of Communications. In its 18th edition, the report includes operating statistics but no expense or revenue data on light rail, rapid rail, and motor bus operations for seven public operators in major urban centers.

In its third edition, *Il trasporto pubblico locale: analisi per regione (16)*, is published annually by the Italian Transport Ministry. The report contains revenues, operating expenses, and service statistics for 1,272 local public operators, including those in Rome, consolidated into 21 regional categories. Data are presented on motor bus, light rail, and rapid rail service, including a limited amount of contract service.

Statistique suisse des transports, 1983 (17), published by the Swiss federal Office of Statistics, contains motor bus, light rail, and trolley bus statistics from 4 regional and 14 urban public operators. Fares, other revenues, and capital and operating expenses are reported for all modes combined; accidents, service outputs, and ridership are reported by mode.

Demographic Data

Demographic information provided by the 10 databases is summarized in Table 1. Section 15, PTE, UITP, INRETS, and the Italian databases provide both population and density of service area; FRG provides only population. Population served, reported by Section 15, UITP, FRG, INRETS, and the Italian databases, is subject to common limitations. For Section 15 and the Italian databases, service areas are defined by political or socioeconomic boundaries and do not necessarily correspond to service access areas. Service areas for FRG and INRETS are not defined. Service area population is valuable for comparisons of access, for example, population within 0.25 mi of fixed-route service, and service outputs or ridership per capita.

Section 15 reports population and density only for the single major socioeconomic urban area served by operators. This consolidation can distort estimates of actual population served and service per capita because service could actually be provided to multiple urban or nonurban areas.

In the Italian database, population is provided only for the 21 regions into which data for 1,272 operators are consolidated. This consolidation could be valuable for national analysis but not for comparisons of operators.

Organizational Structure—Public or Private Ownership

Analysts are interested in the different levels of government funding transit, the mix of public and private operation, and the use of contractors. Important policy questions require information on how local systems are funded and managed; identification of public and private participation (joint development, contracting of functions or entire operations, and nonsubsidized service); and estimates of the growth of the private sector.

Standardized categories allow identification of the public or private character of purchasers and providers of contract services. More detailed descriptions would require narratives or follow-up calls to operators.

Costs, revenues, service, and ridership should be allocated between publicly operated and contracted service to prevent distortion in performance measures yet permit analysis of the effects of contracting and other privatization. Section 15 separates contracted from publicly operated outputs and ridership but provides incomplete costs for contract service. Although it is useful to distinguish the costs of management or maintenance contracts, at a minimum the value of all contracts should be consolidated.

None of the European databases clearly identifies ownership and use of contractors (Table 1). This lack is not an issue when operators are all publicly owned and operated, as in the Netherlands. Section 15 publishes contract service costs, outputs, and ridership and also identifies but does not publish information on public-private arrangements.

All PTE, UITP–RR, and Dutch operators are public, although that will change in the United Kingdom after deregulation, when PTE operators compete with private firms. PTE provides contract expenses for unspecified functions, and the Dutch provide costs of contract drivers. INRETS summarizes management and other roles of contractors but does not provide costs or other details. The value of UITP descriptions of organizational structures would improve with development of standardized categories.

Labor Data

All 10 databases measure total employees, and all but FRG count operators and maintenance staff (Table 2). With important cautions, these data can be used in labor productivity

TABLE 2 LABOR, FLEETS, CAPITAL EXPENSES, AND REVENUES[1]

	Labor Counts	Route Miles	Fleet Inventory	Capital Expenses	Revenues Total/Fares	Public Contributions
USA	Oper,Main, Admin	Yes	Peak,spares, base	Yes	Yes/System only	Yes
UITP	Oper,Main, Admin	Yes	Total	No	No/No	No
UITP Rail	Oper,Main, Admin	Yes	Peak, off-peak	Yes	Yes/Yes	Yes
Great Britain	Oper,Main, Admin	No	Total,peak	No	Yes/Modal	Yes
FRD	Totals only	Yes	Total	No	No/System only	No
France	Oper,Main	Yes	Peak,spares	No	Yes/System only	Yes
Holland	Oper,Main, Admin	Yes	Peak,spares	Yes	Yes/System only	Yes
Belgium	Oper,Main, Admin	Yes	Total	No	No/No	No
Italy	Oper,Main, Admin	Yes	Total	No	Yes/System only	Yes
Switzer-land	Oper,Main, Admin	Yes	Total	Yes	Yes/System only	No

[1] Abbreviations follow Table 5.

measures, for example, contrasting the cost per employee, or vehicle- or passenger-miles per employee or operator.

Imprecise definitions restrict the value of labor data for comparisons but can be overcome through use of standardized labor equivalents, measured in paid labor-hours. This method eliminates confusion about whether counts are annual averages or maximums or whether part-time staff are distinguished from full-time staff. For example, the Section 15 definition of a labor-year equivalent is 2,080 paid hours. A second approach is a head count of staff, with specification of whether the count is an annual average, maximum, or fiscal year end total, and whether part-time staff are weighted or counted as equal to full-time staff.

The European databases appear not to define whether counts are in standardized labor-years or are head counts. With over 1,000 reporters, UITP accepts whatever data are collected locally. It may be reasonable to assume consistency in databases collected by national transport ministries, although development of definitions would assist international analysts.

On the basis of an APTA recommendation, UMTA has redefined labor categories to match labor expenses and is evaluating methods to define part-time staff, which will be difficult because of inconsistent approaches in the industry.

Section 15 employee counts exclude contractors, whose roles are increasing in operations, management, maintenance, and security areas. This increase is distorting comparisons of labor productivity (vehicle-miles per employee) between operators with and without contractors.

On the basis of the limited statistics of the other databases, Section 15 may collect excessive labor data. Consolidation of separate labor equivalent and time-of-day head counts, as recommended by APTA, may be advisable. As a trade-off for reduced detail, clear annual measures of part-time labor, as collected by INRETS, and contract labor, as collected by the Dutch, could be added to allow analysis of these management options.

Physical Network

All databases except PTE measure rail and motor bus route lengths, as presented in Table 2. Only UITP and Section 15 describe system networks. UITP's network size for rapid transit, priority right-of-way, and exclusive right-of-way for nonrapid transit modes appear to correspond to directional route miles, exclusive right-of-way, and controlled access right-of-way, respectively, in Section 15.

It is essential to specify whether rail and nonrail networks are measured in one-way miles (1 mi of two parallel tracks or routes traveled in opposite directions counts as 2 mi), or round-trip miles (the previous example would count as 1 mi). INRETS uses round-trip miles; Section 15 and FRG use one-way miles.

Fleet Inventory

Basic fleet inventory measures include vehicles required to meet peak- and base-time-period schedule requirements and spare vehicles required to maintain peak service. Analysts use peak-to-base vehicle ratios to understand daily service variation and peak-to-spare ratios to understand maintenance performance and fleet size requirements. All 10 measure fleet sizes, whereas only 5 measure the seating or standing capacity of their vehicles (Table 2).

UITP, FRG, Belgian, Italian, and Swiss databases provide undefined single fleet numbers, perhaps assuming that users are familiar with national definitions. These data sources do not provide the information required for the basic fleet ratios. Section 15, Dutch, PTE, and INRETS provide peak and spare counts; Section 15 and UITP–RR provide peak and base counts. Section 15 also provides scheduled fleet by time period (peak and base counts).

Section 15 and UITP describe vehicle types in detail. Section 15 includes vehicle type and manufacturer for all vehicles owned, as well as vehicles available for national emergency. APTA proposes to add air conditioning, registering fareboxes, radios, and lifts to inventories. Although inventory details are important to national policy makers and the transit industry, expansion of Section 15 inventories may not be justified.

Revenues

Fares and the sources and amounts of subsidies are used nationally and internationally to analyze farebox recovery rates, public and private support levels, and innovative mechanisms for distributing subsidies.

Fundamental information on subsidies includes institutional sources (government agencies, transit authority, or private sources); tax sources (income, sales, or employer); amounts; and distribution methods (percent of deficit, political discretion, incentive formulas, matching funds, tax credits, or direct subsidies to riders in special categories). These data can be combined with expenses, population, service outputs, and ridership to analyze subsidies in operator, modal, national, international, and other categories.

Except for the UITP and Belgian databases, all databases report fare revenues, but only PTE provides modal fares for multimodal systems (Table 2). Although Section 15 reporters are allowed to voluntarily distinguish fare revenue by mode, few have done so. All databases except UITP, FRG, Belgium, and Switzerland report the source and amount of governmental subsidies.

Details on subsidy distribution methods in the 10 databases are limited, perhaps because publishers assume analyst familiarity. Section 15 identifies federal, state, and local sources but does not describe distribution methods. The amount of assistance distributed on the basis of riders in specific categories is identified by PTE and INRETS and is collected but not published by Section 15. At a minimum, text summaries of distribution methods would be valuable to international analysts.

Section 15 identifies sources of revenues, including fares, advertising, dedicated taxes, and private contributions. It also distinguishes capital from operating subsidies.

UITP has the most thorough information on fare structures, including coordination among modes, transfers, discount passes, and collection technology. INRETS also summarizes fare systems. Because local fare policy, particularly low fares or recent increases, could be crucial to analysts, Section 15 allows optional unpublished narratives, which could be made available to analysts.

Capital Expenses

Without capital expenses, analysts focus on operating expenses, limiting and distorting comparisons among operators or modes with different labor and capital intensities. This is apparent in comparisons among automated guideways and other rail systems, with heavy capital and light labor costs, and bus systems with old fleets and high labor costs. Although it is difficult to compare systems operating under different conditions, such comparisons are vital for a variety of analyses. For example, an analysis of alternative modes and technologies for a service extension could use capital and operating expenses from national or international operators to derive unit costs for projections.

All 10 databases lack clearly defined capital expenses. Only Section 15, UITP–RR, Dutch, and Swiss databases identify capital expenses (Table 2). UITP–RR identifies annual capital costs for rolling stock and new works, but there may be comparability problems among 26 reporters in almost as many countries. In addition to amortization and depreciation, the Swiss database provides annual capital costs for construction and renovation of equipment.

APTA proposed eliminating the Section 15 balance sheet because of questions about its value to analysts and correspondence to operators' internal accounts. UMTA could investigate Swiss and UITP–RR reports of annual capital expenditures, along with other alternatives to modify the balance sheet.

Section 15, PTE, INRETS, Swiss, and Dutch databases identify depreciation or amortization as separate expenses, enabling analysts to define their own approaches to these costs and to avoid ambiguity over whether these costs are included in operating expenses. In the four European databases, depreciation is a system total and cannot be used for modal analyses of multimodal systems.

Operating Expenses

Operating expenses are vital to policy and management analysis. In transit accounts, operating costs are typically divided into operations, maintenance, labor, and administration. Performance measures determine costs per service unit; for example, maintenance expense per vehicle-mile. Some account structures permit cross-classification of expenses into combined function-object classes, for example, maintenance labor cost. Standardized total operating expenses are crucial for comparisons, with explicit approaches to depreciation, interest, and taxes. Also, modal allocations are required to respond to modal questions.

Differences in accounting conventions between modes within a country, such as commuter rail and urban bus in the United States, and internationally make it difficult to standardize. Also, operators resist divulging competitively damaging information. For example, the seven PTEs in the United Kingdom might cease public reporting of data after deregulation, when they will form separate companies and compete with private operators for market positions *(18)*. Expenses could be underestimated and comparisons biased if multiple public agencies are involved. For example, if New York City uses city police to patrol subways, as planned, these costs may not appear in the operator's financial report.

Operating expenses published in the 10 data sets are summarized in Table 3. All but UITP, FRG, and Belgium provide total operating expenses. FRG collects but does not publish costs. Of the seven databases with operating expenses, all provide a maintenance total, six separate costs of operations, and all but INRETS and the Swiss database provide modal costs for multimodal systems. Contract costs, which are important for analysis of privatization, are identified in Section 15, PTE, Dutch, and Swiss databases.

Section 15 provides a complex matrix of 44 expense functions and 47 object classes for the 22 operators that voluntarily report the most detailed expenses. Some 85 percent of reporters, however, use only the four minimum or required functions. The matrix cross-classifies functions and object classes. For example, labor or materials costs can be identified for operating or maintenance functions.

Although use of more than four functions is voluntary, APTA recommended four functions for all reporters. The cost of reporting up to 44 functions is not the issue—operators report details voluntarily and may have information systems based on these accounts. APTA argued that the current structure is too complex and that because voluntary details produce choice-based rather than random samples, these data have no valid applications. Contrary to the APTA view that some data are worse than no data, voluntary data have legitimate applications if sources are identified and if universal conclusions are avoided without statistically valid methods. For example, voluntary data have been used in time series analyses, in deriving unit maintenance costs in national rail cost projections, and in an industry marketing trend study *(19)*.

From a review of the other databases, 44 functions appear excessive. As recommended by the UMTA committee, the optimal number may be more than the four proposed by APTA and the three or four common to the European systems. Examples of potentially useful costs lost under the APTA proposal include uninsured liability payouts, marketing, and fare collection. Compromises could consolidate the current 10 insurance objects into 2 (premiums and payouts) and preserve one marketing function in place of the current four, instead of consolidating all marketing into administration, as proposed. It is likely that UMTA and APTA will collaborate to simplify accounts while maintaining the most valuable details.

Service Outputs

A transit system's products are typically measured in units of service supplied, including vehicle-miles or vehicle-hours, with important distinctions between vehicle-miles, or total distance traveled, and revenue vehicle-miles, which are limited to revenue service. All 10 databases provide outputs, including vehicle-miles (Table 4). UITP–RR provides train instead of the car vehicle-miles reported in the other databases for rail modes. All except INRETS and the Dutch database provide the modal outputs of interest to many analysts. Only three databases report vehicle-hours—considered the single most valuable output measure by many analysts because of strong correlations to labor, the major component of cost. Only Section 15 reports revenue vehicle-hours and revenue vehicle-miles, which can be subtracted from vehicle-miles to determine deadheading, an important cost factor.

Five databases report capacity-miles, which UMTA has proposed eliminating *(20)*. Capacity-miles (seating and standing capacity multiplied by vehicle-miles) are difficult to define because of variations in seat configurations and local policies on standees. Nonetheless, capacity-miles are the only supply measure that reflects vehicle size variations within and between modes; for example, it allows distinctions between outputs of motor bus and rail, which are not permitted by vehicle-miles.

In five databases, capacity-miles can be combined with passenger-miles to derive load factors (passenger-miles divided by

TABLE 3 OPERATING EXPENSES[1]

	Operating Expenses	Operations	Maintenance	Administration	Labor	Contracts	Interest or Depreciation
USA	Modal	Yes	Yes	Yes	Yes	Yes	Yes
UITP	No	No	No	No	No	No	No
UITP Rail	Modal	Yes	Yes	Yes	Yes	No	No
UK	Modal	Yes	Yes	Yes	Yes	Yes	MB only
FRG	No	No	No	No	No	No	No
France	Total	No	Yes	No	Yes	No	Yes
Holland	Modal	Yes	Yes	Yes	Yes	Yes	Yes
Belgium	No	No	No	No	No	No	No
Italy	Modal	Yes	No	No	Yes	No	No
Switzer	Total	Yes	Yes	Yes	Yes	Yes	Yes

[1] Abbreviations follow Table 5.

TABLE 4 SERVICE OUTPUTS AND RIDERSHIP[1]

	Modal	VHr	VM	Capacity Miles	Passenger Trips	Passenger Miles
USA	Yes	Yes	Yes	Yes	Unlinked	Yes
UITP	Yes	No	Yes	D	Undefined	RR only
UITP Rail	NAP	No	Yes	No	Undefined	Yes
UK	Yes	Yes	Yes	No	Unlinked	Yes
FRG	Yes	No	Yes	Yes	Linked	Yes
France	No	No	Yes	Yes	Undefined	No
Holland	Yes	Yes	Yes	Yes	Unlinked	Yes
Belgium	Yes	D	Yes	Yes	Undefined	Yes
Italy	Yes	No	Yes	No	Undefined	Yes
Switzer	Yes	No	Yes	No	Undefined	No

[1] Abbreviations follow Table 5.

capacity-miles), a vital indicator of utilization. Capacity-miles are also valuable for comparisons between transportation industries, for example, to reflect differences in unit costs among air, intercity bus and rail, and transit.

Section 15 collects actual and scheduled revenue vehicle-miles, which provide estimates of missed trips and reliability. PTE is the only other database to indicate schedule adherence, with a measure of lost mileage.

Time-of-day data are used by analysts to explain cost trends, in models to predict costs of service changes, and by managers to develop deficit reduction strategies, including use of part-time drivers and peak-hour fares. Because costs correlate closely to peaking *(21)*, time periods with excess supply relative to demand could indicate cost savings opportunities, and excess demand could suggest service expansion.

Section 15 reports eight service measures by time of day, including vehicle-miles and vehicle-hours by peak and other time periods. If absence of time-of-day distinctions in the European databases is considered, Section 15 details appear excessive. For example, both actual and scheduled revenue vehicle-miles are not required to indicate peaking. However, APTA's proposal to report only vehicles by time of day appears extreme. Time-of-day data could be reduced to vehicle-hours and vehicle-miles, which better reflect congestion and speed than do vehicles. Vehicle-hours are of particular value because of strong correlations to costs.

Ridership

The basic measures of ridership are passenger-miles, unlinked trips (boardings), and linked trips (completed origins to destinations). Although unlinked trips are inexpensive to collect and could suffice for time series analysis of one operator, they are limited for comparisons among modes or operators with different transfer rates. Linked trips are costly to collect but are a superior measure of benefits because they are not inflated by transfers, which are required by route design and other conditions but do not produce additional benefits. Both linked and unlinked trips are limited for comparisons between modes, operators, or other transportation industries with different average trip lengths. For example, trip lengths can vary from 3.6 mi for light rail to 21.3 mi for commuter rail in the United States.

Passenger-miles, or the total distance travel by all passengers, allow comparisons between operators and modes with different transfer rates and average trip lengths. Although passenger-miles are a theoretically complete and comparable demand measure, collection can involve costly sampling or technology, and can produce inaccurate data.

Ridership information is presented in Table 4. With the exception of INRETS, all 10 databases provide modal data. All collect passenger trips: Section 15, PTE, and Dutch databases specify unlinked, FRG specifies linked, UITP reports linked and unlinked without identification, and five do not define trips, perhaps assuming national consistency. Without explicit definitions, operators report what they collect internally, and analysts do not know whether trips are linked or unlinked. Ambiguity could bias comparisons because unlinked trips could be as frequent as 60 percent more than linked trips. If trips are labeled as linked or unlinked, adjustments can be made in analysis.

Passenger-miles are controversial in Section 15 because UMTA requires annual totals to satisfy statistical standards of 95 percent confidence and 10 percent accuracy, and uses passenger-miles in the Section 9 apportionment formula. Although there is debate in the United States over the value of passenger-miles relative to collection costs, they are included in 8 of the 10 databases, and they have important planning and evaluation uses in the European countries surveyed. For example, passenger-miles are used in Great Britain as a proxy for benefits in the methodology mandated by the Ministry of Transport *(22)* to plan and make investment decisions. The Dutch Ministry of Transport uses passenger-miles to evaluate the performance of operators and plans to use the measure to allocate proceeds from the national fare program.

The accuracy, costs, and benefits of passenger-mile collection in Europe would be an interesting topic for future research and would provide insights for the Section 15 debate. For example, it would be interesting to know how the benefits of passenger-mile information compare to the costs of automated counters provided to operators by the Dutch Transport Ministry.

Section 15 requires estimates of passenger-miles and unlinked trips by peak and other periods. If the questionable accuracy of passenger-miles by time period (standards apply only to annual totals) and the absence of peak distinctions in the other databases are considered, it may be justifiable to limit time-of-day demand measures to unlinked trips but not to eliminate all measures, as proposed by APTA. Important uses for combined supply and demand data by time period were discussed in the previous section.

Performance Measures

Performance measures are typically ratios of expenses, revenues, outputs, and ridership. Efficiency measures typically indicate unit costs of outputs (cost per mile or per hour), and effectiveness measures indicate the extent to which outputs are consumed (passenger-miles per capacity-mile) or the unit costs of ridership (operating expense per unlinked trip) *(23)*. Other commonly derived ratios include peak to spare vehicles, load factors (passenger-miles per capacity-mile), speed, and average trip length (passenger-miles per trip).

Seven of the databases publish performance measures to assist analysts, who otherwise derive their own ratios (Table 5). Four produce and three allow derivation of average trip lengths. Two produce and four allow derivation of load factors. Section 15 does not publish load factor and average trip length but uses both in data validation. The importance others assign to these measures may interest UMTA as it considers reducing passenger-mile reporting. Four databases publish operating costs per passenger and vehicle-mile.

The most commonly published ratios are for labor and vehicle productivity, comparing outputs to employees and vehicles. Although cost recovery (the ratio of fares to operating expenses) is important for analysis, only UITP–RR publishes it; this factor can be derived from five other databases. Modal performance measures are limited by the availability of modal costs, ridership, and outputs, as discussed. Although the performance measures published out of the great number derivable could imply applications, analysis of how performance measures from each database are used would provide additional insights for the debate over what to report under Section 15.

CONCLUSIONS

The 10 databases were evaluated for their ability to provide information for performance evaluation and policy analysis. In

TABLE 5 PERFORMANCE MEASURES[1]

	Cost per Pass/Output	Peak/ Spare	Load Factor	Labor/Vehicle Productivity	Speed	Average Trip Length
USA	Yes/Yes	D	D	Yes/Yes	D	D
UITP	No/No	No	D	D/D	No	Yes
UITP Rail	D/Yes	No	Yes	Yes/Yes	No	D
UK	D/Yes	Yes	Yes	Yes/Yes	Yes	Yes
FRG	D/D	No	D	D/D	No	Yes
France	Yes/Yes	D	No	Yes/Yes	Yes	Yes
Holland	D/D	Yes	D	D/Yes	Yes	D
Belgium	No/No	No	No	No/No	Yes	No
Italy	No/No	No	No	Yes/No	No	No
Switzerland	No/No	No	No	No/No	No	No

[1]Abbreviations Used in Tables 1 to 5

Admin - Administration
CapMi - Capacity or place miles (kilometers); (seating + standing) X VM
CE - Capital Expenses
CR - Commuter Rail
D - Derivable
Emp - Employee
LR - Light Rail or Streetcar
Main - Maintenance
MB - Motorbus
NAP - Not Applicable
NAV - Not Available
OE - Operating Expenses
Ops - Operators
PM - Passenger Miles (Kilometers)
Pass - Passenger Trips (linked or unlinked)
RR - Rapid Rail or Metro
TB - Trolley Bus
Tr - Train
TrKm - Train Kilometers
Veh - Vehicles
VHr - Vehicle Hours
VMi - Vehicle Miles (Kilometers)
VM - Vehicle Miles (Kilometers)
VRH - Vehicle Revenue Hours
VRM - Vehicle Revenue Miles (Kilometers)

comparison to Section 15, the European databases are of modest scale, with fewer categories and less detail within each category. The comparisons between operators allowed by the European databases are less detailed than those allowed by Section 15. The 10 databases combine to provide valuable resources for international analysis because of similar measures of outputs, ridership, costs, and revenues. All 10 report passenger trips, vehicle-miles, labor counts, and fleet size; 8 report fares; 7 provide operating expenses; and 8 record passenger-miles.

The value of these databases is limited by inconsistent definitions. Database producers, particularly transport ministries, may assume that users are familiar with definitions. Analysts can adjust for inconsistent definitions, but missing definitions create formidable problems, particularly when it is unclear whether trips are linked or unlinked, whether operating expenses include depreciation, and whether vehicle-miles include deadhead. Thorough definitions and a structure that ties cost, revenue, labor, and other data categories together are major strengths of Section 15.

Comparative analysis of the other databases provides insights for the debate over Section 15 reporting. UMTA is considering reducing reports of passenger-miles, a key demand measure in seven other databases, and eliminating capacity-miles, a supply measure in five others. All 10 databases generally neglect capital costs, although Swiss and UITP–RR reports of annual capital expenditure could provide useful alternatives for UMTA. Detailed labor counts in Section 15 could be improved through incorporation of approaches to part-time labor by INRETS and contract labor by the Dutch. Identification of the costs, revenues, outputs, and ridership of contract service is a strength of Section 15 that the other databases could incorporate to improve analysis of privatization policies.

In other important areas, Section 15 appears excessively detailed. Time-of-day data for eight output and two ridership measures could certainly be reduced. Operating expense categories could also be reduced, although the optimal number may be more than the four proposed by APTA and common to the European systems.

Several promising areas for related future research were identified. The U.S. industry might be interested in the collection methods, accuracy, and applications made of passenger-miles in the other databases, including how the benefits compare to the costs of automated passenger counters in the Netherlands and elsewhere. Also, a framework to identify data required for specific types of applications would require theoretical efforts and a review of representative analyses, but it would focus the Section 15 debate and provide a basis for future development of comparative databases.

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REFERENCES

1. Section 15 Reporting System Advisory Committee. *Final Report to the Administrator on the Quality and Usefulness of the Nation's Mass Transportation Data Base.* UMTA, U.S. Department of Transportation, Sept. 30, 1986.
2. W. M. Lyons, J. Freilich, and D. Nicholas. *Analysis of APTA's Proposed Revisions to Section 15.* Transportation Systems Center, U.S. Department of Transportation, March 1986.
3. R. Turner and P. White. *To Plan or Not to Plan: Three-Year Plans Under the 1983 Transport Act, the "Buses" White Paper, and Beyond.* Presented at the Annual Conference of the Institute of British Geographers, University of Leeds, Leeds, 1985.
4. G. J. Fielding et al. *Indicators and Peer Groups for Transit Performance Analysis.* UMTA, Department of Transportation, Jan. 1984.
5. *National Urban Mass Transportation Statistics: 1983 Section 15 Annual Report.* Report UMTA-MA-06-0107-85-1. Transportation Systems Center, U.S. Department of Transportation, Dec. 1984.
6. *Urban Mass Transportation Industry Uniform System of Accounts and Records and Reporting System: Reporting Manual and Sample Forms.* UMTA, U.S. Department of Transportation, June 1986.
7. *Compendium of National Urban Mass Transportation Statistics: 1983 Report Year.* UMTA, U.S. Department of Transportation, July 1985.
8. *UITP Handbook of Public Transport.* International Union of Public Transport. Brussels, 1985.
9. T. Ridley and H. H. Meyer. *Productivity Comparisons Between Metropolitan Railways.* International Union of Public Transport, 45th International Congress, Rio de Janeiro. Brussels, 1983.
10. *Inter P.T.E. Comparisons, 1982/83 & 1983/84.* Passenger Transport Executive Group, Sheffield, England, undated.
11. *Code of Practice: Publication of Information by Bus Operators.* U.K. Department of Transport, London, undated.
12. *Statistik '85.* Association of Public Transit Operators (Federal Republic of Germany), Köln, May 1986.
13. *101 Réseaux de transport urbain, statistiques 1975–1984.* Urban Ministry for Housing and Transport (France), State Secretary for Transport, Center for Urban Transport Studies, Paris, Dec. 1985.
14. *Bedrijfsvergelijking voor de 9 Stedelijk Openbaar Vervoerbedrijven, Jaarrenkening, 1983.* Economic Bureau for Roads and Waterworks (The Netherlands), Commission for Economic Concerns. The Hague, Jan. 1985.
15. *Les Transports en Belgique.* Ministry of Communications (Belgium). Brussels, 1986.
16. *Il trasporto pubblico locale: analisi per regione, 1983.* Ministry of Transport (Italy). Rome, Oct. 1985.
17. *Statistique suisse des transports, 1983.* Federal Office of Statistics (Switzerland). Bern, Dec. 1984.
18. *Transport Act 1985.* Circular 3/85. Department of Transport, London, Dec. 4, 1985.
19. R. Booth. Bus Marketing Costs: Experience of 18 Section 15 Reporters from 1981 to 1983. In *Transportation Research Record 1078,* TRB, National Research Council, Washington, D.C., 1986, pp. 31–38.
20. Uniform System of Accounts and Records and Reporting System. 49 CFR, Part 630, *Federal Register,* Washington, D.C., May 8, 1986.
21. R. L. Oram. *Peak Period Supplements: The Contemporary Economics of Urban Bus Transport in the U.K. and U.S.A.* Progress in Planning, Pergamon, Oxford, 1979.
22. R. Turner and P. White. *Urban Bus Operators' Performance in Relation to the 1983 Act Plans.* Transport Studies Group, Polytechnic of Central London, London, 1984.
23. G. J. Fielding et al. *Indicators and Peer Groups for Transit Performance Analysis,* UMTA, U.S. Department of Transportation, Jan. 1984.

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Effects of Disseminating Service Information and Free Ride Coupons on Bus Ridership

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Although several studies of system-wide, free-fare experiments have suggested that such programs do not stimulate sustained ridership gains and actually result in revenue losses, the possibility remains that targeted, route-specific free-fare programs could stimulate ridership without significant disruption on individual routes. Studies of service information dissemination also suggest that this may be an effective means of stimulating ridership and revenues. In this paper, the effects on ridership of distributing (a) route-specific service information only and (b) information with free-ride coupons to residential areas bordering three high-ridership urban bus routes are described. In addition to one premeasure and two postmeasures of ridership on the routes, surveys of riders on the routes and of all coupon users were undertaken. The experimental design controlled externalities affecting ridership. Neither the information alone nor the coupons caused significant ridership gains. Most coupon users were existing high-frequency, transit-dependent riders. Few new riders were gained, and existing riders did not significantly increase their frequency of bus use. Survey findings also suggest that with direct-mail promotions, it is not sufficient to target areas bordering bus routes, as many current and potential riders may not live in these adjacent areas.

As local public transit agencies attempt to increase ridership and revenues, one question that arises is the extent to which simply informing people about services will stimulate ridership. Marketing efforts emphasizing information dissemination are based on the recognition that among the many determinants of mode choice are awareness and knowledge of transit services. Further questions that arise are whether incentives in the form of free rides are effective in inducing trial by new riders and whether any immediate effects are sustained in the form of longer-term gains in ridership and revenues.

These questions are significant to transit agencies as they devise and implement marketing strategies. If it is true that dissemination of information does yield ridership gains, it is appropriate to allocate marketing resources to programs that inform the public of transit services and their features. It is important, of course, to target groups with a potential for becoming riders, as it is not efficient to undertake programs that spend a large share of marketing funds reaching staunch nonriders unlikely to use transit services. With free-fare promotions, it is not effective to primarily reach existing riders who merely use free-fare coupons as substitutes for cash fares they otherwise would pay.

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RELATED STUDIES

Some evidence exists to suggest that information dissemination and free ride programs may be effective. Ellson and Tebb *(1)* studied a network of eight rural bus services in South and West Yorkshire, England. About 12,000 leaflets containing schedules and route information were distributed on buses, at fixed distribution points, and from model libraries. Ridership on the services increased 13 percent 4 weeks after distribution and was still more than the predistribution level 17 weeks after distribution. The extra revenues directly attributed to the information dissemination were about four times the cost of producing and distributing the leaflet. These results later were substantiated in a study by the Transport and Road Research Laboratory (TRRL) in the city of Bingley, West Yorkshire *(2)*.

Several cities have experimented with elimination of offpeak transit fares to stimulate ridership. In the fall of 1979, the Utah Transit Authority charged no offpeak fares for 1 month *(3)*. The free fares were billed as an introductory offer, and publicity was given to the program to try to stimulate people who did not regularly ride the bus to try it and continue riding. Ridership data and the results of an on-board survey were analyzed. Weekday ridership increased between 4 and 12 percent as a result of the free fares. Most of the extra bus trips during the month of promotion would otherwise have been taken by car, and between 17 and 50 percent were taken by people who had not previously used the system. While a long-term increase of 8 percent on weekday ridership was observed, the hypothesis that no long-term effect occurred could not be rejected.

UMTA has sponsored studies of the effect of system-wide, offpeak free fares in Denver, Colorado *(4)*, and Trenton, New Jersey *(5)*. During the free-fare periods, offpeak ridership increased by about 50 percent. Relatively little of the increase was sustained when fares were reinstated, however. Revenue losses of approximately 40 percent were experienced in Denver. The demand for offpeak service created problems for schedule adherence, capacity, and perceived security.

In a study by the Southern California Rapid Transit District (SCRTD), the effect of alternative means of distributing line-specific free-ride coupons for underutilized lines was examined *(6)*. Three distribution methods (newspaper inserts, direct mail, and door hangers) were tried, each on one line; a fourth route served as a control. A before-measure ridership count was taken within 6 months of the project, and the after-measure count was taken 3 months after coupon distribution. Surveys of coupon recipients and coupon users were undertaken. The coupons were found to increase ridership 18 to 22 percent, depending on method. About three-quarters of the coupons were redeemed by existing users; SCRTD concluded that the trips taken by coupon users were in addition to their regular trips.

RESEARCH OBJECTIVES

The purpose of the research project was to explore the effect on ridership on selected bus routes of an urban transit system of dissemination of information about those routes and of coupons for free rides. The primary question posed was "Does dissemination of information and free-ride coupons stimulate trial by new riders or increased use by current riders, and is any immediate effect sustained over time?"

Specific research objectives included the following:

1. To examine the effects on ridership of the dissemination of information about services.
2. To determine the groups among which information dissemination is most likely to stimulate ridership.
3. To identify the effects on ridership of the dissemination of coupons for free rides, including examination of the time of day of use and the extent to which any increases represent net new ridership as opposed to use of coupons to replace fares that otherwise would be paid.
4. To explore the extent to which dissemination of coupons is effective with different types of recipients (new versus previous riders and frequent versus infrequent riders).

RESEARCH METHODOLOGY

The research reported here was conducted in 1986 in Norfolk, Virginia, a city with a large downtown business district and several large military installations. Two different types of experimental stimuli were applied: (a) information about bus service on a specific route, and (b) information accompanied by a coupon for a free ride on a specific route. Two bus routes were designated as experimental routes, with coupons distributed along part of each route and information only along another part of each route. On a third route, information only was disseminated along part of the route, while another segment served as a control. The bus routes were selected after detailed analysis of all the routes in the system (including their ridership, operating characteristics, and demographics of service areas). The objective was to select three routes that were similar in frequency and hours of service, ridership levels, and characteristics of riders. Routes 1 and 2 were experimental routes. Route 1 ran from the Norfolk CBD along a major street, skirting the huge Naval base and continuing to its terminus at the Naval amphibious base. With a 14-min headway and 89 hr of service per day, this route served approximately 3,200 riders on weekdays. Route 2 ran from downtown Norfolk past a medical center and a university to the Naval base. Serving approximately 2,700 riders on weekdays, this route provided 70 hr of service per day with 15-min headway. Route 3 included experimental and control sections. It, too, originated in downtown Norfolk and ran along a major street to the Naval base. It operated 90 hr per day with a 15-min headway and averaged weekday ridership of 3,300 riders. The experimental design is presented in Table 1.

Four major types of pre- and postmeasures were obtained during the project, as follows:

1. Measures of ridership,
2. Measures of coupon redemption,
3. Measures of coupon users' characteristics, and
4. Measures of riders' characteristics.

TABLE 1 EXPERIMENTAL DESIGN

			Treatment Condition		
Route Segment	Route Number	Description	Information Only	Information and Coupon	Control
1	1	Northern		X	
2	1	Southern	X		
3	2	Northern	X		
4	2	Southern		X	
5	3	Central	X		
6	3	Balance			X

For each route included, postal carrier routes bordering the route or within four blocks of the route were identified. Carrier routes that also were close to other bus routes were excluded. Because most routes originated in the downtown area, the area immediately surrounding the CBD was excluded. To avoid possible spillover effects, buffer zones in which information and coupon distribution were withheld were established between route segments.

Two types of material were distributed to experimental route segments. The information-only material consisted of a two-color brochure (a single sheet of paper folded into several panels). Separate brochures were developed for each route. The cover featured a photograph of a bus being boarded and identified the route name and number and major destinations served. Inside the brochure were a complete route schedule, route map, fare and service information, and instructions for using the bus. The material distributed on coupon segments differed only in that a banner across the front of the brochure read, "Free Rider Coupon Inside, See Details." On these brochures, the last panel was a coupon good for a free ride on all zones on that route, valid until a date approximately 5½ weeks from the date they were mailed. A short questionnaire on the back of the coupon sought information on riding habits and personal characteristics, and the front bore the notation that the coupon could be used only if the questionnaire were completed.

The materials were mailed to every residential postal address in the carrier routes included in the experimental route segments. Table 2 presents the number of packets distributed in each route segment.

A total of 29,155 brochures were mailed, including 13,025 with coupons and 16,130 with information only.

Measures of Ridership

An important measurement was obtained by counting riders boarding at each stop along each of the routes. These measurements were obtained during three periods: (a) a premeasure

TABLE 2 NUMBER OF HOUSEHOLDS PER PROJECT ROUTE SEGMENT

			Treatment Condition		
Route Segment	Route Number	Description	Information Only	Information and Coupon	Control
1	1	Northern	–	7,958	–
2	1	Southern	5,052	–	–
3	2	Northern	4,407	–	–
4	2	Southern	–	5,067	–
5	3	Central	6,671	–	–
6	3	Balance	–	–	9,750
		Total	16,130	13,025	9,750

period in mid-February 1986, (b) a postmeasure period in mid-March 1986, after information was mailed on March 7, 1986, to gauge short-term effects, and (c) a second postmeasure period in mid-April 1986, to gauge longer-term effects. Because ridership varied by day and by block, observations were made on the same three blocks on each of the same 3 days for each route during each measurement period. For example, if the 6:15 a.m. run on Route 1 was observed on the Monday and Thursday of the third week in February, measurements were obtained on the same run and the same days in March and April. In all, about 15 runs were observed on each route on each of 3 days in each of three periods.

Measurements were made during the morning peak and midday offpeak periods; it was not necessary to measure the afternoon peak period, as it was not expected to differ significantly from the morning peak period. Evening and weekend offpeak periods were not measured because they were not as critical to system revenues and ridership. The second and third weeks of the month were chosen because they were least likely to be affected by unusual peaks in ridership.

Measures of Coupon Redemption

The number of coupons redeemed was determined by counting the number deposited in fare boxes each day.

Characteristics of Coupon Users

The questionnaires on the back of coupons yielded the following information: use of the bus system before use of the coupon, frequency of previous use, time of day of coupon use, household size, access to motor vehicle, zip code of residence, age, and annual household income.

Characteristics of Riders

A survey of on-board riders on the project routes was conducted to gather information about rider characteristics and awareness of and response to information dissemination. The self-administered questionnaires were printed on cards, distributed on board to riders and collected before they left the bus. The questionnaire addressed the following areas: use of the bus service before the date of information dissemination, frequency of previous use, household size, access to motor vehicles, zip code of residence, age, and income. In addition, riders were asked whether they recently received information in the mail from Tidewater Regional Transit (TRT). In order to identify coupon users without publicizing the dissemination of coupons to those did not receive them, the questionnaire asked if the information received included a questionnaire and whether the respondent completed that questionnaire. In addition, the interviewers recorded the route segment (information only, coupon, or control) in which the rider boarded and the time of boarding.

The on-board survey was conducted during the second 2 weeks in March, at the same time as the on-board count of ridership and immediately after the information and coupons were mailed. Like the on-board survey, they were concentrated in the morning peak and midday offpeak periods. Approximately 400 questionnaires were completed per route.

FINDINGS

The findings are reported for each of the major data collection methods.

On-Board Survey of Riders

A total of 1,252 riders were surveyed on the three experimental routes. Most riders were high-frequency regular riders who were transit-dependent young adults. Most riders used the system before information and coupons were distributed, and only 9.6 percent were new riders. The majority (61.4 percent) of the previous riders rode the bus 5 days or more per week. Nearly half (44.9 percent) of the riders began their trips between 6 and 9 a.m., although another 46.7 percent began their trips in the midday offpeak period between 9 a.m. and 4 p.m. Only about 37.0 percent of riders usually had access to an automobile. Most (62.6 percent) of the riders lived in households with combined annual income under $15,000, and 39.4 percent reported incomes under $10,000. Over half (55.1 percent) of the riders were 19 to 34 years old. Only about 10 percent of the riders were elderly. About half (48.2 percent) of the riders lived in households with three to five members.

Riders on the three routes did not differ significantly with respect to annual household income, awareness of receiving information, previous use of the bus system, or the frequency of previous users. Not surprisingly, the route serving the university had more riders aged 19 to 24 years.

Only 24.4 percent of those boarding in information-only segments were aware of receiving information, and 21.7 percent of those boarding in coupon segments reported receiving information by mail. Interestingly, 15.4 percent of those boarding in areas to which no information was distributed reported receiving information. There are two possible explanations for this anomaly. The first explanation is that the areas in which riders board are not necessarily near their homes, so a treatment applied in one section of a bus system can have effects in other areas. The second explanation is that there is some amount of error in respondents' reported awareness of promotional activities.

One reason for the relatively low level of awareness is the fact that many riders do not live in areas immediately adjacent to the routes. Areas of residence were assessed by asking respondents for their home zip codes. Many riders did not live in the areas defined at the onset of the project as bordering the routes (17.3 percent on Route 1, 62.4 percent on Route 2, and 17.5 percent on Route 3). Many of these appeared to be riders who transferred from connecting routes.

When new riders were compared to previous riders, no clear differences emerged, and results were not consistent across routes. On two routes, new users were more likely than previous users to have access to motor vehicles. On one route new riders tended to be younger and have lower incomes than previous riders; on another, new riders were more likely to use the bus during peak times.

On all routes, those riding 5 days or more per week were least likely to have access to motor vehicles. High-frequency riders were more likely to board during morning peak hours, as expected, because they tended to be commuters. On one route, very infrequent riders (those riding less often than once per week) were younger.

Examination of the differences between those who reported receiving information and those who did not failed to yield any indication of distinctive characteristics of riders who attend to transit information. Those who reported receiving information and those who did not were essentially similar with respect to previous use of the bus, frequency of previous use, time of boarding, age, income, household size, and access to motor vehicles.

As noted, approximately 9.6 percent of riders were new riders (a finding that suggests that there is a relatively high level of turnover among riders). Of these, 15.9 percent (1.5 percent of all riders) were defined as net new riders gained by information dissemination, a category applied to all new riders who reported receiving information. Thus most of those who were aware of receiving information were already riders, and most were high-frequency riders. Relatively few new riders were gained by the dissemination of information.

Survey of Coupon Users

A total of 909 coupons, or 7.0 percent of the 13,025 mailed, were redeemed. On Route 1, 623 coupons, or 7.8 percent of those distributed, were redeemed; whereas on Route 2 the 286 coupons used represented 5.6 percent of those mailed. About 22.3 percent of the coupons were redeemed during the first week after they were mailed, and 38.9 percent were redeemed during the second week. In the last half of the 5½-week period during which they were valid, only 23.3 percent of the coupons were redeemed. Those using their coupons early in the project were more likely to be high-frequency riders, whereas late users were more likely to be elderly. More than half the coupons were used for offpeak trips. Of those used during peak periods, most were used during the morning peak period, whereas those redeemed during offpeak periods most often were used during the midday periods on weekdays. Peak-period users were more frequent bus users than those who redeemed their coupons during offpeak periods. Peak- and offpeak-period users did not differ significantly with respect to age, income, household size, or vehicle access.

Most coupon users (93.8 percent) were previous riders who used the bus often, although not as frequently as all riders. About 42.9 percent of those who previously used the bus reported that they rode 5 days or more per week, compared to 61.4 percent of all riders surveyed during the on-board survey. Most coupon users were transit-dependent—only 30.4 percent usually had access to cars.

Coupons seemed to appeal largely to low-income persons. Some 51.6 percent of the users reported annual household incomes under $10,000, and 29.1 percent reported incomes of less than $7,000. By comparison, of the riders responding to the on-board survey, 39.4 percent reported incomes under $10,000, and 22.6 percent reported incomes under $7,000. The age distribution of coupon users was similar to that for all riders: 23.6 percent were 19 to 24 years old, and 33.7 percent were 25 to 34 years old; only about 1 in 10 was 60 years old or older.

When coupon users who previously rode the bus were compared to new riders, few differences were apparent. Among the previous riders who used coupons, the relationship between frequency of use and rider characteristics is what would be expected. The ages of high-frequency riders (those who use the bus 5 days or more per week) were more likely to be in the typical working range of 19 to 59 years old. These riders were also more likely to have used their coupons during the peak periods associated with commuters.

The coupon users on the two routes were compared. Those redeeming coupons on Route 2, which had the lower rate of coupon redemption, tended to have higher incomes, to be slightly older, and to live in larger households. The two routes did not differ with respect to previous use of the bus system, frequency of previous use, or access to motor vehicles.

Analysis of Boarding Count Data

Boarding count data were obtained by recording the number of riders boarding at each stop on each run observed on each of 3 days during each of three measurement periods. The number of stops ranged from 161 on Route 2 to 240 on Route 3. As a first step, stops were grouped into the carrier routes in which they are located. When the street along which a bus ran served as a dividing point between two carrier routes, those carrier routes were treated as a group. Had they not been grouped, all riders boarding on outbound runs would have been coded in one carrier route and those boarding on inbound runs in another carrier route, regardless of where they lived. The information entered into the database was the number of boarding riders in a given carrier route cluster on a given run on a given day for a given period.

Transformation of the data was required. The results gained by simply looking at the absolute magnitude of changes between periods would have been distorted by the scale effects of differences in the routes and the sizes of carrier route clusters and by possible externalities. It was not possible to calculate meaningful percent changes because of the problems inherent in determining the percent change implied by a drop from 3 or 4 riders to none. To counteract these problems, boarding counts were standardized to deviations from average boardings. Analysis of variance was then done on the differences in z scores between the premeasure and first postmeasure counts, between the premeasure and second postmeasure counts, and between the first and second postmeasure counts.

The total number of boardings by period are presented in Table 3. Overall, ridership on the three routes rose 9.6 percent from February to March and then declined 4.8 percent between March and April. Peak ridership rose 2.0 percent from February to March and 4.5 percent between March and April. Even greater initial gains were seen in offpeak ridership, which rose approximately 13.0 percent between February and March but declined 8.5 percent in April.

Ridership on the route segments on which information only was distributed rose 4.8 percent between the premeasure and the March measure, taken shortly after the information was distributed. However, it declined about 6.5 percent between the March and April observations. Results on the segments that received coupons for free rides showed stronger gains—a rise of 9.7 percent in total boardings between February and March and a decline of only 0.4 percent between March and April. Interestingly, however, the control segment showed the sharpest ridership increases, with a 22.7 percent gain from February to March and a decline of 8.5 percent in April.

Analysis of variance was used to determine if differences between boardings from period to period were statistically significant. Separate analyses were done for changes between the premeasure and the first postmeasure, the premeasure and the second postmeasure, and the first and second postmeasures. The dependent variable in each was the change in the standardized boarding counts between the two periods under consideration. The treatment condition (information only, information with coupon, and control) and time period (peak or offpeak) were introduced as factors. Table 4 shows the results for the test for short-term and longer-term effects. Despite observed gains in ridership, differences among the three treatments and between peak and offpeak periods were not statistically significant.

The obvious conclusion is that dissemination of information or of free-ride coupons did not have a significant effect on ridership on the routes studied. Neither the treatment nor the time of boarding explained variations in ridership, and there was no significant interaction between treatment and time. Further, the pattern of no significant difference held true when treatment and time were considered individually as factors and when route was introduced, either alone or in conjunction with either time or treatment, or both.

To determine whether the characteristics of adjoining neighborhoods were associated with the boarding levels in neighborhoods, a number of demographic and economic characteristics of carrier routes were introduced as covariates. The following demographic characteristics were considered:

- Median household income,

TABLE 3 TOTAL BOARDING COUNTS AND PERCENT CHANGE

	Total Boardings			Percent Changes		
	Periods 1	Periods 2	Periods 3	Periods 1-2	Periods 1-3	Periods 2-3
Total	2629	2882	2743	9.6%	4.3%	(4.8)
Peak	800	816	853	2.0	6.6	4.5
Off-Peak	1829	2066	1890	13.0	3.3	(8.5)
Coupon	890	976	972	9.7	9.2	(0.4)
Peak	270	258	306	(4.4)	13.3	18.6
Off-Peak	620	718	666	15.8	7.4	(7.2)
Information Only	1276	1338	1251	4.8	(2.0)	(6.5)
Peak	382	400	391	4.7	2.4	(2.3)
Off-Peak	894	938	860	4.9	(3.8)	(8.3)
Control	463	568	520	22.7	12.3	(8.5)
Peak	148	158	156	6.8	5.4	(1.3)
Off-Peak	315	410	364	30.2	15.6	(11.2)

NOTE: Totals are across all observed routes, runs, days, and carrier routes for a given boarding period.

TABLE 4 ANALYSIS OF VARIANCE OF CHANGE IN BOARDINGS

Source of Variation	Sum Of Squares	DF	Mean Square	F	Significance of F
Pre-Measure to Fist Post-Measure					
Main Effects	4.869	3	1.623	1.149	.328
Treatment	1.120	2	.560	.396	.673
Time	3.571	1	3.571	2.528	.112
2-Way Interaction	1.515	2	.758	.536	.585
Pre-Measure to Second Post-Measure					
Main Effects	3.005	3	1.002	.666	.573
Treatment	2.914	2	1.457	.968	.380
Time	.089	1	.089	.059	.807
2-Way Interactions	.790	2	.395	.263	.769
First Post-Measure to Second Post-Measure					
Main Effects	6.337	3	2.112	1.472	.220
Treatment	1.330	2	.665	.463	.629
Time	4.791	1	4.791	3.338	.068
2-Way Interactions	.778	2	.389	.271	.763

- Percent of households owning motor vehicles,
- Percent of households owning more than one motor vehicle,
- Percent of households in single-family dwellings,
- Percent of households in owner-occupied dwellings,
- Percent of households residing at the current address for 2 years or less,
- Percent of households that are black,
- Percent of households with children,
- Percent of households with only an adult female and no adult male present, and
- Median age of adults aged 18 and over.

For carrier route groups, weighted averages of characteristics for the group as a whole were obtained. Analysis of variance using these characteristics as covariates failed to reveal any pattern of relationship between neighborhood characteristics and changes in boarding levels.

CONCLUSIONS

Dissemination of route-specific service information in a form resembling bus schedules and of single free-ride coupons to residents in areas bordering bus routes was not effective in significantly increasing ridership on those routes. Relatively few new riders were induced to use bus service by the receipt of coupons or information, and existing riders did not significantly increase their frequency of usage. In short, information and coupons stimulated little ridership that could have been expected to result in sustained gains in ridership and revenue.

Most of the riders who were aware of receiving information and most of those who redeemed coupons were existing, high-frequency riders, whose low incomes and lack of access to motor vehicles suggested they were transit-dependent.

At least half of the free-ride coupons redeemed were used for offpeak trips, usually during the weekday offpeak period. This statistic suggests that though free-ride coupons apparently did not attract a large number of new riders, they also did not result in the worst-case outcome of being used primarily by high-frequency riders during peak periods.

The mass distribution of information to residential areas bordering bus routes must be undertaken with caution. Mailing solely to adjoining neighborhoods does not reach riders who transfer from other areas and risks wasting a large number of the promotional materials on staunch nonriders unlikely to be induced to use transit services. To target informational programs for existing services, it may be wise to begin by conducting relatively inexpensive on-board surveys of existing riders to identify both the specific geographic areas in which they live and their characteristics. Direct-mail methods will then allow the transit marketer to target specific areas feeding these services that appear to have high probabilities of containing residents who resemble existing riders and may be induced to use bus service or, if they are already riders, to take additional trips by bus.

Finally, it may be necessary to develop informational materials that do not resemble traditional transit schedules. Disseminating coupons for more than one ride or awarding coupons to those who actually ride may yield different results.

These results are not consistent with those of other experimental projects; however, it is difficult to compare findings because of significant differences in research designs and analysis techniques. Although information dissemination was found to be effective in two English studies, the projects are not comparable with the research described here because the latter was conducted in an urban area, and information was mailed to all nearby residents rather than being made available on buses and at distribution points.

Comparison of this project with free-fare studies in Salt Lake City, Denver, and Trenton also is difficult. First, all these projects involved elimination of offpeak fares system-wide, whereas this project offered single-use route-specific free rides good at any time of day. Denver and Trenton were year-long projects, whereas the coupons distributed in Norfolk were good for 1 month. Further, it is difficult to compare statistical analyses. In Denver, for example, the issue of ridership change was complicated by external influences (introduction of a new fare structure 1 month before project initiation, substantial service increases, and some route restructuring). The measurements of ridership in Denver had to be based on estimated ridership without the free-fare project, with data adjusted for externalities. In the project reported here, ridership measures were based on actual counts, with the days and runs observed carefully matched across observation periods. Although ridership gains were observed, they did not prove to be statistically significant.

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REFERENCES

1. P. B. Ellson and R. G. P. Tebb. *Costs and Benefits of a Bus Service Information Leaflet*. Report LR 825. U.K. Transport and Road Research Laboratory, Crowthorne, England, 1978.
2. P. B. Ellson and R. G. P. Tebb. *Benefits and Costs of Providing Additional Information about Urban Public Transport Services*. Monograph LR 991. U.K. Transport and Road Research Laboratory, Crowthorne, England, 1981.
3. K. Train. The Salt Lake City Experience with Short-Term Elimination of Transit Fares. *Transportation*, Vol. 10, No. 2, Elsevier, Amsterdam, June 1981.
4. *Evaluation of the Denver TRTD Off-Peak Free Fare Transit Demonstration*. UMTA, U.S. Department of Transportation, March 1980.
5. *Service and Methods Demonstrations Program Summary Report*. UMTA, U.S. Department of Transportation, Dec. 1981.
6. *Four-Way Marketing Test*. Southern California Rapid Transit District, Los Angeles, May 1981.

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Estimating Small-Area Public Transit Use by Direct Survey

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Projecting ridership for a new transit service requires market research to establish the probable level of demand and the proper fare and service frequency. To assess the market for proposed bus services in Northern Virginia, a survey was conducted of all households in the proposed service areas. Questions asked on the survey were designed to permit analysis using a screening process to determine if the respondent was a probable transit user. The screening was based on work trip characteristics (e.g., work hours, work place, proximity to Metrorail) and worker characteristics (e.g., need to pick up or drop off children). For the one bus service initiated since completion of the analysis, ridership is quite close to that obtained from the screening process.

Should a new bus service be instituted? How frequently should service operate? What fares should be charged? These questions are faced by transit operators on a day-to-day basis. Many techniques have been applied to provide answers. Some of the techniques used to estimate patronage and hence costs and revenues for new services include

- Subjective evaluation based on comparison with similar existing services,
- Application of specially designed short-term forecasting models *(1–3)*, and
- Application of regional travel demand models.

Each of these approaches has limitations that suggest the need for alternative procedures. When applied by an experienced practitioner, subjective evaluation can yield reasonable results; however, no two cases are ever exactly comparable, and slight variations in demographic or work location characteristics can lead to large variations in transit use. Two neighborhoods may look the same, but if one has a higher concentration of CBD workers, the transit use patterns may be quite different.

Specially designed short-term models can also yield quite good results *(4)* but are only an option if a previously developed, calibrated, and tested model is available. Developing a model for route level patronage forecasting requires gathering travel pattern and demographic data at a level of fine geographic detail, describing the quality of transit services at the same level of detail, and then using statistical techniques to fit a relationship. Even when a good overall fit is obtained, there will be cases for which the estimate has substantial error. This will not be due to any defect in the model but rather is inherent in any statistical procedure. Thus for any specific route or service proposal, the patronage estimate could have a large probable error.

Regional travel demand models typically do not offer adequate precision to provide useful estimates of transit patronage on a small scale, for example, a single route serving a specific neighborhood.

Stopher et al. *(5)* present a method for using regional-level simulation data for route level planning. The method involves a specially written computer program and requires that networks meet certain specific requirements, providing greater detail than typically found in regional models. Even so, there ". . . will remain a need for a significant level of professional judgment to be applied to the final result." Given the level of effort necessary to prepare regional networks and travel models, a regional approach could be desirable if many route and service options are to be explored. For detailed analysis of only a few options, the analysis effort would not be compatible with the risk.

Two communities in Northern Virginia were faced with the problem of estimating transit use for proposed new bus services. The opening of the final segment of Washington, D.C.'s Metrorail Orange Line provided a high level of line haul services to many communities, but park-and-ride facilities are already filled to capacity. Greater use of feeder bus services will be required to achieve maximum benefit from the rail service. The study described in this paper estimated the demand for feeder bus services in two Northern Virginia suburban communities, the city of Falls Church and Centreville in Fairfax County. The two communities joined with the Northern Virginia Transportation Commission (NVTC) to engage a consultant to estimate demand within well-defined areas and to develop techniques that could be readily applied throughout the region.

STUDY APPROACH

It was determined at the outset of the project that household surveys would be conducted to collect the data necessary for analysis. The project team started with a fresh look at market research techniques, and the first questions to be answered were "Which type of survey should be conducted?" and "How would the survey data be used to estimate transit use?"

A self-administered household survey distributed to every household in the target area was selected as the most comprehensive and cost-effective survey technique. Questions were

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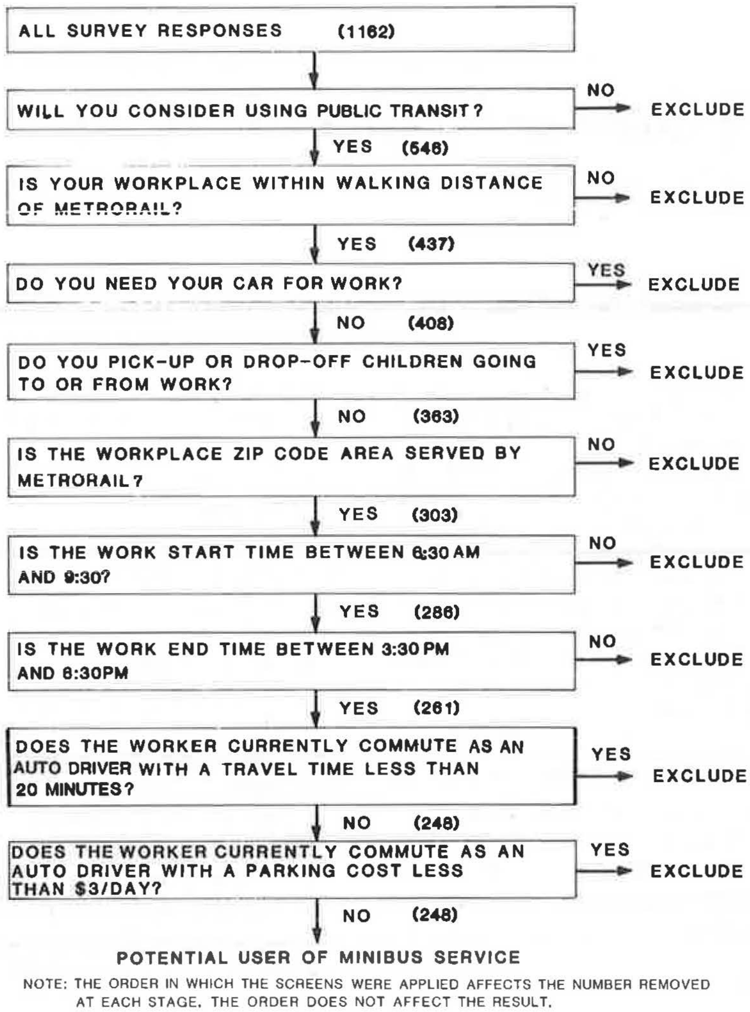

FIGURE 1 Technique for screening survey responses—Falls Church, Virginia.

posed that would enable the analyst to objectively evaluate the strength of an individual response to the basic question "Will you use the proposed feeder service?" The questions and techniques for interpreting the responses are described later. For the analyses described in this paper, the data were gathered from households in the areas of interest by leaving a form with each household, to be picked up after completion, as discussed by Hitlin et al. in another paper in this Record. A telephone survey or other household level survey technique could also have been used to obtain the data necessary for analysis.

Return rates of 23 to 24 percent were obtained in the household surveys. A small-scale telephone survey of nonrespondents was used to confirm that returns from the household survey were representative of the entire population.

Market research studies often explore What if questions, such as "Would you buy this product if it were 10 percent cheaper than product X?" In transit market research, a similar question might be of the form "Would you ride the bus if the stop were 1 block from your home?" Experience has shown that the proportion of respondents that answer yes to such questions is substantially greater than the proportion that will actually exhibit the behavior. A rule of thumb is that for activities requiring a change from current behavior, about one-third of those indicating a change in behavior will actually make such a change. Thus transit service planning based on a stated intent to use a proposed service can lead to provision of far more service than required, excessive expenditure, and poor cost recovery.

To overcome this problem, mode choice models apply known time and cost relationships to estimate the proportion of a population that will choose to use transit. Such models tend to be unreliable for small areas, however, and disregarding stated choice behavior ignores detailed data provided by the very population for which the transit service is proposed.

Rather than apply a rule of thumb to the target group indicating a willingness to use a proposed new transit service, the approach used was to qualify the probable validity of the response by asking a series of questions that would reveal behavior patterns such that the respondent could be classified as either a probable transit user or a probable nonuser. The responses to the qualifying questions were then judged according to predetermined decision criteria. Survey responses that survived the criteria (screens) produced a subset of probable transit users at the end of the process.

The screening questions and elimination process are shown in Figure 1. The first question was, "Will you consider using public transit to travel to and from work?" Respondents who said they would not consider transit use were excluded from the pool of potential riders.

Subsequent questions were used in a series of tests to determine whether the feeder bus or rail service would actually serve the needs of the user. These include "Workplace within walking distance of rail station?" "Workplace in zip code served by rail?" and "Work start and end times that were compatible with planned feeder bus service period?"

For the walking distance question, a specific definition of walking distance (e.g., 2 blocks, 5 min) was not established. Rather, this definition was left to be a subjective measure for each respondent, recognizing that some persons would perceive 2 blocks as too far, whereas others would be willing to walk 1/2 mi or more. The key to an individual's choice is that individual's perception of the walking distance.

The question about zip code of the place of work was used to eliminate unreasonable trips proffered by persons who obviously overstated walking distance or misunderstood the question.

The work start and end time responses could be applied as a screen because the feeder bus service being considered would operate only in the morning and evening peak hours. The service would not be a realistic work trip mode unless the individual's work schedule conformed to the times of proposed service.

A third set of questions related to activities that would make it difficult for an individual to use the combined feeder bus–rail service on a regular basis. These questions were, "Do you need your car for work?" and "Do you pick up or drop off children going to or from work?" The last question reflects the growing importance of child care for many workers. Those who responded yes to either of these questions were considered unlikely to use the proposed feeder bus service and were eliminated as potential patrons.

Finally, three questions were asked about the current trip pattern: current mode used, door-to-door travel time, and daily parking cost. Those who were currently automobile drivers and had either a door-to-door travel time of less than 20 min from Falls Church (45 min from Centreville) or a parking cost of $3.00/day or less were then screened out. Trip times on the bus-rail service would exceed 20 min (or 45 min, respectively) in all cases, and the cost of a bus-rail trip would be $3.00/day or more.

The application of the screening technique yielded a pool of potential users of the feeder bus service. This estimate was then adjusted to account for frequency of use to determine daily patronage. The findings and interpretation of the survey results for each community are discussed next.

City of Falls Church

The city of Falls Church is bounded on the east and west by newly opened Metrorail stations. The city was particularly interested in determining the demand for feeder bus service at various service frequency and fare levels in order to decide whether the city should undertake provision of service and, if so, what type of service. A total of 1,162 Falls Church residents who were employed outside of the home responded to the survey, and 21 percent of them remained after application of all screens. Figure 1 shows the process and the number of respondents remaining after application of each screen. Because many responses fail on more than one screen, the number remaining at each stage depends on the order of application. Table 1 presents the number of respondents failing each specific screen.

It is noteworthy that at least 45 percent of the surveyed group passed each individual screen, so that no single question would have served as a reliable indicator of probable transit use. In combination, the responses provide a far better indication of probable behavior.

Falls Church is an established suburban residential community located only 8 mi from the Washington, D.C., central business district. Therefore, a large proportion of the work force is expected to be oriented to the downtown area. The survey revealed, however, that only 50 percent of the Falls Church workers travel to locations served by the Metrorail system. The remaining 50 percent are not even potential candi-

TABLE 1 PERCENTAGE OF RESPONSES FAILING INDIVIDUAL SCREENING QUESTIONS—FALLS CHURCH, VIRGINIA

		Yes	No
1.	Will you consider using Metrorail?	(50.7)	49.3
2.	Is workplace in walking distance of Metrorail station?	(47.8)	52.2
3.	Do you need car for work?	21.2	(78.8)
4.	Do you pick-up/drop-off children?	13.3	(86.7)
5.	Is workplace zip code served by Metrorail?	(50.4)	49.6
6.	Is work start time 6:30-9:30 AM?	(87.0)	13.0
7.	Is work end time 3:30-6:30 PM?	(86.1)	13.9
8.	Auto driver, travel time < 20 minutes?	50.0	(50.0)
9.	Auto driver, parking cost < $3.00/day?	55.7	(44.3)

( ) = group considered potential transit riders.

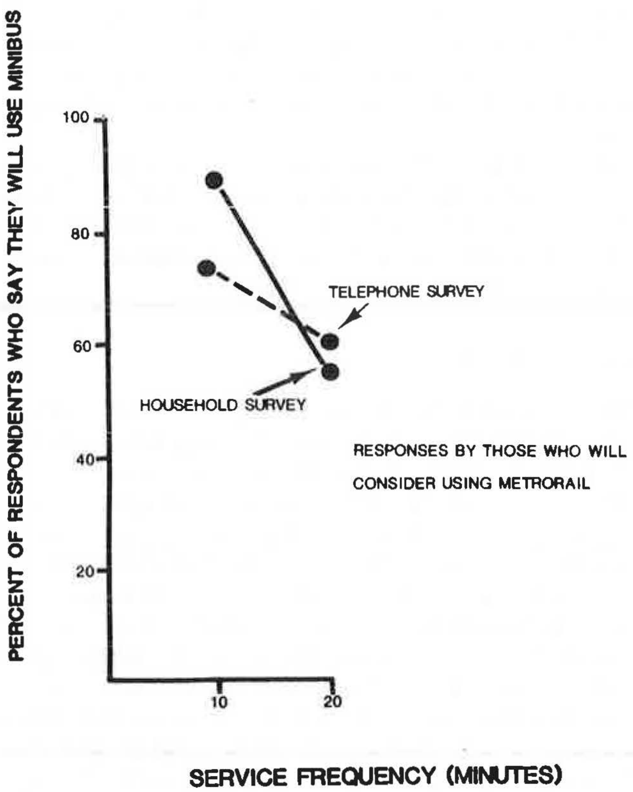

FIGURE 2 Falls Church, Virginia, transportation survey elasticity to frequency as reported by respondents.

dates for a feeder bus service. Thus, whereas only 21 percent of the resident workers were identified as possible system users, they represented over 40 percent of the total potential market.

The potential transit market established through the screening process was based on a service description that featured a free service operated at a 10-min frequency. To develop ridership estimates, it was necessary to adjust for probable frequency of use and for alternative fare and service levels. To provide information on these questions, the Falls Church survey asked, "How many days per week would you use this service?" "Would you ride if the fare was: free, 25 cents, 50 cents, 75 cents?" and "Would you ride if the frequency was: 10 min, 15 min, 20 min?"

On the basis of responses to these questions, for that portion of the sample that answered yes to the question "Would you consider using Metrorail?" the following factors were developed (Figures 2 and 3):

Conversion from potential riders to typical day = 0.60.

This factor was based on response to the question "How many days per week would you use this service?"

Percentage of potential riders who would use the service at a given fare—

Fare (cents)	*Percentage (%)*
0	100
25	99
50	64
75	31

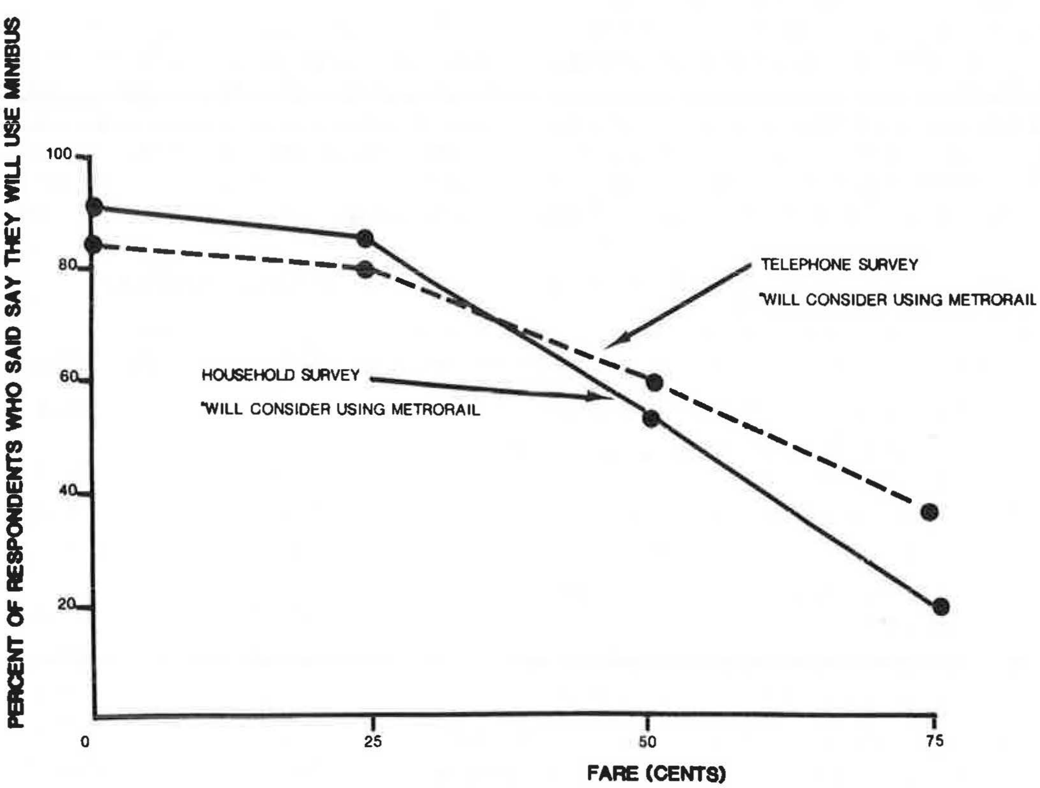

FIGURE 3 Falls Church, Virginia, transportation survey elasticity to fare as reported by respondents.

TABLE 2 FALLS CHURCH, VIRGINIA, PATRONAGE ESTIMATES

SERVICE FREQUENCY	FARE LEVEL		
	Free	$.25	$.50
10 minutes	1324 (± 202)	1308 (± 200)	844 (± 164)
15 minutes	1116 (± 186)	1106 (± 186)	718 (± 152)
20 minutes	900 (± 168)	812 (± 162)	580 (± 138)

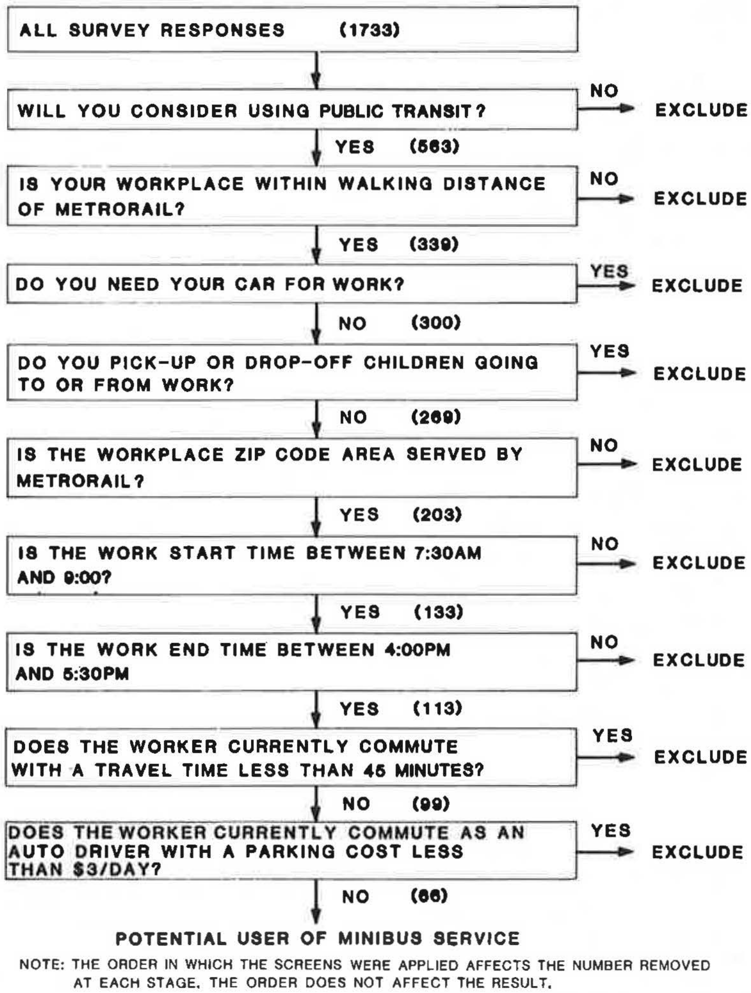

FIGURE 4 Technique for screening survey responses—Centreville, Virginia.

Percentage of potential riders who would use the service at a given frequency—

Frequency (min)	*Percentage (%)*
10	100
15	84
20	68

Estimates of typical daily ridership for each fare and frequency combination were then prepared. These estimates are presented in Table 2.

These data permit the city to evaluate the economics and service benefits of various operating plans and, if it chooses to implement a service, to offer the service best suited to its goals. Further, because the survey was administered uniformly throughout the city and the residence block of respondents was included in the survey data, developing a routing plan targeted to the greatest concentration of potential riders is possible.

Centreville, Fairfax County

Centreville is a rapidly growing residential community located 20 mi from the downtown employment area. Fairfax County,

TABLE 3 PERCENTAGE OF RESPONSES FAILING INDIVIDUAL SCREENING QUESTIONS—CENTREVILLE, VIRGINIA

	Yes	No
1. Will you consider using Metrorail?	(29.9)	62.8
2. Is workplace in walking distance of Metrorail station?	(25.2)	73.1
3. Do you need car for work?	32.1	(67.9)
4. Do you pick-up/drop-off children?	13.2	(86.8)
5. Is workplace zip code served by Metrorail?	(27.0)	73.0
6. Is work start time 6:30-9:30 AM?	(81.7)	18.3
7. Is work end time 3:30-6:30 PM?	(61.2)	48.8
8. Auto driver, parking cost < $3.00/day?	56.6	(43.4)

( ) = group considered potential transit riders.

through Washington Metropolitan Area Transit Authority, started a new feeder bus service to the Metrorail terminal station, approximately 9 mi to the east, in June 1986. Before service initiation, a market research analysis was conducted in Centreville to forecast the number of patrons for the new feeder service. Fairfax County representatives, who had already determined to operate a basic service, also wanted to know whether an earlier or later bus trip would be appropriate.

The market analysis in Centreville was very similar to the process used in Falls Church, as shown in Figure 4 and Table 3. Some of the criteria, such as travel time to work by automobile, were adjusted to reflect the geographic differences between the two communities. Out of 1,733 workers responding to the survey, 563 expressed an interest in using public transit. However, only 66 workers survived all of the screens. These surviving samples represented workers likely to be regular users of the service. To obtain a typical day estimate, a factor of 0.65 was applied to account for the probable frequency of use stated by respondents. On June 26, 1986, 1 week after initiation of service, the new bus route carried 41 patrons during the a.m. period. Counts on 3 days in October 1986 showed 35, 36, and 51 a.m.-period passengers. The observed ridership suggests that the forecasting technique produces reasonable patronage estimates in the short run. A follow-up survey wasplanned for Spring 1987 to confirm the screening factors used to model patron decisions and to put bounds on the time frame that the demand estimate covers.

SUMMARY

The direct survey technique followed by a screening on the basis of the characteristics of individual workers has proven to be an efficient technique for developing reasonable estimates of the market for a new transit service. Real-world factors that affect an individual's choice of mode are reflected in the screens, and each response can be examined in detail. An added benefit is that the procedure can easily be explained to individuals who have little technical knowledge, so that elected officials and citizens groups can evaluate the reasonableness of patronage forecasts.

REFERENCES

1. SG Associates, Inc. *Bus Route Demand Models, Cleveland Prototype Study.* Report OH-09-7002-83. UMTA, U.S. Department of Transportation, Aug. 1983.
2. Tri-County Metropolitan Transportation District. *Bus Route Demand Models, Portland Prototype Study.* Report DOT-I-83-37. UMTA, U.S. Department of Transportation, June 1983.
3. Multisystems, Inc. *Route Level Demand Models: A Review.* Report DOT-I-82-6. UMTA, U.S. Department of Transportation, Jan. 1982.
4. D. G. Yuratovac. Bus Route-Level Demand Modeling. In *Transportation Research Record 862,* TRB, National Research Council, Washington, D.C., 1982, pp. 16–21.
5. P. R. Stopher, W. A. Davidson, L. K. Tamny, and G. S. Spivack. Using Regional Forecasting Methods of the Urban Transportation Planning System for Detailed Bus Route Analysis. In *Transportation Research Record 1037,* TRB, National Research Council, Washington, D.C., 1985, pp. 52–58.

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Regional Transit Connection: A Multioperator Ticket Clearinghouse Experiment

LINDA T. RHINE AND SYDWELL M. FLYNN

The Regional Transit Connection (RTC) is a one-stop ticket and pass clearinghouse for the San Francisco Bay Area that provides a simple method for employers to sell transit tickets and passes to their employees at the worksite. The program began in September 1984 as an UMTA demonstration project with the Metropolitan Transportation Commission as the project sponsor. After federal demonstration funds were expended, the program was extended through September 1987 using local funds. During its 26 months of operation, the RTC has worked out agreements with eight major Bay Area transit operators for sale of transit tickets and passes and enrolled 64 employers and employer consortiums representing 270 separate firms. Sales for October 1986 (the most recent month of operation) totaled $232,000, with the cost/revenue ratio reduced to 4 percent. Plans for expanded clearinghouse opportunities include enrolling new employers, promoting regional sales at selected retail outlets and establishing a regional transit sales office.

The Metropolitan Transportation Commission (MTC), the regional transportation planning organization for the nine-county San Francisco Bay area, received a demonstration grant in fall 1983 from UMTA to develop and implement a coordinated transit ticket program for the major Bay Area transit systems through increased employer participation. In June 1984, MTC contracted with a local consulting firm to set up, operate, and market a transit ticket clearinghouse (one-stop shop) to provide a simple method enabling employers to sell transit tickets and passes at the worksite. This program, known as the Regional Transit Connection (RTC), began operation in September 1984 with one member employer. After 17 months of operation, when the UMTA grant terminated, 42 employers or consortiums of employers representing approximately 150 firms had joined the program. Because it was premature to determine the success and long-term viability of the project, the MTC in conjunction with local transit operators extended the program with local funds through September 1987. At that time, a decision was to have been reached as to whether the program should be continued on a long-term basis.

The major accomplishments during the RTC's 2 years of operation were

- Working out agreements with the eight transit operators for sale of transit tickets and passes,
- Developing and refining all the necessary operating procedures to run the program.
- Enrolling 64 member employers or consortiums of employers representing approximately 270 firms, and
- Completing 26 months of operation, with ticket and pass sales for the most recent month (October 1986) totaling $232,000 and the cost/revenue ratio reduced to 3.8 percent.

The development and evaluation of the RTC during the project 2-year duration is the subject of this report.

The San Francisco Bay Area encompasses nine counties and 93 cities. Over 5 million people live in this 7,000-mi^2 area. Unlike most major metropolitan areas in the United States, which are served by a single dominant transit system, the San Francisco Bay Area is served by eight different major transit systems and several smaller systems. Figure 1 shows the service areas of the eight major transit systems.

Although the major concentrations of employers are in the central business districts of San Francisco, Oakland, and Silicon Valley, residential communities are scattered throughout the region. Consequently, workers who commute to employment centers in Oakland, San Francisco, and San Jose may use several different transit systems.

The RTC was the first entity in the Bay Area to offer the full menu of transit tickets and passes of the eight major transit operators. A complete listing of the transit fare prepayment items by operator is shown in Figure 2. Although ticket and pass sales through employers had previously existed on a limited scale, the concept of a regional transit clearinghouse was new to the Bay Area. The RTC was implemented in addition to existing sales and distribution methods practiced by the eight major transit systems. These distribution methods included sales at district headquarters, retail outlets, and transit operator information center outlets.

The following project objectives were developed as a means by which the project could be evaluated.

1. Increase private sector involvement in promotion of public transportation services.
2. Allow employers to take advantage of tax credits and deductions allowed under federal law. (The Tax Reform Act of 1984 established as a tax-exempt employee benefit an employer-subsidized transit pass of up to $15/month.)
3. Provide a convenient mode of distribution for transit tickets and passes.
4. Enroll 50 or more employers in the clearinghouse program.
5. Develop an experimental database concerning which marketing strategies work and which do not.

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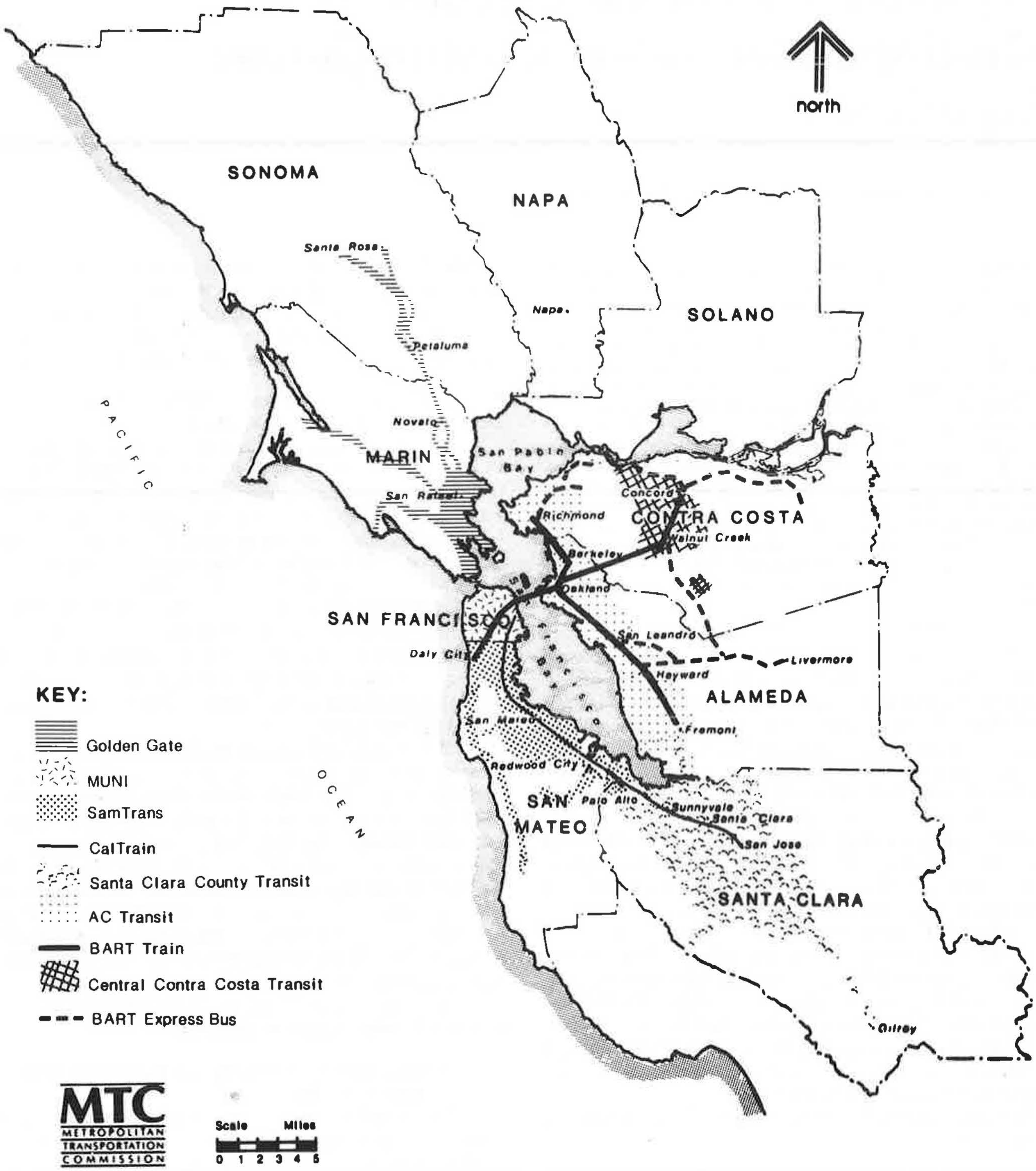

FIGURE 1 Service boundaries of the eight major San Francisco Bay Area transit operators.

(1) AC TRANSIT

20-Ride Ticket Books		
_____	Express Zone 1	$15.00
_____	Express Zone 2	20.00
_____	Express Zone 3	25.00
_____	Transbay Zone 1	30.00
_____	Transbay Zone 2	37.00
_____	Transbay Zone 3	45.00
Monthly Passes		
_____	Local Adult	$30.00
_____	Local Senior	5.00
_____	Local Handicapped	5.00
_____	Transbay Zone 1	54.00
_____	Transbay Zone 2	67.00
_____	Transbay Zone 3	81.00
_____	Youth	16.00

(2) BART

_____	$32.00 Adult	$30.00
_____	$21.00 Adult	20.00
_____	$16.00 Sr. Citizen	1.60
_____	$16.00 Handicap./Youth	1.60

(3) CALTRAIN

Monthly Passes		
_____	Zone 1 to S.F.	$42.20
_____	Zone 2 to S.F.	49.25
_____	Zone 3 to S.F.	56.25
_____	Zone 4 to S.F.	63.25
_____	Zone 5 to S.F.	70.35
_____	Zone 6 to S.F.	75.75
_____	Single zone	36.00
Interzone (Sticker) Required		
_____	1 Zone	42.20
_____	2 Zones	49.25
_____	3 Zones	56.25
_____	4 Zones	63.25
_____	5 Zones	70.35
Interzone (No Sticker Required)		
_____	1 Zone	42.20
_____	2 Zones	49.25
_____	3 Zones	56.25
_____	4 Zones	63.25
_____	5 Zones	70.35
_____	Super Pass Sticker	13.00
_____	Bus/Rail Pass	40.00
_____	Parking Permit	3.00

(4) CENTRAL CONTRA COSTA TRANSIT

_____	40-Ride Punch Card	$22.00
_____	Commuter Card	15.00
_____	Monthly E&H Pass	8.00

(5) GOLDEN GATE

Transbay Ticket Books		
_____	Zone 2 (Saus. Fer.)	$33.30
_____	Zone 3 & 9 (Lark. Fer.)	39.60
_____	Zone 4	45.90
_____	Zone 5 & 7	60.30
_____	Zone 6 & 8	66.60

(6) MUNI

Monthly Passes		
_____	Adult Fast Pass	$23.00
_____	Senior/Handicapped	4.50
_____	Youth Pass	5.00

(7) SAMTRANS

Monthly Passes		
_____	50¢ Ride Value	$21.00
_____	$1.00 Ride Value	42.00
_____	$1.25 " "	52.50
_____	$1.50 " "	63.00
_____	$1.95 " "	70.00
_____	Discount	6.00

(8) SANTA CLARA COUNTY TRANSIT

Ride Cards		
_____	20-Ride Regular	$12.00
_____	40-Ride Express	40.00
_____	10-Ride Handicap.	1.00
Monthly Passes		
_____	Regular	$20.00
_____	Express	29.00
_____	Handicapped	3.00

FIGURE 2 RTC ticket offerings.

ORGANIZATIONAL ROLES

Major participants in planning, operating, and evaluating the RTC are as follows:

- UMTA funded the demonstration and was responsible for monitoring all project activities and expenses.
- The Metropolitan Transportation Commission (MTC), as the grant recipient and project sponsor, had ultimate responsibility for policy decisions and for coordinating consultant, transit operators, and advisory board roles.
- The Regional Transit Association (RTA), an organization of the six largest transit systems in the Bay Area, served as an oversight body during the demonstration.
- The eight Bay Ara transit operators were responsible for processing transit ticket request forms in accordance with predetermined schedules.
- A project Advisory Committee with public and private sector representatives was responsible for review and recommendation of the overall program.
- Crain & Associates, which designed all procedures and systems necessary to run the RTC, currently operates the program, and with MTC is responsible for its evaluation.

PROJECT ADMINISTRATION

In the follow sections, how the RTC works, project organization, the roles of the various participants, and issues that were resolved during the planning and operational phases of the program are discussed.

How the RTC Works

The RTC uses two methods to sell transit tickets and passes: consignment sales and over-the-counter sales.

Consignment Sales

Under this sales option, employers purchase tickets and passes on consignment and then sell them to their employees. The employer and the RTC both sign the Employer Agreement Form, which describes the responsibilities of both parties. The RTC assists the employer in determining the amount and variety of tickets and passes to order and schedules a delivery date. To be cost-effective, the RTC devised a schedule whereby it would visit operators and employers only once each month.

Over-the-Counter Sales

This sales option was offered to selected companies that had no internal mechanism for selling tickets and passes and where there was a reasonable expectation that a high volume of ticket and pass sales would occur, on the basis of the number of employees at the worksite and easy access to transit systems from the worksite.

Operational Issues

Ticket Distribution Schedule

In planning the clearinghouse operation, the first major consideration for the RTC staff was how to set up a schedule for ticket distribution that would be agreeable to all three parties (RTC, operators, and employers) and would require single monthly visits to operators and employers.

The schedule is cost-effective because it calls for a single monthly visit to each outlet. It does, however, cause a continuing although minor problem because RTC staff must simultaneously deal with ticket and pass orders for two different months. If an employer enters the system in January, for example, the RTC processes and delivers its February order in January, but payment and return of unsold items occur at the end of February, at which time the March ticket order has already been delivered.

Ticket Orders Versus Sales

In the early months of the project, there was often a large discrepancy between the number of tickets and passes ordered and the number sold. The RTC wished to avoid this problem because it led to unnecessary accounting time for both the RTC and the operators. By the end of the first 6 months of operation, this problem was largely solved because employers became more aware of their employees' transit needs and because in taking an employer's first ticket order, the RTC staff could offer guidance based on the selling experience of a similar employer.

Sales Volume and Geographic Area Served

Another operational issue that persists concerns employers whose monthly sales volume and geographic location do not justify providing the RTC service.

If the RTC continues beyond its currently funded operation through September 1987, it appears that some companies with low monthly sales (e.g., under $500) should be dropped. At the end of the second year of operation, 10 companies are below the $500 mark.

Security

Security was carefully considered during the RTC planning phase, and specific measures were taken to ensure a safe operation. Typical measures are that all staff handling cash or tickets are bonded, that each delivery is verified by both an RTC and employer representative, and that the employers assume full responsibility for all tickets in their possession.

Computerization

Computerization of RTC accounting began early in the project. The objective was to produce monthly summaries and to verify total sales to each employer. Spreadsheets were also created to chart employer orders, to determine the number of tickets needed from each operator to match employer orders, and to determine the amount owed to the operator for current monthly ticket sales.

MARKETING AND EMPLOYER RESPONSE

Planning Activities and Marketing Efforts

Efforts to market the RTC began in October 1984. Initial enrollment of companies was somewhat slower than anticipated for three principal reasons. First, it is often difficult to identify the right person to contact within a company. The initial approach to candidate employers was through a letter to the top executive, unless the company had a designated transportation coordinator. When this approach brought little response, the RTC staff shifted its emphasis and first attempted to determine the appropriate individual to contact within a company, usually someone within human resources or personnel management.

Second, the internal decision processes to implement the program are somewhat complex and time-consuming. Typically, several departments must review the contract document before a management decision is made. The average time it took RTC staff to obtain a signed contract during the program's first year, from date of initial personal (not mail) contact to delivery of contract, was 2 to 3 months. (During the second year of operation, when marketing efforts were discontinued and the RTC responded only to employer-initiated inquiries, this time shortened to approximately 4 weeks.)

A total of 361 firms were contacted by the RTC during its first year of operation. By the end of the first year, 37 (10 percent) of the firms had joined the program, 34 percent were in the process of making a decision, and 55 percent had declined to participate.

The MTC and RTC staff agreed that the goal of the second year was to refine operations and further reduce the cost/revenue ratio. Thus marketing efforts were discontinued, although the RTC continued to respond to all inquiries from employers who had previously been contacted and those who had heard about the RTC by word of mouth. During the second year, 31 additional firms joined the RTC.

Number of Employers Contacted, by Geographic Area

Figure 3 shows the location of the 64 RTC member employers or consortiums of employers as of October 1986. Of these 64 firms, 10 manage buildings or business parks that house a number of tenants so that the number of firms whose

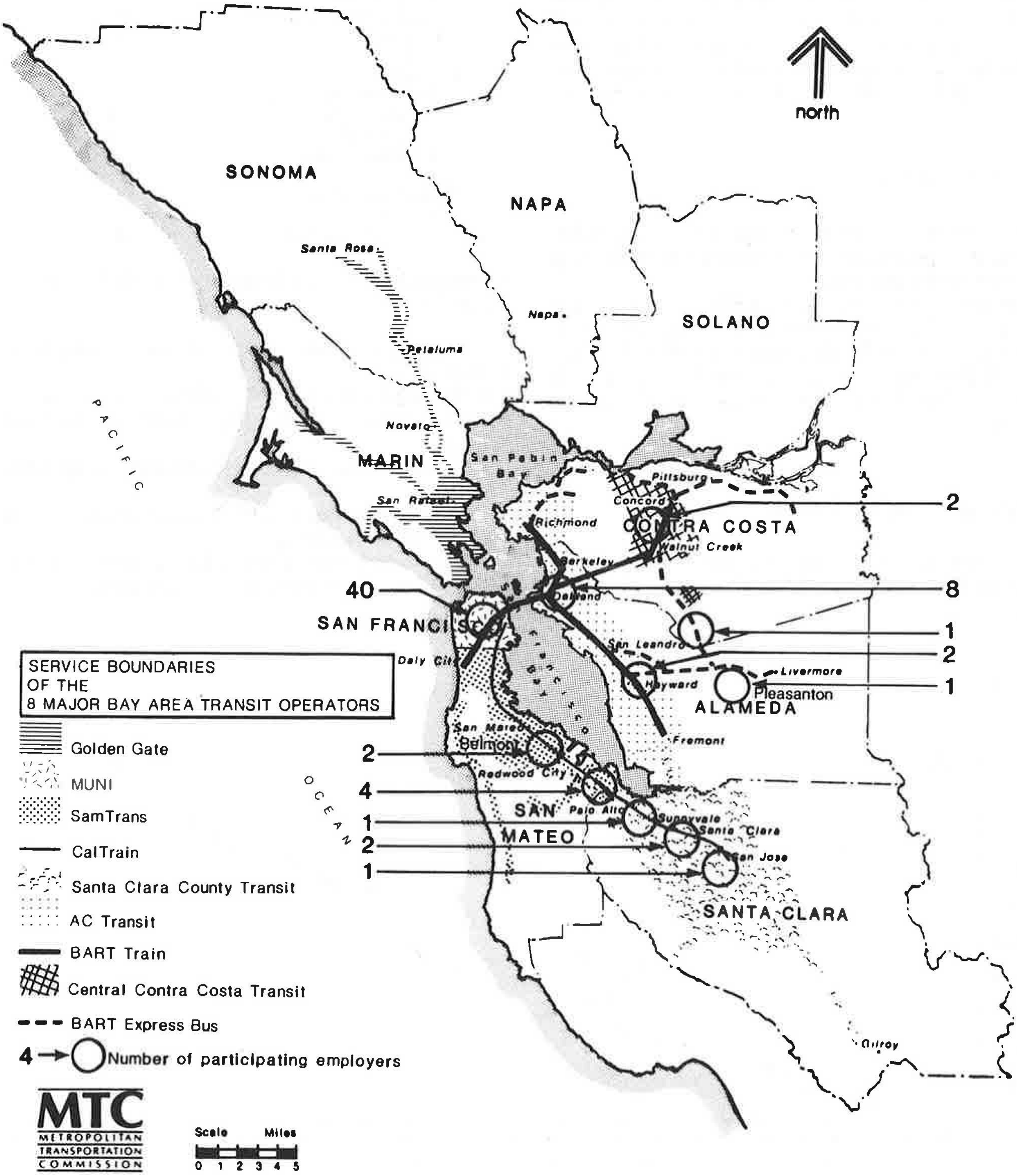

FIGURE 3 Location of member employers.

employees can purchase transit tickets and passes from the RTC is greater than 64 (about 270, although some of these are small firms with less than 10 employees).

During the first year, marketing efforts were concentrated in San Francisco. Reasons for this concentration of effort were (a) San Francisco is well served by six of the eight public transit systems, (b) the lack of parking facilities and high parking costs encourage transit use by commuters, and (c) there is a large concentration of commuters within a single building. In the first year, 23 of the member employers (62 percent) were located in San Francisco, most of these within the financial district. During the second year, after marketing efforts were discontinued, 27 additional firms joined the RTC. Again, most of these (18, or 67 percent) were located in San Francisco.

Value of Tickets Sold

Figure 4 shows the growth in RTC sales over 26 months. The number in parentheses indicates the number of participating employers for selected months.

Two transit systems, the San Francisco Muni and the Bay Area Rapid Transit (BART), account for about 80 percent of all ticket sales. The San Francisco Muni serves all of San Francisco; BART brings commuters from the East Bay (Alameda and Contra Costa Counties) into downtown Oakland and San Francisco.

Factors Influencing Participation

The following table presents a profile of employers participating in the RTC as of October 1986.

Profile of Participating Employers

	No.
Number of Employers	64
Type:	
Public	10
Private	54
Size (employees):	
Small (to 100)	5
Medium (100 to 500)	20
Large (500+)	39
Location:	
Central business district	38
Single site, urban	8
Business park	11
Single site, suburban	7
Transit Coordination:	
Have coordinator	18
Do not have coordinator	46

The principal reasons cited by employers for joining the RTC are the following:

- The program provides low- or no-cost benefit for employees.
- The program is a means to fulfill the transportation systems management (TSM) requirements of the local jurisdiction.
- The program makes it easier for employees to use public transit.
- Through participation in the RTC, companies gain a good image within the community.
- The program provides a way for management firms to offer an amenity to tenants in multioffice buildings.

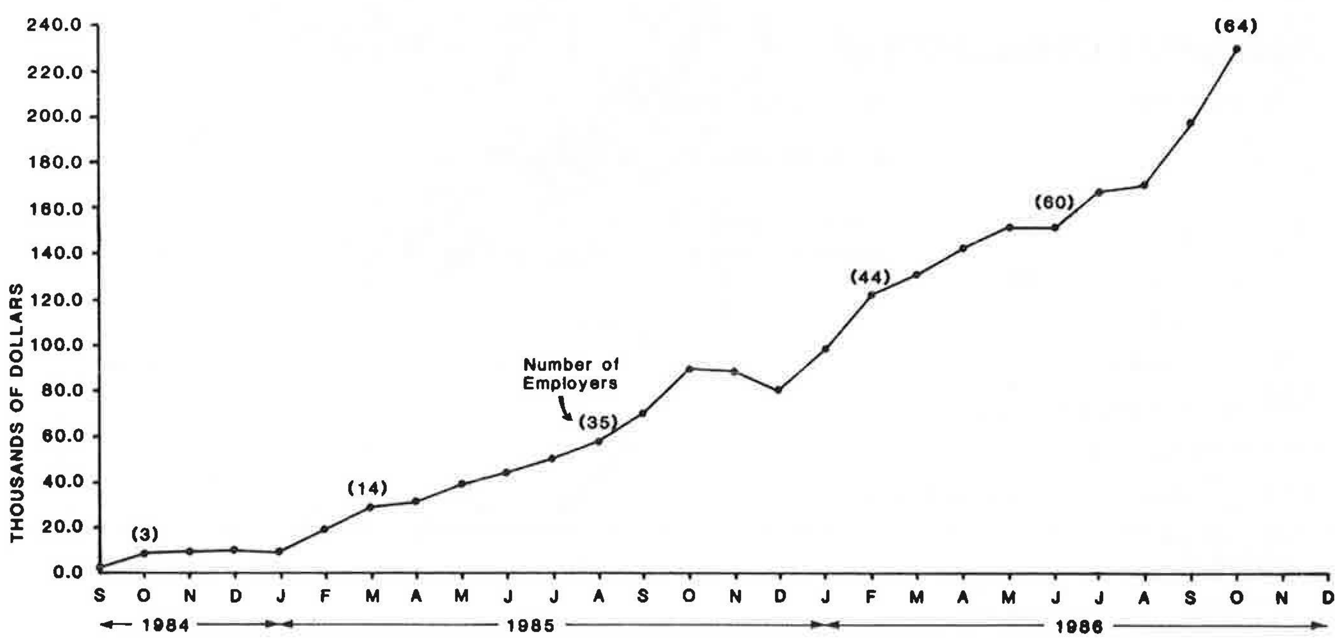

FIGURE 4 RTC revenue, by month.

• Companies lack parking space in rapid-growth areas that no longer have adequate on-street or inexpensive off-street parking.

The two principal reasons an employer would not join the RTC are the following:

• The firm does not have the personnel or does not want to spend the time to administer the program.
• A small percentage of the firm's employees use public transit.

The first reason is often cited by companies that operate on a tight profit-loss margin and by public agencies that operate on a stringent budget. Other reasons offered, which correlate with the first reason, are as follows:

• The firm does not have the right physical space to sell the tickets, that is, there is no general place accessible to employees that also offers the security required for cash transactions.
• The employer has no way to handle cash transactions.
• Accounting is done by a parent firm (often on the East Coast).
• It is too difficult to accommodate a new program, usually because of the company's strict accounting procedures.

To summarize, businesses vary in terms of their interest and willingness to participate in the RTC because of these factors:

Factor	*Likely to Join RTC*	*Unlikely to Join RTC*
Location	CBD, high-density area	Low-density area
Access to transit	Good	Limited
Number of employees	Over 200	Under 200
Type of business	Mix of employees with regular hours working in single location	High percentage of professional employees High percentage of sales staff working out of the office Manufacturing firms with odd hour shifts
Profit-loss margin	High	Low

PROJECT COSTS

Monthly Costs by Task

A breakdown of RTC project costs by task for two typical months is presented in Table 1. September 1985 represents project costs at the end of the first year of operation; October 1986 represents a typical month. Only operating costs are given in the table; one-time costs associated with setting up the RTC, printing, and promotional materials and documentation are excluded. The number of sites served is subdivided by consignment sales (that is, sales of tickets and passes through individual employers), and over-the-counter sales. These sales reach all employees within the building where the sale is conducted and in some cases employees from adjacent office buildings.

In the next section, the 10 activities that represent the monthly operating costs given in Table 1 are described.

Operating Costs

Administration costs include project management and costs associated with security such as insurance against loss or theft of the ticket inventory and rental of a safe deposit box as a repository for the tickets.

The cost of taking orders from employers increases with the number of employers served. However, the cost per employer decreases with the percentage of repeat customers because set-up costs are spread out over time. Employer orders are kept on the word processor and revised as necessary each month.

The cost of ordering from transit operators consists of the courier's time to aggregate and phone in orders and the word processor's time to update the operator order form for the current month. Estimating the number of tickets needed to fill employer orders takes most of the time, because some tickets and passes are good for a whole quarter or indefinitely and can be reused the next month to fill new employer orders *(1)*.

The cost of the transit operator pickups and returns task varies somewhat depending on the number of operators visited each month. Some transit operator tickets and passes are good indefinitely or for a whole quarter, so the courier can skip runs to these operators during some months.

Collating tickets per employer orders is a task that currently takes the better part of a day to accomplish. The courier must take into account the estimate in the task of ordering from transit operators the nonmonthly (good quarterly or indefinitely) tickets still on hand at each employer.

The cost of employer pickups and deliveries increases as the number of employers increases. In September 1985, the average time to serve an employer was just under 1 hr. About one-third of this time was spent processing tickets with the employer representative. The remaining time was for travel, visits to the safe deposit box to keep the value of tickets carried within insurance limits, and productivity loss (e.g., breaks and phoning central office).

The cost of processing returns involves the courier's time to tally the tickets on hand and to check that tally against the difference between tickets ordered and sold, as summarized on the master control sheet for each transit operator.

The cost of ticket and cash accounting involves the accountant's time to audit the sales forms, process payments from employers, and pay the transit operators.

Marketing costs include coordination and outreach only; documentation and development of promotional materials are excluded. Marketing costs remained fairly constant over the first year.

Over-the-counter sales costs are directly related to the number of sales sites because they involve the labor to staff the sale and travel costs to and from the site. The cost of procuring tickets and passes is buried in general operations.

Cost/Revenue Ratio

RTC revenues are increasing as the number of employer sites increases. The rate of increase in costs is being reduced by the learning process. Figure 5 shows cost as a percentage of revenue. As shown in Figure 5 and Table 1, the ratio was reduced to 11.7 percent in September 1985 after the project had been in

TABLE 1 TYPICAL RTC COSTS AND REVENUES

Operating Cost		September 1985 n	September 1985 %	October 1986 n	October 1986 %
Administration		$2,502	30.3	$1,744	19.7
Taking employer orders		312	3.8	620	7.0
Ordering from transit operators		229	2.8	451	5.1
Transit operator pickups & returns		361	4.4	700	7.9
Collating tickets per employer orders		130	1.6	404	4.6
Employer Pickups and deliveries		683	8.3	1,375	15.5
Processing returned tickets		251	3.0	404	4.6
Ticket and Cash accounting		1,253	15.2	2,271	25.7
Marketing[a]		2,073	25.1	--	--
Over-the-counter sales[b]		468	5.7	873	9.9
Total Cost		$8,262	100.2	$8,842	100.0
	Consignment sales	33		60	
# Sites	Over-the-counter	4		4	
	Total	37		64	
Cost/site		$223		$138	
$ Revenues		70,520		231,717	
Revenue/site		1,906		3,621	
Cost Revenue Ratio (%)		11.7		3.8	

[a]Marketing efforts were discontinued in January 1986.

[b]Over-the-counter (OTC) sales costs isolated here are for labor costs to staff the sale site on each day of OTC sales; procurring tickets and passes from transit operators and other costs related to the OTC sales are included in the above cost categories.

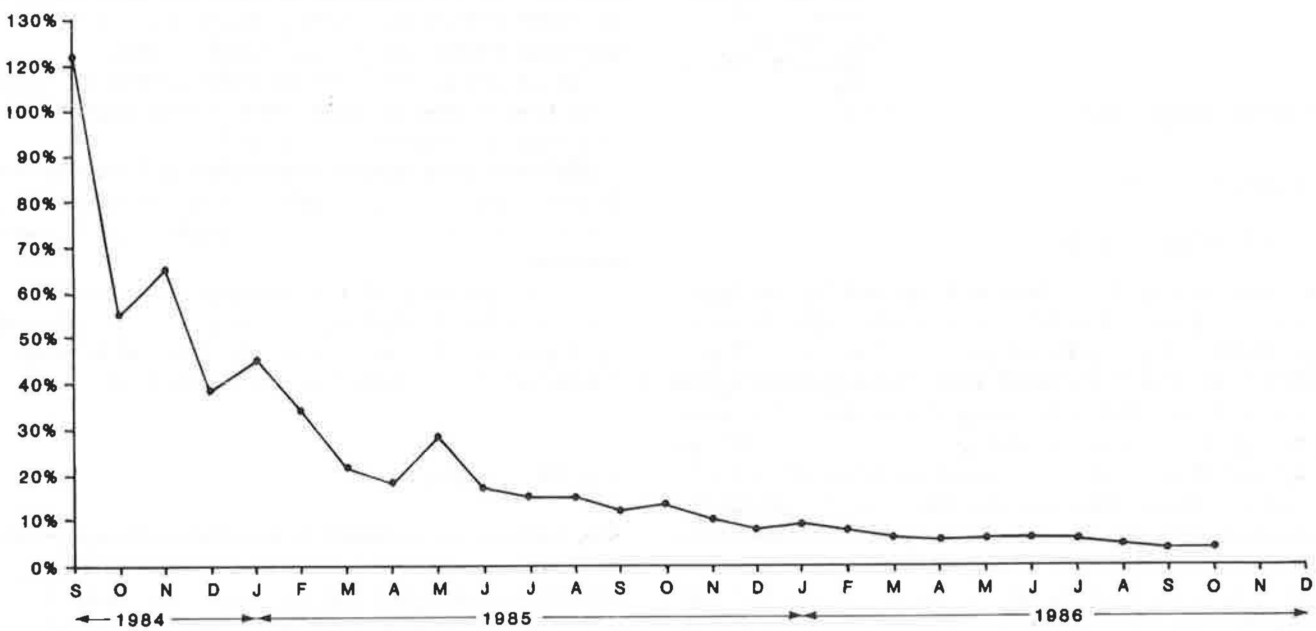

FIGURE 5 RTC cost as a percent of revenue, by month.

operation for 1 year. In October 1986, after 26 months of operation, the cost/revenue ratio was reduced to 3.8 percent.

SUMMARY AND CONCLUSIONS

The Regional Transit Connection began operation in September 1984 as a one-stop transit shop providing a simple method for employers to sell transit tickets and passes at the worksite. After 2 years of operation, the RTC was working well. The RTC has provided transit users with a convenient method for purchasing tickets and passes and has increased the role of the private sector in promoting public transit services.

During the first year of RTC operation, procedures were developed and refined to ensure smooth operation. Such procedures included a ticket distribution schedule, agreements with transit operators and employers, and a computerized system of accounting.

Marketing and outreach efforts resulted in enrollment in the RTC of 64 employers and employer consortiums representing approximately 270 separate firms. The principal reasons cited by employers for joining the RTC are that it is a low- or no-cost benefit to its employees, and for new San Francisco office building projects it is a means to fulfill one of the city's transportation systems management (TSM) requirements.

Ticket and pass sales steadily increased over time after an initial 4-month period of moderate growth. The cost/revenue ratio has shown an improving trend as procedures were refined and the number of employers increased. After 2 years of operation, the cost/revenue ratio was reduced to 3.8 percent and was expected to stabilize under ongoing operations.

Future Funding Arrangements

Funding during the first year of operation was provided by an UMTA demonstration grant. After the UMTA funds were expended, local funds were provided through September 1987 to extend the RTC for an additional 2 years. The goal during this time period was to continue attracting new employers to the RTC and to maintain the cost/revenue ratio at or below 4 percent. A decision to continue funding the RTC on a long-term basis is in large part based on the fact that the RTC is more cost-effective than individual transit operator efforts.

The transit operators have agreed to continue the RTC through June 1988, using a cost-sharing formula whereby each participating operator pays an amount commensurate with the services received. This formula is based on an RTC operating cost not exceeding 4 percent of gross revenue, a minimum fee of $100 per month for each participating operator to cover marketing and outreach efforts, and a cost sharing based on the number of units sold for each operator.

RTC Expansion Opportunities

Three additional services have been tentatively identified as opportunities to expand the RTC.

Regional Ticket Office

The major function of a regional ticket office would be to sell tickets and passes of all the eight major transit systems and to provide transit schedules, maps, and other information at a highly visible central location. This proposal is considered long term, as it requires evaluation of storefront location sites, development of operating procedures and guidelines, and agreement on a secure financing arrangement *(2)*.

Over-the-Counter Sales

The RTC has demonstrated the effectiveness of this sales system, whereby a temporary storefront is established at a major worksite and sales are conducted during a 3-hr period. This sales option is more expensive to run than the regular RTC consignment operation. However, a surcharge could be levied on employers for the additional costs. There has been some interest expressed by downtown developers in San Francisco to pay this surcharge in order to meet one of their TSM requirements.

Delivery to Selected Outlets

This option calls for the RTC to deliver tickets and passes to selected retail outlets in San Francisco and to transit agency ticket outlets. There would be no start-up cost for this activity because the new delivery points would simply be another RTC customer and all procedures for adding new customers are in place *(2)*.

Transferability of Project

The San Francisco Bay Area experience in planning and implementing a regional transit ticket and pass clearinghouse for employers should be transferable to many metropolitan areas, particularly those with a multiple-operator setting. Metropolitan areas served by a single transit operator may wish to start an employer ticket sales program. An important element in developing this type of program is that the participating transit operators have fare prepayment items to offer and that such items are available to employers on a consignment basis. The findings of this demonstration show that employers are willing to sell tickets and passes at the worksite provided that their employees would use and benefit from the service and that the program can be easily administered.

Experience elsewhere shows that transit operators need to make a long-term commitment to an employer pass program because it takes years to build an employer base. In Boston, the Massachusetts Bay Transportation Authority (MBTA) initiated an employer pass program 12 years ago and has gradually increased employer participation to 800 companies. (Telephone communication, Nov. 17, 1986, with Ernest Deeb, MBTA) The Chicago Transit Authority (CTA) has approximately 400 employer accounts after a 9-year commitment to an employer pass program. This program is currently benefitting from word-of-mouth publicity after the first 2 years of intensive marketing efforts. (Telephone communication, Dec. 16, 1986, with Glen Schofield, CTA) A newer program initiated by the Southern California Rapid Transit District (SCRTD) has 16 employers in its Corporate Pass Program (Telephone communication, Nov. 29, 1986, with Terry Davis, SCRTD).

Employer pass programs supplement other distribution and sales methods, such as sales through retail vendors, in-station sales, and mail order *(3)*. At the CTA, employer sales represent approximately 17 percent of total pass sales; at the older and better established program of the MBTA, 60 percent of the total pass sales are through employers.

A common policy among transit properties that sponsor employer pass programs is that there is no commission paid to an employer, whereas a commission is usually paid to retail vendors and other distribution outlets. It is therefore possible that a long-term commitment to an employer pass program can reduce the cost of a transit operator's total sales and distribution budget *(3)*.

Of particular significance in initiating an employer pass program was the experience in San Francisco's financial district, where office building projects of gross area 100,000 ft^2 or more can meet one of the city's transportation systems management (TSM) requirements by selling transit tickets and passes on-site to employers. This requirement enhanced the success of the RTC in San Francisco and was particularly timely in view of the growing interest of major metropolitan areas in implementing TSM ordinances. The results of the RTC experience in the San Francisco Bay Area should provide other metropolitan areas, especially those with TSM requirements, some practical information on how to plan and implement a regional transit clearinghouse and attract employers to its services.

REFERENCES

1. P. Mayworm and A. Lago. The Costs of Transit Fare Prepayment Programs: A Parametric Cost Analysis. UMTA, U.S. Department of Transportation, Feb. 1982.
2. D. Reinke. *Transit Fare Prepayment Distribution Methods in Sacramento, California.* Transportation Systems Center, U.S. Department of Transportation, June 1985.
3. SG Associates, Inc. *Establishing An Employer Pass Program.* UMTA, U.S. Department of Transportation, June 1980.

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AC–BART Joint Ticket: Next Step Toward Fare Integration in San Francisco Bay Area

JOEL MARKOWITZ

A project has been underway since 1980 to improve the integration of fares among the three largest public transit operators in the San Francisco Bay Area: the San Francisco Bay Area Rapid Transit District (BART), the Alameda-Contra Costa Transit District (AC), and the San Francisco Municipal Railway (Muni). AC–Muni and BART–Muni joint passes were introduced in 1981 and 1983, respectively. A new joint fare instrument for AC and BART was introduced in February 1987. For the first time, BART riders using a specially marked, high-value stored-fare ticket will be able to use that ticket as a flash pass for boarding local AC buses. They will no longer need to stop at a transfer-issuing machine or carry exact change for the bus transfer payment. The added convenience and discounted fare were designed to be attractive to the regular riders and to induce them to purchase higher-valued BART tickets. It remains to be seen whether the new instrument will either attract new BART riders or cause current BART riders to shift mode of access. Beyond the immediate goal of providing another two-agency fare instrument, the project will examine new ways to expand the use of stored-value tickets, including on-board bus equipment.

The progress of a long-standing project to improve interagency fare coordination among the public transportation providers in the metropolitan area is updated in this paper. The new interagency instrument described could represent a significant step forward toward a universal stored-value card. Although the market response to the new instrument will not be known for some months, the manner in which implementation issues of design, market definition, pricing, and distribution have been addressed by the project may be useful in other complex metropolitan settings.

The San Francisco Bay Area is served by a large number of independent public transit agencies. In the central metropolitan area, the three largest operators in the region serve overlapping areas. The Bay Area Rapid Transit District (BART), the Alameda-Contra Costa Transit District (AC), and the San Francisco Municipal Railway (Muni) serve three counties that had a combined January 1987 population of approximately 3 million.

To facilitate interagency travel for the patrons in the three counties, the Multioperator Pass and Transfer Project was begun in 1980 as a joint effort of the three operators and the Metropolitan Transportation Commission (MTC). The MTC was created by state law in 1970 to be the regional transportation planning agency for the nine-county San Francisco Bay Area. The agency is charged, among other things, with promoting coordination among the region's transit agencies.

Metropolitan Transportation Commission, Metrocenter, 101 8th St., Oakland, Calif. 94607.

The prior stages of this project have been reported before. A three-volume report sponsored by UMTA was completed in 1981 *(1–3)*. Dittmar *(4)* described the single-system pass users in 1982. The first tangible product of the project was a joint pass enabling transbay AC Transit riders to use connecting Muni services in San Francisco *(5)*, described in 1983. These documents *(1–5)* presented the institutional background for the project, which has continued to be focused on multiagency institutional coordination as much as on technical issues.

BART operates rail rapid transit service within three counties (Alameda, Contra Costa, and San Francisco), with 71 mi of track, 34 stations, and 440 rail cars. Ticketing and fare collection are accomplished with magnetically encoded stored-value fare cards. BART carries about 200,000 one-way trips each weekday. AC operates local bus service in the urbanized strip along the east side of San Francisco Bay and from that area across the San Francisco–Oakland Bay Bridge to a terminal in downtown San Francisco. AC has 850 vehicles and carries about 250,000 trips each weekday. Muni operates diesel and trolley buses, light-rail vehicles (Muni Metro), and cable cars within the city and county of San Francisco. Muni's fleet of over 1,000 vehicles makes over 800,000 trips each weekday. The map in Figure 1 shows the area served by BART, AC, and Muni.

Since 1974, Muni and AC have had separate but similar arrangements for transfers to and from BART. In the 20 East Bay BART stations served by AC, exiting patrons may obtain a paper transfer at no charge from a transfer-issuing machine, similar to those used in Washington, D.C. The two-part transfer is then good for a discounted cash fare on a connecting AC bus away from and back to the station. As of the July 1986 AC fare change, AC riders presenting the BART transfer pay 50¢ during peak periods and 30¢ otherwise, instead of the normal 75¢ base local bus fare.

In San Francisco, patrons deposit one full Muni fare in a transfer-issuing machine and receive a two-part transfer that is honored as full payment on trips away from and back to the station. In January 1986, the Muni base fare, and thus the price of the two-part transfer, went from 60¢ to 75¢.

Since 1974, Muni has maintained the half-fare round-trip discount, but AC has gradually reduced the level of discount with each fare increase. Table 1 presents the recent history of fare changes for AC, BART, and Muni. Only full fares are shown. AC has a flat fare for local service throughout its East Bay service area and three-zone fares for transbay service to San Francisco. Muni has a flat fare for all service within the city but charges a premium cash fare for the cable cars. BART

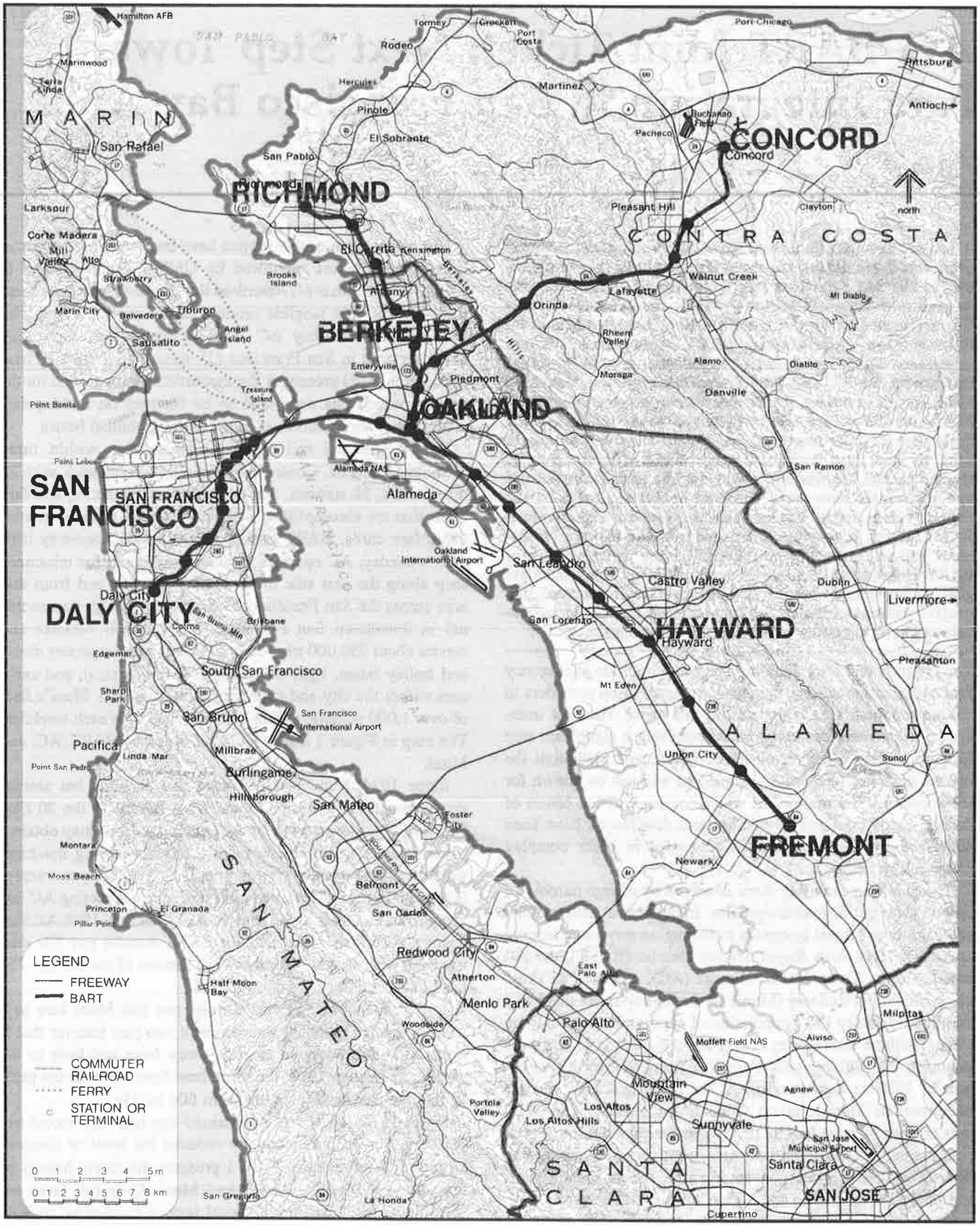

FIGURE 1 Map of San Francisco Bay Area.

TABLE 1 AC, BART, AND MUNI FARE STRUCTURES—HISTORICAL COMPARISON

DATE:	AC TRANSIT Base Fare	AC TRANSIT Local Pass	AC TRANSIT Transbay Fares	AC TRANSIT Transbay Passes	AC-MUNI Joint Pass	S.F. MUNI Base Fare	S.F. MUNI Local Pass	BART-MUNI Joint Pass	BART Base Fare	BART Distance Fares: Low	BART Distance Fares: High
Jul 1978	$0.35		$0.75 $1.00 $1.25			$0.25	$11.00 (x44)		$0.30	$0.35	$1.45
Nov 1979		$15.00 (x43)									
Mar 1980			(x36)	$30.00 $40.00 $50.00							
Apr 1980						$0.50	$16.00				
Jul 1980	$0.50	$18.00 (x36)	$1.00 $1.25 $1.50				(x32)		$0.50	$0.55	$1.75
Oct 1980			(x36)	$36.00 $45.00 $54.00							
Sep 1981					$50.00 $59.00 $68.00						
Apr 1982					$58.00 $67.00 $76.00	$0.60	$24.00 (x40)				
Jul 1982	$0.60	$24.00 (x40)	$1.25 $1.50 $1.75	$45.00 $54.00 $63.00	$67.00 $76.00 $85.00						
Sep 1982									$0.60	$0.70	$2.15
Apr 1983								$24.00			
Oct 1984					$63.00 $72.00 $81.00		$20.00 (x33)	$20.00			
Jan 1986					$66.00 $75.00 $84.00	$0.75	$23.00 (x31)	$23.00	$0.80	$0.85	$3.00
Jul 1986	$0.75	$30.00 Peak $24.00 Off-peak	$1.50 $1.85 $2.25	$54.00 $67.00 $81.00 (x36)	$75.00 $88.00 $102.00						

has a distance-based graduated fare. All three services have a variety of discounts for youth, elderly, and handicapped riders. Although all three services adopted similar base cash fares (50¢ in 1980 and 60¢ in 1982), and AC and Muni had identical local pass prices ($24) from 1982 to 1984, both cash fares and pass prices have since diverged. The differences in pricing philosophy among the three agencies have had a direct impact on the existing and planned interagency fares, as will be further examined in the next section.

THE AC–MUNI AND BART–MUNI JOINT PASSES

The AC–Muni Joint Pass

The AC–Muni joint pass has a limited market, which has changed little since its introduction in September 1981. The joint pass is simply any of the existing three AC transbay zoned monthly passes with a Muni sticker affixed so that Muni vehicle operators can recognize it as a valid fare during the month. This joint pass is not magnetically encoded and thus cannot be directly used on BART or in the faregates of the four downtown stations of Muni's light rail system.

To protect against revenue loss, the AC–Muni pass is priced at the sum of the AC transbay passes and the Muni monthly pass (the fast pass), minus $2. The original combined prices of $50 to $68 have increased with each separate AC and Muni fare change to $75 to $102 in 1986 (Table 1). The $2 discount has been kept constant and now apparently provides little purchase incentive for such high-priced instruments. The AC–Muni joint sticker sales reached a peak of 1,300 in 1981, and have steadily fallen off to 550 to 600 in 1986, tracking the decline in overall AC transbay pass sales (Figure 2).

The BART–Muni Fast Pass

The AC–Muni joint pass market was further reduced with the introduction of the second product of the project in April 1983, the BART–Muni fast pass. Figure 3 shows the sales of BART–Muni passes, which replaced the Muni-only monthly pass. For only $2 more than the AC–Muni pass, an AC transbay rider can buy the BART–Muni pass and get unlimited intra-San Francisco BART rides.

The BART–Muni fast pass allows unlimited travel for a month on all Muni vehicles and on BART within San Francisco. The fast pass is used as a flash pass on all Muni surface vehicles, and the magnetic encoding is recognized by both the Muni Metro light-rail faregates in its subway stations and by the BART faregates in the eight San Francisco stations.

With subsequent BART and Muni fare changes, the BART–Muni fast pass has become a great bargain for intra-San Francisco BART riders, whether or not they ever use Muni. As Figure 4 shows, the number of monthly intra-San Francisco BART trips using the joint pass surpassed those using the regular BART ticket in late 1984 and now constitutes 70 percent of those trips.

The switch from regular BART tickets (and the AC–Muni sticker) to the BART–Muni fast pass was encouraged in October 1984, when Muni reduced the fast pass price from $24 to $20. The windfall to riders was the result of a political decision to return a temporary city surplus to the voters and taxpayers in the form of reductions in fees. The price reduction remained in effect until January 1986, when a general Muni fare increase brought the BART–Muni fast pass price to $23, still lower than the price before October 1984. Because BART increased its base fare at the same time to a higher level than Muni's (80¢ versus 75¢), the resulting multiplier (break-even point) made

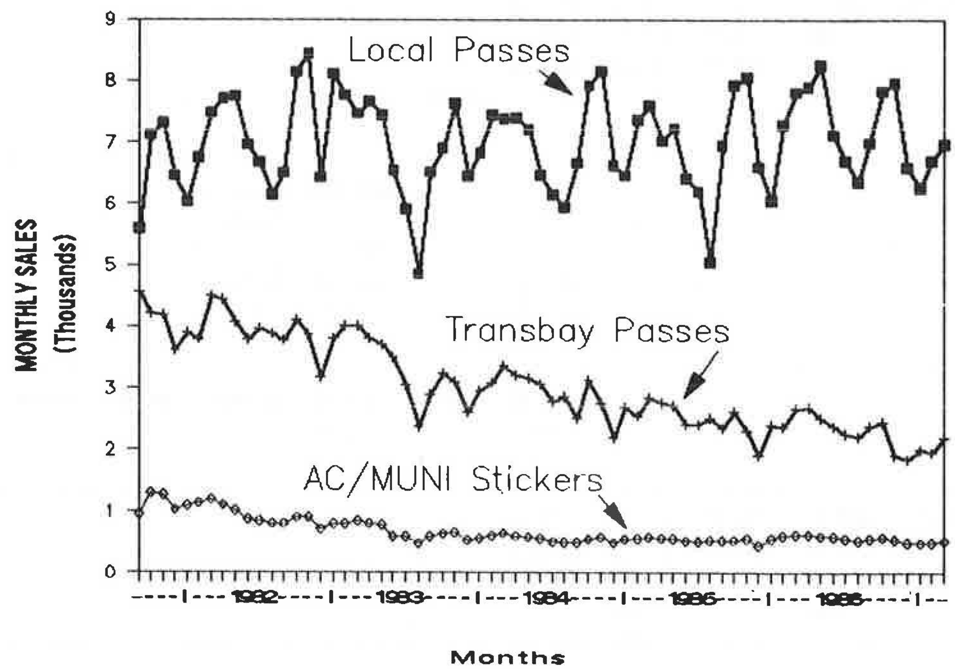

FIGURE 2 AC monthly pass sales—Sept. 1981 to March 1987.

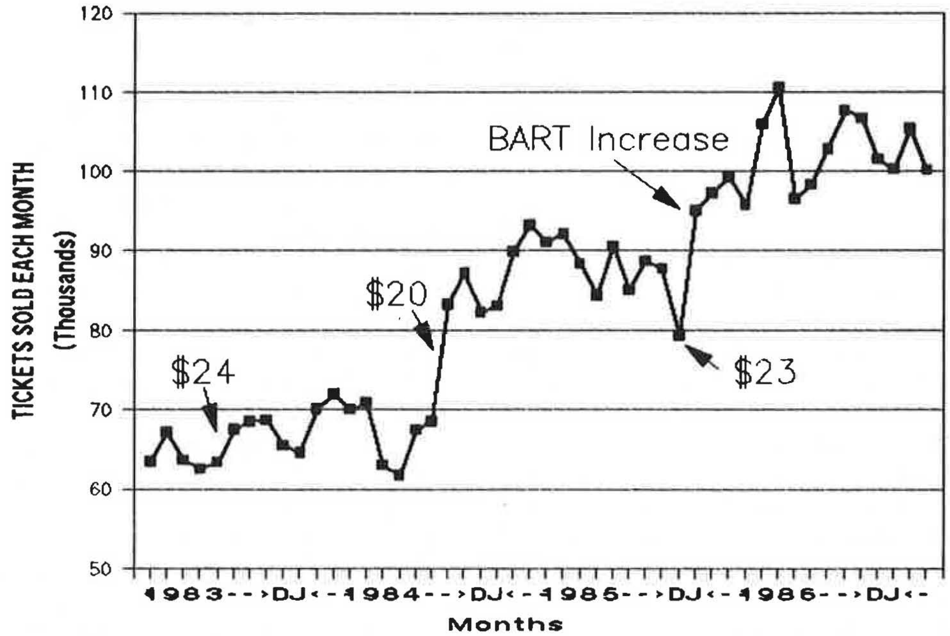

FIGURE 3 BART–Muni fast pass—April 1983 to March 1987.

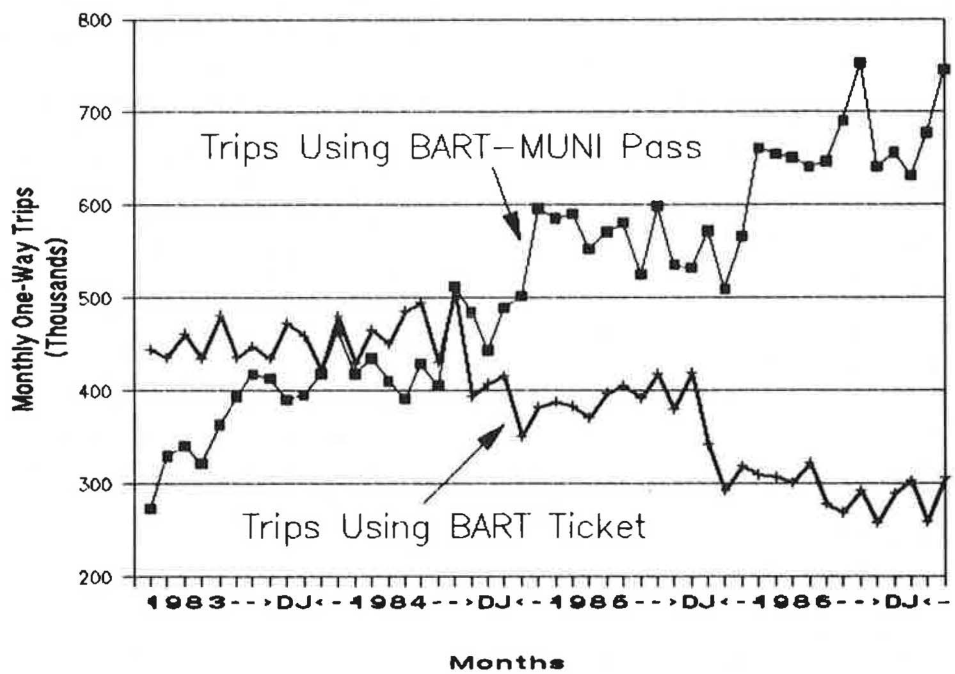

FIGURE 4 Intra-San Francisco BART trips—April 1983 to March 1987.

the fast pass even more attractive to San Francisco BART users.

THE AC–BART JOINT TICKET

Changes in Direction

The AC–BART joint ticket represents a substantial departure from the direction set earlier in the project. In 1982 a tentative decision was made to work toward a joint pass that would be honored by all three agencies. The concept was known as the value-based pass. It would have allowed unlimited rides on any of the systems during a given time period on the basis of the maximum single-trip value printed on the pass. A rider would have bought a pass based on the typical commute trip value and then would have been able to use the pass for any other trip of equal or lesser value on any of the three systems.

It eventually became clear that none of the operators were particularly enthusiastic about pursuing the value-based pass. There were two principal criticisms. First, it would have required a higher level of cooperation in the setting of fares than the operators had ever achieved. Each agency is governed by independent elected boards and views its mission and constituency differently. The coordinated action to simultaneously adopt a common fare structure was perceived by operator staff and management as an insurmountable obstacle. Second, agency staff believed that an unlimited-ride fare instrument would necessarily lead to uncontrollable revenue losses. With the value-based pass rejected, the project came to a standstill.

To help break the logjam, the MTC retained J. W. Leas & Associates as its consultant in early 1985 to critically examine the project and develop other fare integration alternatives. Although the earlier proposal had been to take the bus operators' existing method (unlimited ride passes) and adapt BART to accept it, the new approach was the reverse—to take BART's stored-value limited-ride instrument for use on the buses. The first step in that direction would be to use a modified, time-limited BART ticket as a bus flash pass. This hybrid could eventually be superseded or supplemented by a system of bus-borne magnetic card equipment that would, like BART faregates, subtract value for each ride taken.

The following sections describe the planning and implementation for the AC–BART joint ticket and directions for future work.

Design Features and Limitations

The joint ticket (AC/BART Plus) is aimed primarily at the regular BART commuter who uses AC buses on one or both ends of the BART trip. The Washington Metropolitan Area Transit Authority (WMATA), whose Metrorail system uses a similar automatic fare collection system, also offers a bus-rail 2-week combination pass. That instrument, however, is aimed at the frequent bus rider only. The small rail value ($5 to $6) is included as a bonus to the bus rider and is only sufficient for a few rail trips.

Initially, the joint ticket was to be issued for a semimonthly period, with a monthly version a possible future option as the market dictates. The choice of semimonthly period was based on several considerations:

1. Only a limited number of lines are available to print remaining value on the ticket as it is used; a shorter time period means fewer printing problems.
2. With little local experience with high-value fare instruments, a shorter time period will keep down the price and may overcome initial hesitancy to purchase.
3. Semimonthly is preferred to biweekly to better coincide with the existing monthly bus pass.
4. Semimonthly tickets may be the preferred choice for those who cannot easily predict their trip-making needs or for periods of holidays or vacations.

During the stated period, the rider will use up the BART value printed on the ticket, much like existing BART tickets. Because of initial distribution limitations (to be described further), only eight preencoded joint ticket values will be available. If patrons use up the BART value before the end of the period, they would have to buy additional regular BART tickets to carry them through to the end of the period. At present, the add-fare machines cannot supplement the value of the new joint tickets. An added feature of the joint ticket is the last-trip bonus—a final BART trip of any value can be taken even if only 5 cents of BART value remains on the joint ticket. If value remains beyond the end of the period, it would expire, as does the bus pass.

The principal features being tested in this demonstration are therefore as follows: (a) market interest in high-valued interoperator tickets, (b) acceptance of a semimonthly period, and (c) response to a time-limited BART value. Incentives for purchase include (a) convenience of a single ticket in place of transfers and exact bus fare for each access trip; (b) discounts on both the BART and bus fares (see pricing, to be discussed subsequently); (c) unlimited local AC bus rides during the period; and (d) the last-trip bonus.

In addition to the advantages to riders, increased use of high-valued prepaid fare instruments could have the following operational advantages to BART: (a) reduced cost of ticket stock, (b) reduced wear and tear on vending equipment, and (c) improved cash flow. Because these effects are difficult to isolate, they were not identified as key objectives of the joint ticket. In 1984, however, WMATA reported that 30 percent of its riders bought three or more farecards each week and 68 percent bought farecards of $5 value or less *(6)*.

As with WMATA, BART sells relatively few high-valued tickets, although comparable survey data are not available. Until 1986, BART sold $10 and $21 (sold for $20) tickets through its office, banks, retail outlets, and employers. The $10 ticket has been phased out and a new $32 (sold for $30) ticket was introduced with the last fare increase. Figure 5 shows the pattern of sales of BART's discounted high-valued tickets, which cannot be vended in stations. The dominance in sales of the $32 over the $21 ticket indicates that some BART riders are willing to buy the maximum available value. This is a positive indication for potential high-valued joint ticket sales.

The AC–BART joint ticket thus is breaking new ground relative to previous joint fare arrangements in the Bay Area and elsewhere. The first 6 to 12 months of sales will be used as a critical demonstration of the market for high-valued, time-limited interoperator fare instruments. The pricing levels, distribution methods, and other features (to be described) may have to be substantially modified on the basis of the initial market response.

Defining the Market

The market for this instrument is focused on the regular BART rider. BART ridership is predominantly working and work-related commuters, 73 percent according to the latest BART survey *(7)*. Further, 60 to 70 percent ride BART 4 days per week or more. The overall trend in BART ridership was up from 1980 through 1985 but began to fall off sharply in late 1985 (Figure 6). This drop may have been connected with the sharp drop in gasoline prices in early 1986, exacerbated by the 30 percent BART fare increase in January 1986. Still, BART has maintained its market share in the transbay commute corridor at about 38 percent of peak-period, peak-direction person-trips since 1983.

A special survey of BART riders was conducted in June 1984 to explore interest in joint passes and tickets, although the specific fare instruments described to respondents were somewhat different from the one developed for the AC–BART joint

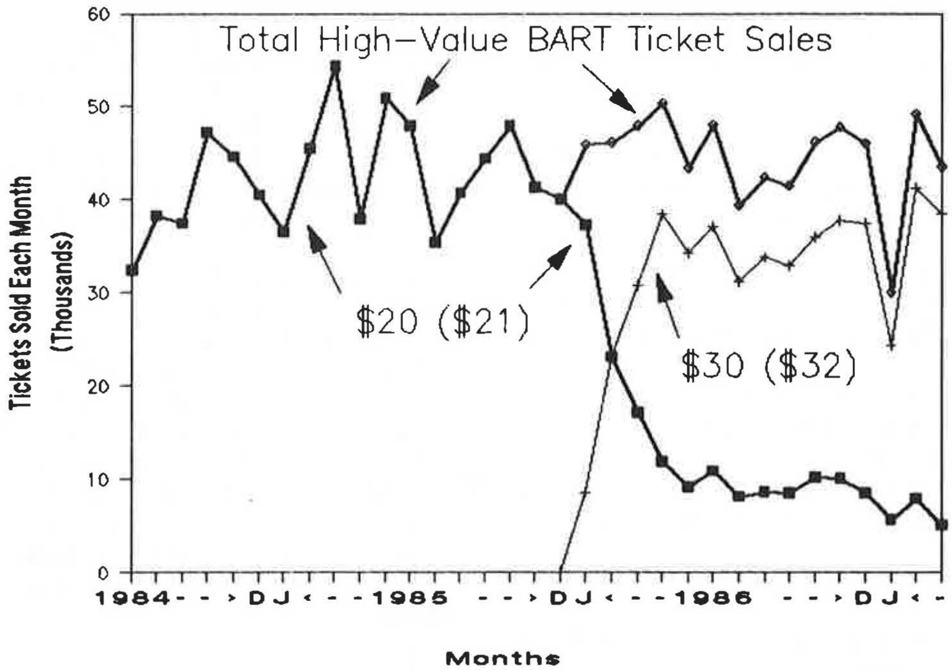

FIGURE 5 BART ticket sales—July 1984 to March 1987.

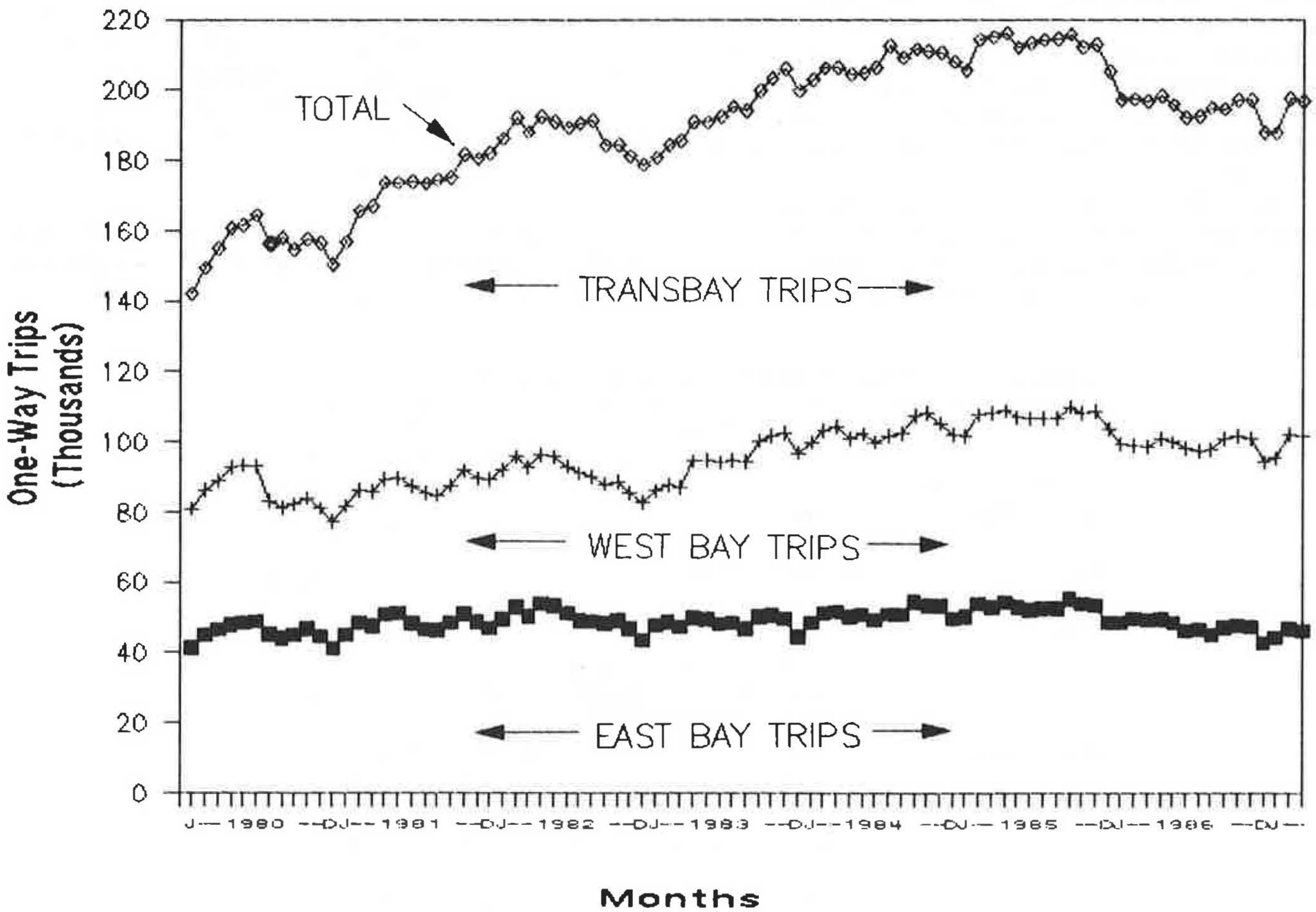

FIGURE 6 Average daily BART patronage—Jan. 1980 to March 1987.

ticket. The study found that 70 percent of all BART riders were interested in such joint tickets. However, only the minority of BART riders who actually used bus access to BART might be truly interested, and only 50 to 80 percent of these might eventually purchase the new instrument *(8)*. This resulted in an initial market estimate of 7,000 to 10,000 persons.

Table 2 shows another way that a market estimate can be derived from approximate aggregate BART markets as of September 1986. BART's market areas are defined as follows:

East Bay CBDs: Central Oakland and Berkeley;
Rest of AC Area: Remainder of the AC service area outside the East Bay CBDs, from Richmond in the north to Fremont in the south;
CCCTA Area: Service area of the Central Contra Costa Transit Authority, serving the suburbs east of the Berkeley Hills, including the five BART stations, Orinda to Concord;
San Francisco CBD: Four downtown BART stations serving the financial, shopping, and theater districts and the civic center;
Rest of San Francisco: Four BART stations in residential areas southwest of downtown; and
Daly City: The Daly City BART station, outside of the BART District in San Mateo County.

The submarket interchanges shown in Table 2 can be summarized by whether either trip end is in the AC service area. Nearly 60 percent of BART trips have one or both trip ends in the AC service area (first two columns of Table 2), including 96 percent of all East Bay trips and 73 percent of all transbay trips. Taking these 112,600 trips as the maximum market, some adjustments can be made to derive a coarse estimate of the joint pass market.

First, divide the number of trips by two, assuming that the one-way trips are symmetrical. Second, of the 56,300 individuals, only 60 to 70 percent are regular enough riders to warrant their considering buying a high-value joint ticket. Third, of these 40,000 persons, only about 20 percent currently use buses on one or both ends of their BART trips. This leaves 8,000 buyers in the primary market. Finally, a smaller number make trips with at least one end in the AC service area and one end at a downtown BART station. The final market is thus 6,000 to 8,000 current BART commuters who use AC Transit, not counting any new BART riders or current riders who switch to bus access. Because this range is about the same as that in the 1984 survey, it will be assumed sufficient for a planning estimate.

Although the immediate market for the demonstration is probably quite narrow, the market potential is much greater. Table 2 shows that 45 percent (86,900 out of 193,800) of all BART riders make trips with at least one trip end in the AC service area and one end in one of the principal downtowns. With BART's parking lots full early in the commute period, the joint ticket may present an opportunity to attract new patrons using transit access. As BART proceeds with its capacity expansion program (more trains, closer headways), the parking access constraints may encourage new patrons to seek transit access, and the joint ticket could become a deciding factor in their choice.

Pricing

BART fares from all East Bay stations to the three downtowns ranged from 80¢ to $2.80. Distribution limitations required reducing the 28 fare values to a manageable number.

Eight values of $5 BART increments were found to adequately cover typical commuting. The pricing in Table 3 was based on the following guidelines:

1. The BART value in $5 increments is given the same discount as the current $32 value BART ticket sold for $30, that is, a 6.25 percent discount.

TABLE 2 BART TRAVEL PATTERNS—DAY, ONE-WAY TRIPS[1]

	East Bay CBD's	Rest of AC Area	CCCTA Area	S.F. CBD	Rest of S.F.	Total
East Bay CBD's	1,600					1,600
	0.8%					
Rest of AC Area	17,700	16,000				33,700
	9.1%	8.3%				
CCCTA Area	4,500	4,200	2,000			10,700
	2.3%	2.2%	1.0%			
S.F. CBD	14,200	45,600	22,800	6,300		88,900
	7.3%	23.5%	11.8%	3.3%		
Rest of S.F.	2,200	4,000	1,200	33,300	3,500	44,200
	1.1%	2.1%	0.6%	17.2%	1.8%	
Daly City	1,100	1,500	700	10,000	1,400	14,700
	0.6%	0.8%	0.4%	5.2%	0.7%	
Total	41,300	71,300	26,700	49,600	4,900	193,800
						100.0%

(1) Approximate number of one-way trips on a typical weekday, Sept. 1986. Calculations made by author from raw data provided by BARTD.

TABLE 3 PRICING

BART Stored Value	Discounted BART Price	Ticket Sales Price
$15	$14	$20
20	19	25
25	23	29
30	28	34
35	33	39
40	38	44
45	42	48
50	47	53

2. The AC value is computed at the offpeak BART transfer charge of 30¢.
3. Some 20 commute trips in a semimonthly period are assumed.
4. Total price is rounded to the nearest dollar.

Each joint ticket was thus priced at

(BART value – 6.25 percent) + (20 trips × 30¢ AC transfer)

A table in the marketing literature helps patrons choose the value that best suits their combination of normal one-way fare and expected trip making. Marketing materials also stress the advantages of the discounted AC transfer and the unlimited ride privileges on the local bus service, so that potential buyers would recognize the combined savings on both services.

With a minimum of 9 and maximum of 11 workdays assumed in a semimonthly period, riders would compute their break-even points relative to taking 18 to 22 trips. For example, a person who normally takes a $1.45 trip would have the choice of buying the $34 ticket ($30 in BART value), allowing 10 days of round trips, with one trip left over, or the $29 ticket ($25 BART value) that allows only 18 trips, requiring purchasing one to four additional BART tickets at the end of the period to take the remaining one to four trips.

One of the important issues for the demonstration and evaluation phase is to determine the purchase and use patterns. Some riders may buy the more expensive tickets, taking into account the added value provided by the last trip bonus and the discount on the BART and bus fares, whereas others may conservatively buy the lowest value, which they are more sure of using up before it expires.

During the introductory period, the loss in AC revenue from pricing the joint ticket at the offpeak transfer rate of 30¢ instead of 50¢ will be partly guaranteed by BART and MTC. The actual revenue experience will be carefully monitored, and the pricing of the AC portion may be modified in the future to meet revenue targets.

Distribution

Because of the more complex magnetic coding for the new joint tickets, they cannot be sold in BART's regular vending machines. They must therefore be preencoded. Neither can a large number of additional types of tickets be sold through most existing retail outlets, grocery stores, or banks, because of their reluctance to take on the additional administrative burdens. A combination of several options is therefore being established:

1. Over-the-counter sales in four downtown BART stations;
2. Location of three new retail vendor outlets near the downtown stations;
3. Increased use of employer-based sales;
4. Increased use of mail-order sales;
5. Sales in three existing transit agency facilities.

In three downtown San Francisco stations and one downtown Oakland station, special sales booths are being installed. The sales costs per unit will be closely monitored relative to the other sales options during the demonstration. Although in-station sales are expected to be the most effective and convenient way to reach patrons, a high sales volume may be needed to offset the costs of the booths.

A few key retail outlets have been established, but as expected, they are willing to handle only a few of the available ticket values. Selected ticket values specific to the markets they serve will be provided to these outlets. In addition, a community ride-sharing office in downtown Berkeley and the student union at the University of California, Berkeley, campus will sell the joint tickets. Employer-based sales have greatly expanded among the largest downtown employers, although patrons who work for smaller employers could be left out. Mail-order sales can be effective but are often costly to staff. To supplement existing AC and BART mail-order sales, arrangements have been made with a private firm to offer toll-free telephone service and credit card payment, paid for by a user surcharge. Sales in three transit agency facilities will complete the distribution picture.

Each of these options has limitations or implementation problems, but the combination should prove effective in reaching the primary downtown commuter market.

Early Response

The AC–BART Plus joint ticket was introduced in February 1987. By the end of the first 3 months of sales, 700 to 800 tickets were being sold each semimonthly period. Only about 40 percent of those tickets were at the minimum $20 price, indicating that there is a market for higher-valued instruments (Figure 7). Although there were increases over the first six sales periods (Figure 8), substantial increases in sales will probably not occur until the in-station sales booths are operational.

CONCLUSIONS AND NEXT STEPS

With the introduction of an AC–BART joint ticket, one more piece of the fare integration puzzle is being put into place. There is still the continuing problem caused by independent jurisdictions taking separate fare actions, but that is the political reality in the Bay Area. As joint fare instruments are introduced, however, these agencies will gain more experience

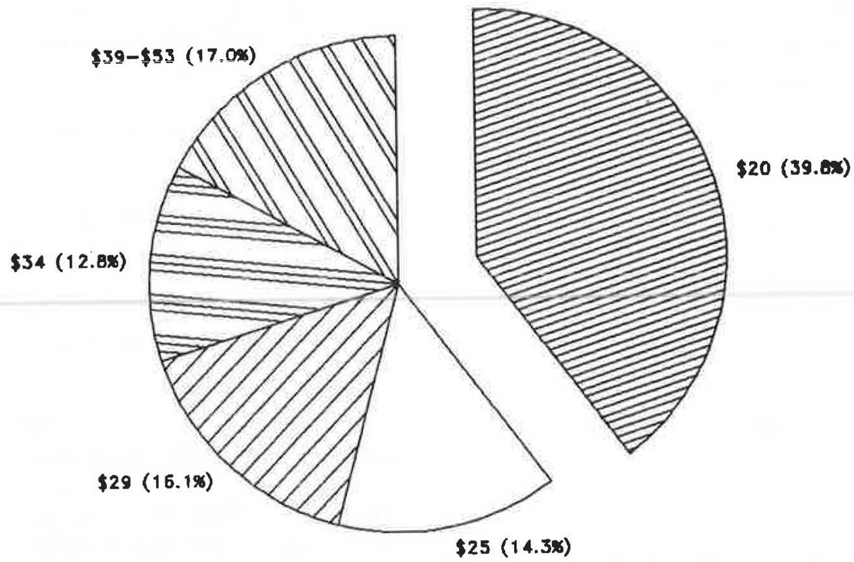

FIGURE 7 AC–BART Plus ticket sales, by value.

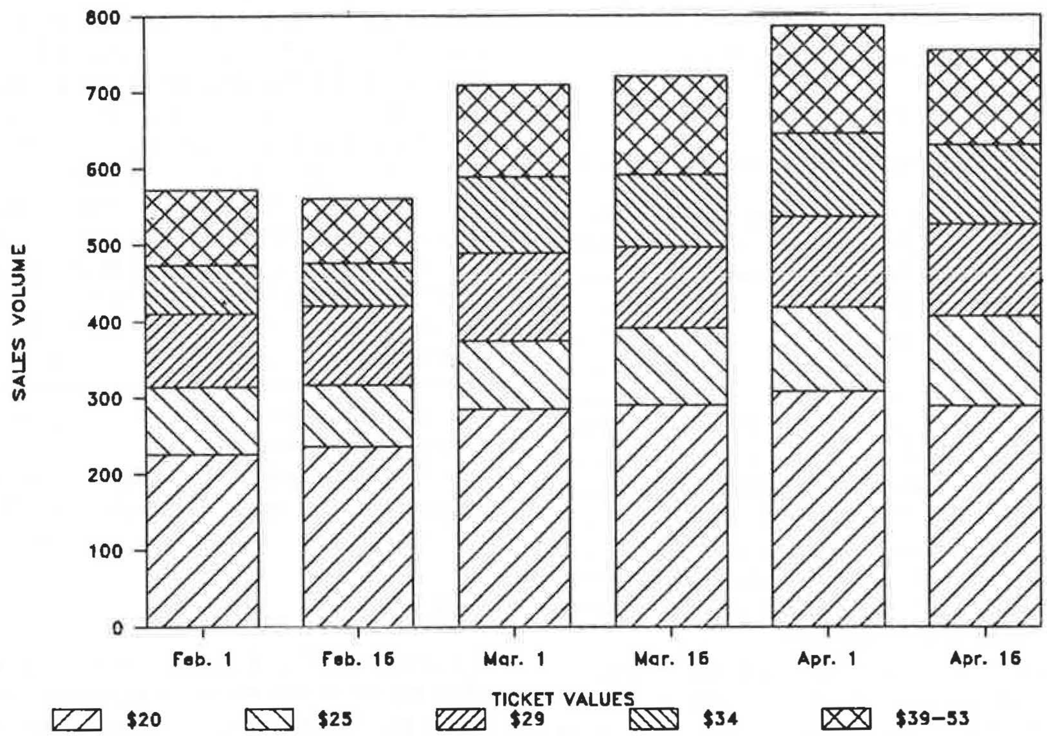

FIGURE 8 AC–BART Plus ticket sales, by sales period.

in working with one another and with the markets for joint fares. The careful evaluation of this demonstration will prove to them whether or not further efforts at fare integration are warranted.

During the introductory period for the new joint ticket, the cost, market, operational procedures, and pricing will be scrutinized, and adjustments will be made as required. By the end of the evaluation, recommendations will be made to the respective policy boards on whether and how to expand or refine the program, including involving other operators in BART's service area and introducing a monthly version.

At the same time, investigations will also continue into two areas of technology development. First, the feasibility of automatic vending equipment for the new tickets will be explored. Such machines should be capable of accepting credit cards and possibly automatic teller debit cards and then vending a properly encoded and printed ticket. This equipment would essentially solve the ticket distribution problem, as well as allow for a larger number of ticket values. Second, specifications for on-board bus ticket reading and writing equipment will be developed, and experience with such equipment elsewhere will be evaluated. On the basis of these findings, financial and institutional issues for implementing one of the courses of action will be outlined. If both vending equipment and on-board bus equipment are economically sensible and technologically feasible, the stage will be set for a universal transit debit card that could be vended anywhere and used on any appropriately equipped surface vehicle. Trip-by-trip recording would provide not only detailed travel pattern data for market analysis but also an accurate basis for interagency revenue sharing. If the latter should come to pass, the interoperator transit user would at last have an integrated fare instrument that would make the color of the vehicle transparent.

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REFERENCES

1. J. Markowitz and H. Dittmar. *Joint Fare Prepayment Demonstration Design Project. Vol 1: Designing and Implementing Multi-Operator Transit Passes in the San Francisco Bay Area.* UMTA, U.S. Department of Transportation, Jan. 1982.
2. J. Markowitz and H. Dittmar. *Joint Fare Prepayment Demonstration Design Project. Vol 2: Describing the Market for Multi-Operator Transit Passes in the San Francisco Bay Area.* UMTA, U.S. Department of Transportation, Jan. 1982.
3. W. Homburger and J. Desveaux. *Joint Fare Prepayment Demonstration Design Project. Vol. 3: Conceptual Plan for Multi-Operator Joint Fare Transit Fares in the San Francisco Bay Area.* UMTA, U.S. Department of Transportation, Sept. 1980/Jan. 1982.
4. H. Dittmar. Profile of Monthly Pass Users in the San Francisco Bay Area. In *Transportation Research Record 877,* TRB, National Research Council, Washington, D.C., 1982, pp. 45–50.
5. J. Markowitz. The AC–Muni Joint Monthly Pass: A Look at the First Step Toward Fare Integration in the San Francisco Bay Area. In *Transportation Research Record 947,* TRB, National Research Council, Washington, D.C., 1983, pp. 34–41.
6. *Attitudes Toward the Automatic Fare Collection System: Patron Study.* Washington Metropolitan Area Transit Authority, Office of Marketing, Washington, D.C., May 1984.
7. Research and Decisions Corp. *BART Passenger Profile Study 1985.* Jan. 1986.
8. Phase III Market Research. *AC/Muni/BART Multioperator Pass and Transfer Project Marketing and Distribution Feasibility Survey.* Jan. 1985.

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A Methodology for Assessing Effects of Federal Subsidy Reductions on Transit Fare and Service

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A simple elasticity-based model is described that was developed to define the sizes of either fare increases or service decreases required to offset possible reductions in federal operating subsidies for transit systems in Indiana. The development of this model is part of a larger study at Purdue University to examine alternative strategies for the distribution of the state's public mass transportation (PMT) funds. The relative significance of the projected fare and service changes on the four categories of transit systems in Indiana and the implications of changes in state PMT funding policy in response to reductions in federal subsidies are discussed.

The federal programs for assistance to urban transit systems are currently in an uncertain state. Present levels of federal operating subsidies may not continue. In an effort to reduce federal deficits, many domestic programs, including transportation, are expected to be cut back. It is argued that the responsibility of operating transit systems primarily lies with the state and local governments.

Revenue for transit operation in Indiana is derived from three basic sources: federal and state subsidies and locally derived income (LDI). The present function of state transit subsidies is to match local funds for federal grants. With a possible reduction in federal funding, the state's role cannot continue to be secondary. State transit funding now will take a more dominant role in addressing the state's transportation and economic development objectives, rather than merely being a matching program for federal assistance.

A study *(1)* has recently been completed at Purdue University to develop alternative procedures for the allocation of state public mass transportation (PMT) funds to the various transit systems in Indiana. This study proposed a system of clustering the transit agencies with similar operational characteristics, providing a basis for a formula distribution of state funds. Currently, this study is being extended to consider the effects on state funding policy of a reduction in federal subsidy.

In particular, the following questions are being addressed: how are the available limited state PMT funds to be distributed? and should the state continue to distribute the funds among all systems proportionately or should the situation be taken as a case of triage, in which only systems with the highest chance of survival in terms of ridership and local support should be funded? The current research addresses these issues and is expected to provide guidelines for subsidy allocation and other aspects of state transit funding.

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OUTLINE OF THE METHODOLOGY

As part of this large study, it was necessary to develop a methodology to examine the effects on fare and service structure of reductions in federal transit operating subsidies. The intention of the methodology was only to define the limits of the effects of subsidy cuts. For simplicity, the effects of subsidy cuts on fares and service are modeled separately. Optimum balances between fare increases and service cuts for each system have not been identified.

The model is based only on broad economic and financial indicators of transit system performance. Individual routes were not considered separately. The projected changes in fares and service should be taken as indicative only.

GROUPING OF INDIANA TRANSIT SYSTEMS

As a result of the recent Purdue study *(1)*, the Indiana transit systems have been divided into four groups for the purpose of allocating state PMT funds. These groups cluster the transit systems such that systems within a group are nearly homogeneous (similar) and the systems of different groups are heterogeneous (dissimilar). The division of systems into groups was based on population, peak hour fleet, average operating speed, wage rate, and type of service, with the expectation that systems within a group could then be compared equally.

This analysis resulted in four general groups, which are shown in Table 1. Group 1 includes the relatively large systems; Group 2 consists of medium-sized systems; Group 3 includes small, fixed-route, fixed-schedule systems; and Group 4 comprises all demand-responsive systems, some of which are county-wide and primarily intended for elderly and handicapped people.

These groupings are approximate only, as each system has its own set of operating characteristics. For example, the NICTD rail system is a unique operation with speed and other characteristics highly different from any other system. As its characteristics are closest to Group 1, it was included in that group. The Madison County system was not a state-supported system in 1984 when the Purdue study was conducted, but it has since become eligible for state support and was included in Group 4 in 1985.

TABLE 1 INDIANA TRANSIT SYSTEMS (1985 DATA)

SYSTEM	POPULATION	ANNUAL REV. VEH. HRS	ANNUAL EXPENDITURE $	FARE+OTHER REVENUE $	FEDERAL SUBSIDY $	OPERATING RATIO *
GROUP 1:						
FT. WAYNE	236 479	123 926	4 266 981	910 141	1 165 093	0.54
GARY	151 953	121 136	5 615 338	2 347 244	1 256 401	0.63
INDIANAPOLIS	711 539	442 784	19 214 946	8 097 601	5 750 666	0.53
NICTD	171 371	42 237	15 521 035	6 121 300	2 173 060	0.42
SOUTH BEND	149 928	136 057	5 144 776	1 172 560	1 229 244	0.62
TOTAL/AVERAGE	1 421 270	866 140	49 763 076	18 648 846	11 574 464	0.52
GROUP 2:						
ANDERSON	66 910	30 296	1 035 815	105 782	464 030	0.25
BLOOMINGTON	52 044	30 089	870 799	151 091	331 041	0.37
EVANSVILLE	130 496	54 040	1 397 277	615 575	443 277	0.47
HAMMOND	93 714	26 760	891 042	147 494	371 774	0.35
LAFAYETTE	91 380	64 614	1 834 531	428 012	700 215	0.49
MUNCIE	77 216	51 635	1 923 140	487 722	623 388	0.51
SO. INDIANA	73 487	11 781	608 414	72 170	268 122	0.27
TERRE HAUTE	63 931	46 513	909 452	179 482	364 985	0.33
TOTAL/AVERAGE	649 178	315 728	9 756 692	2 187 328	3 566 832	0.41
GROUP 3:						
BEDFORD	14 410	6 770	154 380	16 652	68 864	0.26
COLUMBUS	30 614	17 730	287 292	50 470	118 411	0.31
EAST CHICAGO	39 787	21 136	673 463	0	294 400	0.27
LAPORTE	21 796	17 074	324 411	60 203	132 104	0.36
MARION	35 874	10 041	305 222	31 865	136 678	0.25
MICHIGAN CITY	36 850	13 950	365 570	73 166	146 202	0.33
MITCHELL	4 641	1 124	44 615	4 204	20 206	0.25
NEW CASTLE	20 056	12 126	315 408	27 938	139 975	0.29
RICHMOND	41 349	16 498	306 945	91 023	107 961	0.41
WASHINGTON	11 325	2 520	33 535	7 355	13 090	0.35
TOTAL/AVERAGE	256 702	118 969	2 810 841	362 876	1 177 891	0.31
GROUP 4:						
GOSHEN	19 665	1 858	24 353	5 765	9 294	0.36
KIRPC	76 239	6 437	180 451	6 605	85 916	0.21
KOSCIUSKO CO.	59 556	14 507	353 030	53 365	149 833	0.29
LCEOC	51 422	40 227	567 002	157 334	204 834	0.44
MADISON CO.	72 426	685	34 868	2 486	16 191	0.23
MONROE CO.	51 114	10 475	300 386	15 594	142 396	0.21
TRADE WINDS	51 422	42 237	553 363	265 308	167 823	0.50
UNION CO.	6 860	4 547	68 826	5 678	31 574	0.24
TOTAL/AVERAGE	388 703	120 973	2 082 279	512 135	807 861	0.37

$$* \text{ OPERATING RATIO} = \frac{\text{FARE, CHARTER AND OTHER REVENUES + LOCAL ASSISTANCE}}{\text{OPERATING EXPENDITURE}}$$

DESCRIPTION OF MODEL

An aggregate model was developed to consider fare and service changes necessary to offset possible federal subsidy reductions. The model is based on demand elasticities and the details are presented in the following paragraphs.

Fare Changes

The fare change module calculates the increase in fare required to offset the decrease in available funds due to a given percentage of reduction in federal subsidy. The steps are as follows:

- Calculate the value of the given percentage of reduction in federal subsidy for each transit system.
- Calculate the average fare given by total fare revenue divided by total ridership.
- Calculate the increase in fare required at current ridership to offset the subsidy cut.
- Calculate the decrease in ridership arising from the fare increase.
- Calculate the net increase in revenue arising from the fare increase and decrease in ridership. For the elasticity values assumed in Table 2, the increase in revenue will be insufficient to offset the subsidy cut.

TABLE 2 FARE AND SERVICE ELASTICITIES

GROUP	FARE	SERVICE
1 Large fixed route	Average= -0.33 Range= -0.25 to -0.5	Average= 0.7 Range= 0.5 to 0.9
2 Medium fixed route	Average= -0.36 Range= -0.25 to -0.5	Average= 0.8 Range= 0.6 to 1.0
3 Small fixed route	Average= -0.42 Range= -0.3 to -0.6	Average= 0.9 Range= 0.7 to 1.1
4 Demand-responsive	Average= -0.2 Range= -0.1 to -0.35	Average= 0.6 Range= 0.4 to 0.8
TOTAL	(a) Simpson-Curtin Rule = -0.33 (1) (b) APTA = -0.3 (2) 50% range= -0.2 to -0.46 75% range= -0.12 to -0.55	Average= 0.8 Range= 0.6 to 1.0

- Select a larger fare increase. For second and subsequent iterations, the model assumes fare increases to give multiples of the required revenue increase at current ridership.
- Recalculate the net increase in revenue arising from the fare increases and associated decreases in ridership.
- Interpolate linearly between the net changes in revenue for multiples of the required revenue increase to obtain net change in revenue equal to federal subsidy decrease.
- Obtain the fare increase required to give the required net change in revenue.

Service Changes

This module calculates the decrease in service required to offset the reduction in federal subsidy. In the model, service is measured in annual revenue vehicle-hours provided by the system. It could equally be measured by annual revenue-miles or average headway.

- Calculate the value of the given percentage reduction in subsidy for each transit system.
- Calculate the variable operating cost as a proportion of total expenditure. The definition of variable operating cost is discussed in the next section.
- Calculate the decrease in service required at current ridership to offset the subsidy cut.
- Calculate the decrease in ridership arising from the service decrease.
- Calculate the resulting reduction in fare revenue due to the decreased ridership. This additional reduction in revenue will require a matching additional decrease in expenditure.
- Calculate the reduction in additional expenditure and consequent decrease in service necessary to offset the combined effect of the initial decrease in service and ridership. Continue this iterative process until the loss of fare revenue from decreases in ridership between successive iterations is small. The model uses a difference of 10 percent or less.
- Calculate required service reduction as percentage of that existing.

ASSUMPTIONS

The objective of the model was to indicate trends in fare and service changes arising from cuts in federal subsidies. Absolute accuracy in forecasting changes in specific systems was not as important as identifying differences between groups and their relative significance for system viability.

A number of simplifying assumptions were made, consistent with the macroscopic nature of the model and also the limited availability of system data.

- All routes within a system are considered to be equally affected by changes in ridership or service. No attempt has been made to isolate specific effects of individual routes or services.
- Fare and service changes were considered separately. The findings of the model only define the limits of available alternative policies, but the implications of combinations of fare and service changes are discussed in the next section.
- Changes in fares or service were assumed to occur incrementally. Fare collection or scheduling considerations that may constrain systems to make changes in steps were not considered. No allowance was made for capital gains from the possible sale of rolling stock that may be made redundant by service reductions.
- Fare and service elasticities were assumed to be constant for each group and not to vary with the size of subsidy cuts. This simplification may tend to underestimate the effects of large subsidy reductions, but little evidence has been found to quantify changes in elasticity with magnitude of change. Elasticities are discussed further in the next section.
- The average fare was determined by dividing annual fare revenue by annual ridership. It does not necessarily correspond to the normal adult fare. For systems where no fare is charged (East Chicago in Group 3, Lake County Economic Opportunity Council and Trade Winds in Group 4), a base fare of 40 cents was assumed. This is of the order of the minimum nonzero fares within these groups and was only used for the purpose of calculating group average percentage fare increases. This assumption was not necessary for calculating real fare increases, which are therefore a more accurate indication of the effect of subsidy cuts on fares.
- Annual expenditure was divided into two components: fixed and variable costs. Cuts in federal subsidy were reflected as cuts in variable cost, which was assumed proportional to the extent of service provided. Variable costs were taken as

  Operators' salaries, wages, and fringe benefits;
  Maintenance and other services;
  Fuels and lubricants;
  Tires and tubes;
  Other materials and supplies;
  Purchased transportation; and
  Leases and rentals.

All other costs were taken as fixed costs.

- Annual revenue hours of operation were assumed to be 256 weekdays, 52 weekends, and 5 holidays. Peak weekday service was assumed to be 6 hr per day.

Although these assumptions may be simplistic, they are sufficient to indicate the significance, if not the actual effect, of the subsidy reductions.

ELASTICITIES

If the effects of subsidy cuts were only to increase fares or decrease service by amounts necessary to offset the loss in revenue, the calculation of the size of the effects would be simple. However, the secondary effect of subsidy cuts, the reduction in ridership and consequent loss of fare revenue arising from fare increases or service reductions, must also be considered.

Transit demand elasticity is the proportional change in the amount of ridership resulting from a proportional change in a system variable. The fare elasticity is the percentage change in ridership for a 1 percent change in fare. Similarly, the service elasticity is the percentage change in ridership for a 1 percent change in service. All elasticities used are arc elasticities. Table 2 presents the fare and service elasticities used in the model.

Fare Elasticities

The Curtin rule *(2)*, widely used in the transit industry, states that an overall fare increase of 1 percent will shrink ridership by approximately 1/3 of 1 percent. This corresponds to an arc elasticity of –0.33. The Curtin rule is considered appropriate for predicting ridership losses from fare increases on typical, predominantly line-haul, local bus operations *(3)*, such as those included in Groups 1–3.

The American Public Transit Association (APTA) has also analyzed the effect of fare increases on ridership, using data reported by transit managers between 1950 and 1967 *(4)*. This study estimated arc elasticities for over 100 American cities ranging in population from less than 50,000 to more than 1,000,000. The average arc elasticity was found to be –0.33, similar to that derived by Curtin's rule, but in only 12 percent of the cases was the elasticity between –0.31 and –0.35.

Although these estimates are imprecise, the message is clear: the use of average values alone may be misleading. The wide variation in values between different systems must also be considered. For the purpose of the present macroscopic study, a range of elasticity values was selected. This corresponds to the 50 percentile range, as determined from the APTA study.

The APTA study also considered the effects of city size, initial fare, and magnitude of fare increase on observed elasticities. The absolute value of the average arc elasticity increased as the population decreased, indicating that fare increases tend to have greater effects in smaller cities. These average values for given sizes of cities were adopted for the present study with ranges as for the overall average. As the APTA study indicated that neither the magnitude of the average fare before the fare increase nor the percentage increase in the average fare (up to 50 percent) had any discernible relation to the size of the elasticity, these effects were not considered.

Another study that provided evidence to define the range of elasticity values was undertaken in Iowa *(5)*. This study found that the fare elasticity varies considerably, depending primarily on the quantity of transit service. At high levels of service, elasticity is about –0.3 to –0.4, depending on city size. However, absolute values were considerably higher at low levels of service. On the basis of the Iowa definition of level of service (bus-miles per capita), Group 1 and 2 systems have medium to high levels of service. Group 3 has medium to low levels of service and therefore could exhibit higher elasticities. As Group 4 is not fixed route–fixed schedule, no comparison was made.

Elasticities for demand-responsive systems (Group 4) were not readily available but were based on the assumptions that a large proportion of the ridership are elderly or handicapped people who are more dependent on these systems. In addition, the demand-responsive nature implies a higher quality of service than fixed-route systems. Consequently, it was assumed that Group 4 systems are less sensitive to changes in fare. The Iowa study supports in general terms the ranges of elasticities presented in Table 2.

Service Elasticities

Less information is available on the ranges of service elasticities, but it is clear that ridership is more sensitive to service than to fare changes. A 1973 study *(6)* derived service elasticities for 17 transit systems, based on population and level of service (bus-miles per capita). A summary of transit service headway elasticities was also given by Carstens and Csanyi *(5)*. Average service elasticities for each group were obtained on the basis of available information. A range of ±0.2 was assumed to represent the 50 percentile spread in the absence of any more specific data. Service elasticities for Group 4 systems were considered to be smaller than for the fixed-route systems, as the quality of service in demand-responsive systems is inherently higher.

FINDINGS AND IMPLICATIONS

A number of important trends are apparent from the results of the analysis. These trends are discussed in the following paragraphs.

Relative Effect of Subsidy Cuts on Groups

Fare increases and service decreases become larger with increasing group size. Group 1 is the least sensitive and Group 4 the most sensitive to subsidy reductions. On average, Group 1 systems increase fares approximately in proportion to subsidy cuts and decrease service at approximately one-half the subsidy rate. Groups 2 and 3 are sensitive, increasing fares by four and six times the rate of subsidy decrease, respectively, and both decrease service at approximately two-thirds the subsidy rate. Group 4 is more sensitive still, with fares increasing at approximately eight times the subsidy rate and service decreasing approximately in proportion to the subsidy rate.

The explanation of this increasing sensitivity with group number can be explained by examining the relative sizes of revenue available to each group. Figure 1 compares the 1985 operating ratios of the four groups. The definition of operating ratio used in this study is consistent with the earlier study *(1)*, in which operating ratio was represented as a measure of local support for a transit system and computed locally derived income (the sum of fares, charter and other revenues, and local subsidies) divided by operating expenditure. A review of Table 1 would indicate that larger systems have higher operating ratios, whereas smaller systems tend to have lower ratios, reflecting the increasing dependence on nonlocal revenue (i.e., federal and state subsidies) with increasing group number.

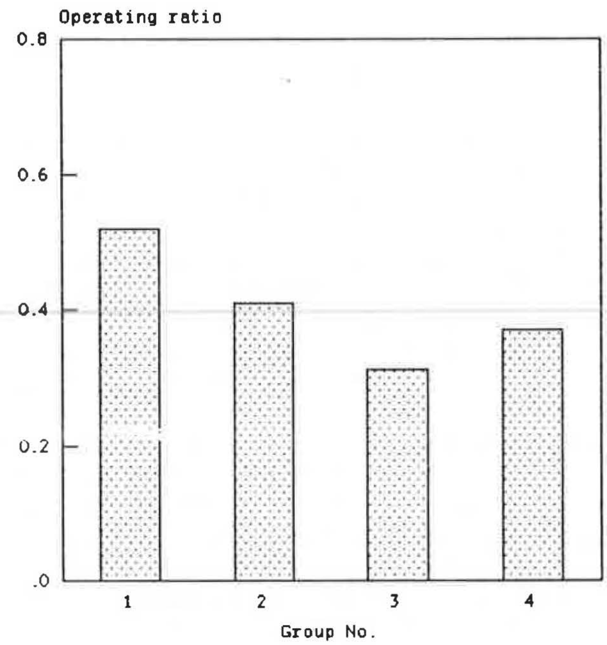

FIGURE 1 1985 operating ratios (group averages).

Consequently, the relative significance of a given cut in subsidy will increase as the dependence on the subsidy increases.

Sensitivity of Fares and Service to Subsidy Cuts

Fares appear to be more sensitive than service to subsidy cuts. For example, a subsidy cut of 30 percent requires fare increases from 40 percent for Group 1 to more than 200 percent for Groups 3 and 4, whereas a service reduction of only 13 to 25 percent is needed between Groups 1 and 4. This sensitivity of fares to subsidy cuts reflects the fact that except for Group 1, fare revenue is smaller than subsidy revenue. Consequently, for

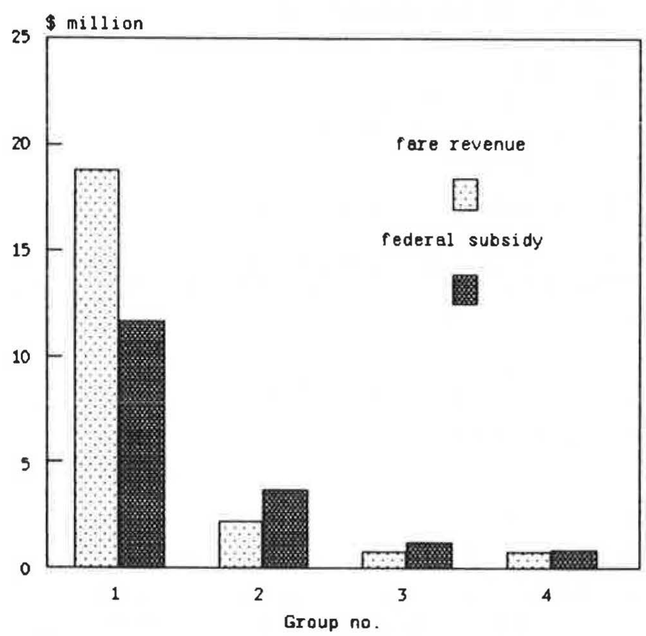

FIGURE 2 1985 fare revenues and federal subsidies (group totals).

a given percentage subsidy cut, the required percentage fare increase must be larger to make up the shortfall in revenue. The relative sizes of fare and federal subsidy revenues are shown in Figure 2.

In addition, the average federal subsidy for each group is smaller than the estimated variable operating cost, which was assumed proportional to service in the model. Therefore the required percentage reduction in service will be smaller than the percentage subsidy cut, reflecting the ability of service cuts to absorb subsidy cuts better than fare increases. Figure 3 shows the federal subsidy for each group as a percentage of variable operating costs.

Significance of Fare and Service Changes

Table 3 presents the significance of effects of subsidy cuts on fare and service. The criteria chosen were a doubling of fare as an upper limit of feasible fare increase and a 50 percent reduction in revenue vehicle-hours as an upper limit on service cuts. In addition, the level of subsidy cuts necessary to require an 80 percent reduction in service is presented as an indication of the level of federal subsidy cuts that would mean virtual elimination of transit service under the existing financial environment.

Again, the lower sensitivity of Group 1 compared with the other groups is apparent. If a policy of equivalent effect is adopted, then it appears that Group 1 systems can accommodate approximately two to three times the level of subsidy cuts of the other groups. In addition, if these criteria are accepted as practical limits to the extent of subsidy cuts for each group, the maximum total subsidy cut would be approximately $9.3 million for fare increases only or $15.9 million for service reductions only. This represents an average subsidy cut of 50 percent for fare increases and 90 percent for service decreases, respectively.

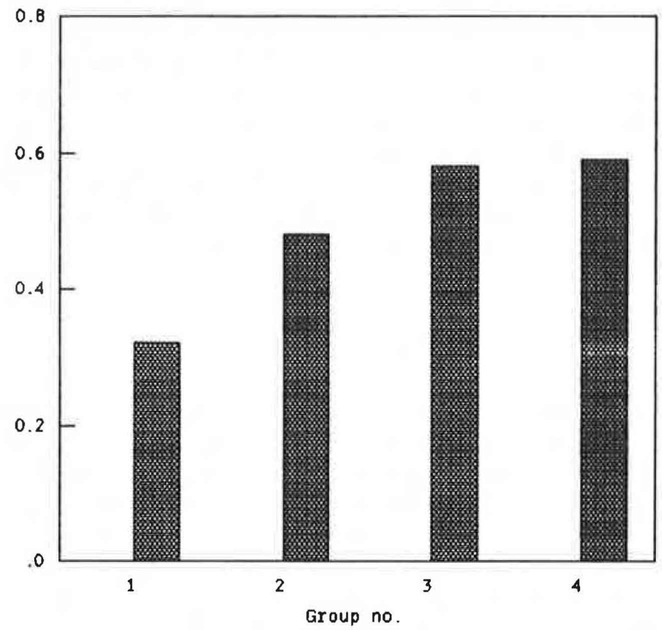

FIGURE 3 Ratios of federal subsidies to variable operating costs (1985 group averages).

TABLE 3 EFFECT OF SUBSIDY CUTS (GROUP AVERAGES)

Group No.	Operating Ratio	Size of subsidy cuts required to achieve stated criteria: 2 x Fare	50% Service Reduction	80% Service Reduction
1	0.52	70%	100%	100%
2	0.41	25%	80%	100%
3	0.31	15% (1)	75%	100%
4	0.37	12% (1)	60% (2)	95% (3)

NOTES

(1) East Chicago (Group3), and LCEOC and Trade Winds (Group 4) do not charge fares. An average fare of 40 cents was assumed only for use in calculating group average percentage increases in fares.

(2) This value is an estimate only as Madison County has reduced services to zero above a 60 percent subsidy cut.

(3) This value is an estimate only as Monroe County has reduced services to zero above a 90 percent subsidy cut.

Variation Within Groups

The variation in effect within each group is large, and the average group effects should not be taken as indicative of the performance of all systems within a group. For example, a 20 percent subsidy cut in Group 1 requires an average fare increase of 16¢, but individual systems have fare increases from 9¢ to 27¢. Similarly, the group average service cut is 9 percent, but individual system decreases range from 7 to 13 percent.

This variation in effect is even larger for other groups. For Group 4 in particular, larger subsidy cuts (more than 50 percent) appear to reduce service below the limits of viability for at least one system, although the group average reduction is more modest. For example, a 50 percent subsidy cut would reduce the Group 4 average service by 42 percent, but one system would be reduced by over 85 percent.

Sensitivity to Elasticity

A detailed sensitivity analysis was conducted to assess the effect of assuming the low, average, and high elasticity values for fare and service charges. For each group, fare increases appear to be more sensitive to changes in elasticity than service decreases. The sensitivity to changes in elasticity also appears to decrease with increasing group number. This decrease is due to the increasing size of the fare increase or service decrease by increasing group number for a given subsidy cut. The secondary effect of revenue losses from reductions in ridership arising from the fare increases or service cuts therefore decrease as a proportion of total revenue reduction with increasing group number.

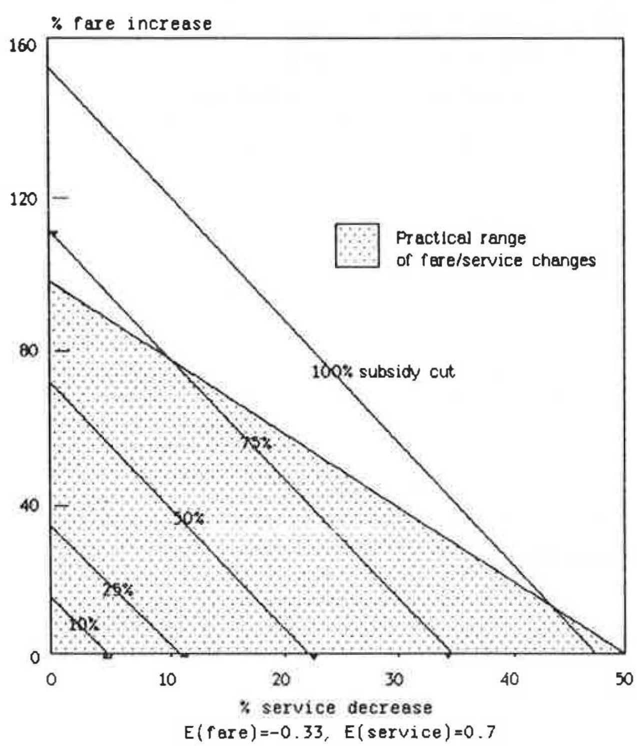

FIGURE 4 Effects of subsidy cuts (Group 1).

Combinations of Fare and Service Changes

Figures 4–7 show possible equivalent combinations of fare and service changes for a given subsidy cut. Although the model was established to consider fare and service changes separately, these indifference curves were developed on the assumption of constant marginal exchange for the purpose of identifying trends only.

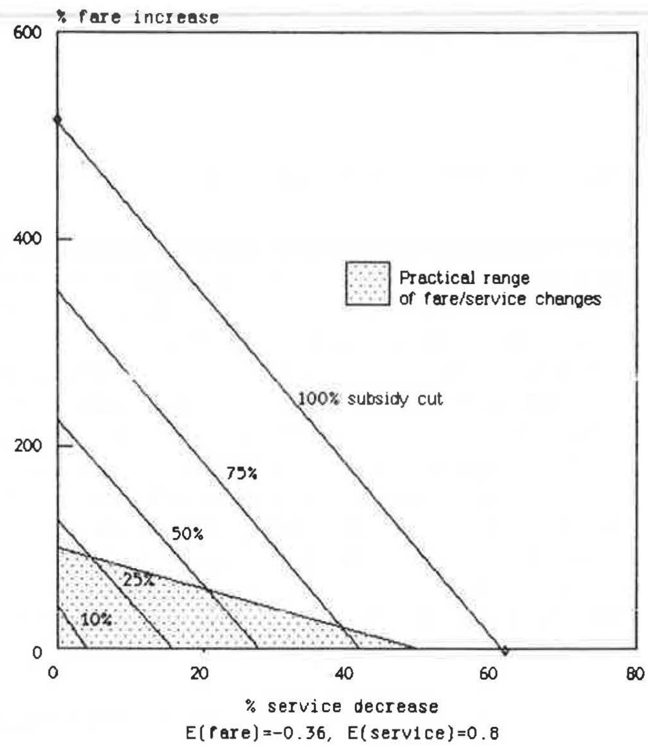

FIGURE 5 Effects of subsidy cuts (Group 2).

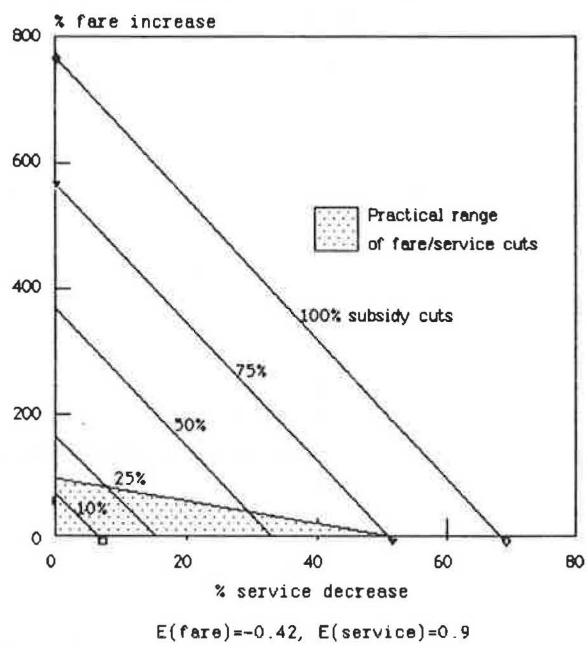

FIGURE 6 Effects of subsidy cuts (Group 3).

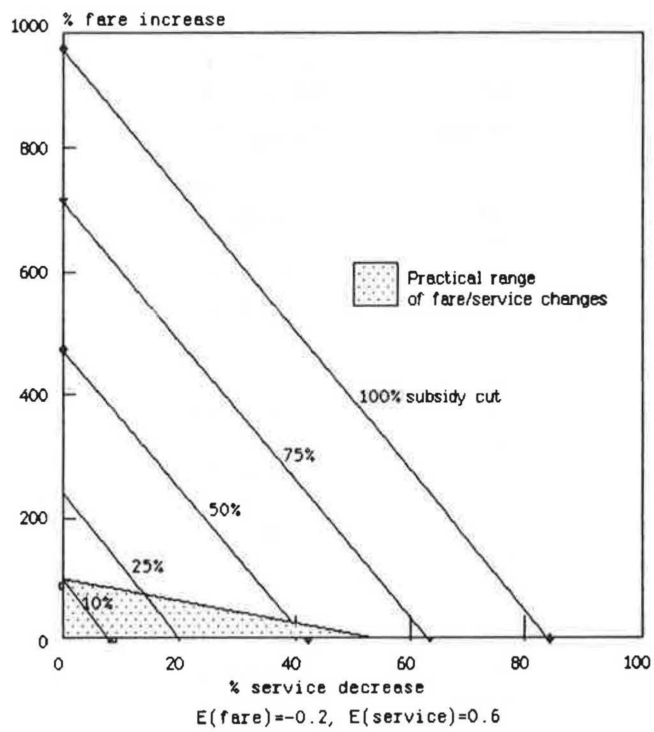

FIGURE 7 Effects of subsidy cuts (Group 4).

As mentioned previously, a doubling of fare was assumed to be an upper limit of possible fare increase and a 50 percent reduction in revenue vehicle-hours as an upper limit on service cuts. The limits of the practical extent of combinations of fare and service changes are shown as the shaded areas in Figures 4–7. The effects of various levels of federal subsidy cuts can be better recognized by examining the indifference curves in relation to the shaded areas. For example, Group 1 can withstand a 50 percent subsidy cut by increasing fare (less than 80 percent) or by reducing service (less than 25 percent), but a 50 percent subsidy cut for Group 2 cannot be matched by fare increase (more than 200 percent). A feasible level of service reduction (less than 30 percent), however, is possible for Group 2 at 50 percent subsidy cut. Similar observations can be made for other groups and other levels of subsidy cuts.

Effects on Individual Systems

An example of the possible effects of federal subsidy reductions on individual systems is presented in Table 4. This example shows the size of subsidy cuts that would make the systems double their average fare or reduce their service by half.

In considering the levels of the existing average fare in Group 1, Fort Wayne, Gary, and Indianapolis can be compared. Gary shows the best ability to absorb subsidy cut through increased fare revenue, whereas Fort Wayne shows the least ability. On the other hand, although even a complete removal of federal subsidy is not sufficient to cause the NICTD to double its fare, the existing average fare level at the NICTD is already high, and its doubling may not be a practical solution. South Bend's situation is the opposite. Its existing average fare is rather low, indicating a high degree of concessional fares. Consequently, South Bend can withstand a considerably high level of subsidy cut through increased fare revenue.

If subsidy cuts are to be compensated for by increased fare revenue, Fort Wayne and possibly NICTD are the most vulnerable systems in Group 1. On the other hand, if service reduction is taken as the criterion, Indianapolis is less robust than the other systems in its peer group.

The same type of evaluation can be made for systems in other groups. For example, in Group 4 as far as the fare revenue is concerned, Goshen, LCEOC, and Tradewinds appear to be more stable than the rest of the systems. However, Goshen already charges 76¢ per trip, whereas for LCEOC and Tradewinds, the doubling of fare revenue would mean the imposition of 40¢ average fare in place of the existing zero fare. On the other hand, Madison County appears to be most vulnerable, as it already charges a high average fare and even a relatively low federal subsidy cut of 15 percent would require its average fare to double.

If service reduction is considered, KIRPC, LCEOC, and Tradewinds indicate a higher degree of resilience than the other systems. The most vulnerable, however, appears to be Madison County, where a 30 percent subsidy cut would require the vehicle-hours be cut by half.

CONCLUSIONS AND RECOMMENDATIONS

A study has been undertaken to evaluate possible state subsidy policies in response to reduction in federal assistance to Indiana transit systems. A methodology was developed to assess the impacts of possible reductions in federal transit operating subsidies on fare and level of service. The results presented involved effects primarily in terms of system groups. However, an analysis was also made to estimate effects on individual systems. On the basis of the results, the following conclusions can be made.

1. If revenue shortfalls due to reductions in federal assistance are to be balanced by increase in locally derived income, either local assistance or fare revenue has to be increased. Otherwise the revenue shortfall must be accommodated by reduction in operating cost through service cuts. In the present paper, only fare and service changes as they are related to operation are considered. An increase in local assistance can be estimated directly as equal to the expected revenue shortfall. However, in view of the general public attitude towards tax increase, it is unlikely that any significant increase in local assistance for transit operation will be forthcoming for most Indiana transit systems.

2. The analysis indicated that, in general, there is a greater flexibility in reducing service than in increasing fare to accommodate revenue shortfalls. However, beyond a certain level of revenue shortfall, the necessary amounts of fare increase or service cut become unrealistically high. These revenue shortfall levels varied from system to system within a group. These cutoff levels can be used in determining what systems should continue to receive state subsidy.

3. The systems in Group 1 indicated a greater capacity to absorb subsidy cuts compared to other groups for the same levels of fare increase and service cut. Other groups are highly dependent on federal subsidy, and their operations become vulnerable even at a relatively small level of revenue shortfall.

TABLE 4 EFFECT OF SUBSIDY CUTS (INDIVIDUAL SYSTEMS)

System	Average Fare	Size of subsidy cuts required to achieve stated criteria		
		2 x Fare	50% Service Reduction	80% Service Reduction
GROUP 1:				
Ft. Wayne	0.51	45%	100%+ (2)	100%+ (2)
Gary	0.53	95%	100%+ (2)	100%+ (2)
Indianapolis	0.49	80%	75%	100%+ (2)
NICTD	2.49	100%+ (2)	100%+ (2)	100%+ (2)
South Bend	0.26	55%	100%+ (2)	100%+ (2)
GROUP 2:				
Anderson	0.27	15%	80%	100%+ (2)
Bloomington	0.27	20%	100%	100%+ (2)
Evansville	0.37	65%	90%	100%+ (2)
Hammond	0.38	25%	100%	100%+ (2)
Lafayette	0.36	35%	75%	100%+ (2)
Muncie	0.32	40%	95%	100%+ (2)
So. Indiana	0.39	20%	80%	100%+ (2)
Terre Haute	0.35	30%	70%	100%+ (2)
GROUP 3:				
Bedford	0.32	10%	70%	100%+ (2)
Columbus	0.27	25%	90%	100%+ (2)
East Chicago	0.40 (1)	95%	70%	100%+ (2)
LaPorte	0.57	25%	90%	100%+ (2)
Marion	0.23	15%	70%	100%+ (2)
Michigan City	0.32	25%	70%	100%+ (2)
Mitchell	0.47	15%	60%	95%
New Castle	0.24	10%	75%	100%+ (2)
Richmond	0.45	45%	80%	100%+ (2)
Washington	0.33	30%	85%	100%+ (2)
GROUP 4:				
Goshen	0.76	50%	55%	85%
KIRPC	0.23	10%	90%	100%+ (2)
Kosciusko Co.	0.44	25%	70%	100%+ (2)
LCEOC	0.40 (1)	60%	95%	100%+ (2)
Madison Co.	2.09	15%	30%	50%
Monroe Co.	0.37	10%	50%	80%
Trade Winds	0.40 (1)	50%	100%+ (2)	100%+ (2)
Union Co.	0.41	15%	70%	100%+ (2)

(1) 40 cent average fare assumed where no fare charged.
(2) Indicates complete removal of subsidy is insufficient to meet criterion.

4. Small-percentage subsidy cuts in Group 4 and other small systems will decrease the adverse effects of the cuts substantially but will have little effect on the total subsidy cut.

5. The results of the analysis presented in this paper are dependent on the assumed elasticity values. These results can be used only as a guide, along with other information, to make decisions as to the state transit subsidy allocation policies in response to federal subsidy cuts.

ACKNOWLEDGMENTS

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REFERENCES

1. K. C. Sinha et al. Development of an Approach for the Allocation of the Public Mass Transport Fund of Indiana. Report CE-TRA-85-3, Indiana Department of Transportation, Indianapolis, July 1985.
2. J. C. Curtin. Effects of Fares on Transit Riding. In *Highway Research Record 213,* HRB, National Research Council, Washington, D.C., 1968, pp. 8–18.
3. Peat, Marwick, Mitchell & Co. *Study of Public Transportation Fare Policy.* Office of the Secretary, U.S. Department of Transportation, Dec. 1976.
4. *Estimated Loss in Passenger Traffic Due to Increase in Fares (1961–1967).* American Public Transit Association, Washington, D.C., 1968.
5. R. L. Carstens and L. H. Csanyi. A Model for Estimating Transit Usage in Cities in Iowa. In *Highway Research Record 213,* HRB, National Research Council, Washington, D.C., 1968, pp. 42–49.

6. J. H. Boyd and G. R. Nelson. *Demand for Urban Bus Transit: Two Studies of Fare and Service Elasticities.* Institute for Defense Analyses, Washington, D.C., 1973.
7. R. H. Pratt Assoc., Inc. *Traveler Response to Transportation System Changes—A Handbook for Transportation Planners.* U.S. Department of Transportation, July 1981.
8. M. A. Kemp. Some Evidence of Transit Demand Elasticities. *Transportation,* Vol. 2, No. 1, April 1973, pp. 25–52.
9. *1985 Annual Report Indiana Public Transportation.* Indiana Department of Transportation, Indianapolis, July 1986.

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Impact of Marketing in Small Urban and Rural Transit Systems

MARC R. CUTLER

In this paper, the results of an UMTA demonstration project, The Idaho Rural/Small City Cooperative Transportation Marketing Demonstration Project, are presented. The purpose of the project was to evaluate the effectiveness of (a) using outside experts to teach local transit managers how to market their services and (b) specific marketing actions to increase ridership and improve the image of public transit in the community. The demonstration was conducted at Pocatello, Idaho Falls, and Twin Falls, in Idaho. The study found that a combination of marketing actions, if properly implemented and targeted, could achieve the desired goals. When these conditions were met in Twin Falls, an 11 percent ridership increase was achieved over a 6-month period. A radio and television advertising campaign in Twin Falls that was aimed at improving the image of the transit system stimulated demand for more specific how-to-ride service information and made people more willing to consider riding transit by choice. Public support and awareness of transit increased at both Twin Falls and Idaho Falls, whereas support increased for local government involvement in transit at all three systems. The project was also successful in teaching transit managers how to use market research techniques to identify marketing problems facing their organizations and how to develop coherent plans to solve the problems. The project did not sufficiently stress teaching the managers how to implement the specific marketing actions included in their plans, which resulted in ineffective and delayed implementation at two sites.

In this paper the findings of the Idaho Rural/Small City Cooperative Transportation Marketing Demonstration Project are presented. The main sections describe, in order, the project—its organization, its goals, and its objectives; the evaluation methodology; the implementation of project activities; the principal findings of the project evaluation; and recommendations for improving implementation of similar projects in the future.

The Idaho Rural/Small City Cooperative Transportation Marketing Demonstration Project was funded with $85,000 under Section 6 of the Urban Mass Transportation Act. Of this amount, $30,000 was earmarked for the conduct of marketing at three selected demonstration sites. The remaining funds were used to hire the services of professional marketing consultants who would train local transit managers in the design and conduct of marketing programs. The demonstration sites were the cities of Pocatello, Idaho Falls, and Twin Falls, and specifically their corresponding transit systems—Pocatello Urban Transit (PUT), Community and Rural Transportation (CART), and TRANS IV.

The project was part of UMTA's Service and Methods Demonstration Program. The grant recipient was the Idaho Transportation Department (ITD), which subcontracted the actual management and implementation of the project to the Marketing Department of Boise State University (BSU). BSU formed a project team that consisted of two marketing professors (with no transit experience) and a consultant with a background in transit operations and marketing. The project concept had been developed by the consultant for the BSU project team. The function of the project team was to both administer the project and to provide marketing training to the three local transit managers. The ITD helped to get the project started and introduced the BSU project team members to the three demonstration site transit managers. By choice, the ITD did not play an active role in project implementation.

Project evaluation was the responsibility of the U.S. Department of Transportation's Transportation Systems Center (TSC) and its contractor, Dynatrend Inc. The project began in December 1984 and was completed in April 1986.

The goal of the project was the development of marketing programs that could be applied at small urban and rural transit systems throughout the nation. This goal was pursued through the statement of two objectives. The first objective was to test the feasibility of using outside experts (i.e., the project team members) to teach local transit managers how to market their systems. The second objective was to actually implement specific marketing activities and test their effectiveness in achieving system goals.

Idaho is a politically conservative state with a population of slightly under 1 million people. The state limits local property taxes by law to 1 percent of assessed valuation and provides no financial assistance to local transit authorities other than through human service contracts. The state has twice provided President Reagan with his largest electoral majorities. Some 50 percent of the population resides in rural areas, and the population is 95 percent white. The natural antigovernment inclination of the people in the intermountain West is augmented by the influence of the politically conservative Church of Jesus Christ of Latter Day Saints, which outside of Utah is most influential in southern Idaho. Therefore the constituency for government-subsidized services is smaller than in most states. In addition, the state has almost no tradition of public transit ridership and none of the standard motivators of transit usage—traffic congestion, air pollution, and parking shortages. During the course of the demonstration, the price of gasoline collapsed. This environment was not conducive to the conduct of a transit marketing campaign.

The three demonstration sites—Pocatello, Idaho Falls, and Twin Falls—are located across the southern tier of the state, as shown in Figure 1. They are three of only five cities in the state

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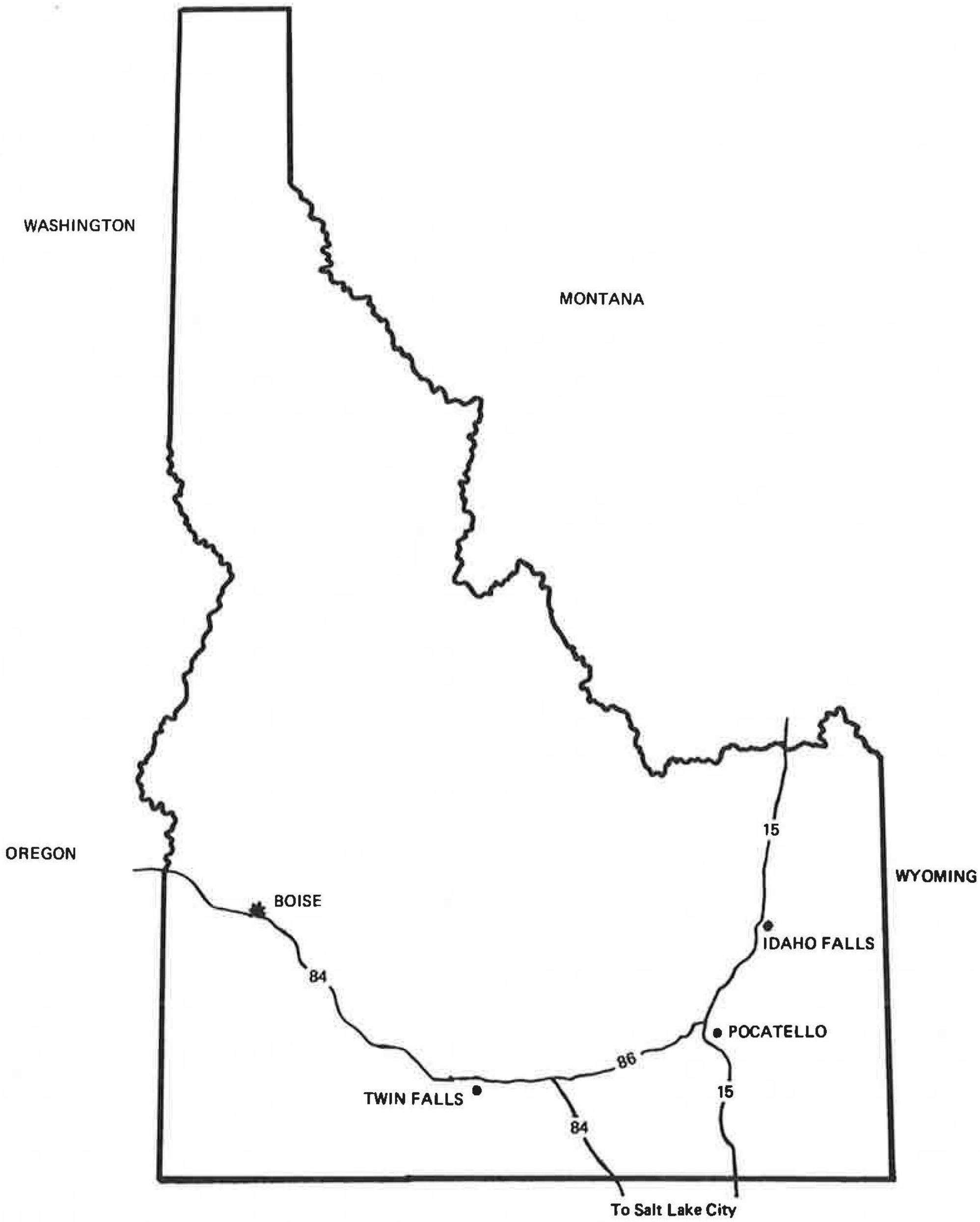


FIGURE 1 Demonstration site locations.

with populations in excess of 20,000. This region of the state is relatively flat and semiarid, with miles of sagebrush interrupted by modest Rocky Mountain ranges.

Pocatello is the most urban of the three cities, having gained official urbanized status in 1980 in conjunction with the small neighboring city of Chubbock. Idaho Falls is a smaller city of some 40,000 people, located near the eastern border of the state. Twin Falls is the smallest of the three cities, with 26,000 residents, but it is the center of a geographic region called the Magic Valley that is larger than Rhode Island. The economy of Pocatello is dominated by heavy industry, whereas the Twin Falls area is largely oriented toward agriculture and tourism. The economy of Idaho Falls is dominated by a federal nuclear energy research facility. Both Pocatello and Twin Falls have sizable student populations, ranging from 6,000 to 7,500 from Idaho State University and the College of Southern Idaho (CSI), respectively. In general, the economy of the area, based heavily on agriculture and energy, has never fully recovered from the recession of the early 1980s.

At the start of the project, the three transit systems had the following features in common:

- Confused public images regarding their status as specialized or general public carriers;
- Lack of general institutional support within the community;
- Lack of sound local financing arrangements;
- Poor vehicle utilization, particularly in the off-peak periods;
- Managers overwhelmed by the demands of day-to-day management and pessimistic about the future of the systems; and

- Lack of many attributes of professional transit operation, such as consistent fleet appearance, driver uniforms, readily available schedules and maps, bus stop signs, and media advertisements.

Many of these problems can be traced to the systems' uneven evolution from special purpose to general public providers during the late 1970s and early 1980s, a situation typical of UMTA's Section 18 Rural Public Transit Assistance Program. Of the three systems, PUT had made the most complete transition. PUT operated three fixed routes with some full-sized buses and received local tax revenues as match to UMTA Section 9 assistance. TRANS IV in Twin Falls was something of a hybrid, operating fixed routes, commuter subscription services, and dial-a-ride. CART in Idaho Falls remained closest to the human service provider model, operating only a dial-a-ride service that was only theoretically open to the general public and subscription services for programs such as Head Start.

EVALUATION METHODOLOGY

Evaluation of the effectiveness of teaching transit managers how to market focused on three skills that are critical in learning how to market. These skills include being able to

- Identify the marketing problem confronting the organization,
- Develop systematic strategies or plans for alleviating the problem, and
- Implement the specific activities included in the plan.

This phase of the evaluation was largely qualitative in nature and was based on interviews conducted by the evaluation contractor with the managers of the three demonstration site transit systems and with members of the project team. On-site interviews were conducted at the beginning and end of the project, and telephone interviews were conducted at several points in the interim.

Evaluation of the impact of the marketing activities focused on quantitative measurements of changes in system ridership and in the public's perception of transit. Ridership increases would, of course, immediately benefit the transit systems, and attitudinal changes might pave the way for long-term ridership increases as well as a more supportive public and institutional environment. Other possible goals, such as reduced traffic congestion or improved air quality, were not perceived as serious problems.

Monthly ridership data were supplied by the transit systems for the period of the demonstration and for the comparable time period in the previous year. These data were collected by bus drivers using mechanical counters as part of their routine operating procedures. Because ridership at all three sites undergoes regular seasonal fluctuations, all comparisons were made between the same months in different years.

Public attitudes toward local transit were measured by means of a telephone survey conducted before and after the implementation of marketing activities in March and April of 1985 and 1986. These surveys were developed by the project team in consultation with the evaluation contractor, TSC, and the local transit managers. The surveys were administered by a professional market research firm under the direction of the project team. By using random digit dialing, a statistically independent sample of 200 male and 200 female respondents was obtained for both the before and after surveys. Survey questions focused on awareness and knowledge of transit services, attitudes toward the service, use of the service, and sociodemographic characteristics of respondents.

The market research firm coded the data for computer analysis. Data were validated by calling back a small sample of households. The project team used the Statistical Package for the Social Sciences to summarize results and prepare frequency distributions in percentage and histogram form for each question. In addition, cross tabulations were conducted on selected question pairs at the request of the evaluation contractor. The purposes of the cross tabulations were to measure the impact of specific marketing activities on attitudes toward public transit and to determine whether more significant changes took place among certain sociodemographic groups.

The evaluation contractor used χ^2 to measure the significance of the change in responses on both individual questions and cross tabulations between the before and after surveys. Changes were considered statistically significant at the 0.05 level.

IMPLEMENTATION

The following is a schedule of the major project events:

Event	*Date*
Commencement	December 1984
On-site interviews	January 1985
Predemonstration market research	March and April 1985
Training session	May 1985
Implementation of marketing actions	July 1985 to April 1986
Follow-up on-site interviews	April 1986
Postdemonstration market research	April 1986

The initial on-site interviews involved having the project team and evaluation contractor spend 1 day at each site interviewing the transit manager and other system employees and community leaders in the fields of government, business, and human service. The purpose of the visits was twofold: (a) to establish a qualitative baseline for the evaluation, and (b) to begin the process of identifying marketing strategies.

After the completion of the market research, the transit managers were brought to Boise for a 1-day training session with the project team. This session focused on the first two objectives in learning how to market—problem identification and strategy development.

The findings of the market research were used by the project team members to help the transit managers identify the problems facing their organizations. The transit operators had little or no experience in the evaluation of survey results. The project team led the operators through the survey findings, instructing them how to interpret the data and then discussing the implications of the findings.

The second half of the Boise meeting was devoted to the development of marketing plans. The project team distributed an outline that included the relationships among the parts of a marketing plan, the format of a marketing plan, lists of marketing activities, and a sample marketing plan. Using this outline and the definition of the problem obtained from the survey analysis, the project team asked the operators to define marketing objectives for their systems. The operators were then asked to identify generic solutions that would accomplish these objectives, regardless of their practicality. The generic solutions (or wish lists) were refined into specific solutions and action items and then assigned a priority by using the objectives. Each project team member was assigned to one operator to facilitate this process.

The result of this process was three marketing plans that incorporated the ideas of the transit managers but were written by the project team members. Each plan contained a large number of activities, but on the basis of estimated funding levels, certain priorities were clear. PUT assigned the highest priority to street signage, bus repainting, advertisements on bookmarks, and new driver uniforms. In addition, funding in PUT's regular operating budget was reprogrammed for schedule printing and distribution. CART attached the highest priority to bus repainting, the hiring of a marketing assistant, instituting a shopper shuttle service to be called the Shopping CART, and developing a new marketing brochure. At TRANS IV, the highest priorities were media advertising, acquiring new driver uniforms, target marketing college students and major employment sites, hiring a marketing assistant, and printing new schedules and brochures.

The training session in Boise did not provide specific how-to-instruction in the implementation of marketing activities. An activity such as writing news releases was discussed in the context of when and why to do such an activity, but no instruction was provided in how to do it.

Once the implementation of marketing activities began, the Idaho project team manager maintained contact with the transit managers at each site by means of monthly telephone calls. The other project team members, including the consultant, who was the only member of the team with public transit experience, were less actively involved in this phase. The project manager focused on the progress being made in implementing the marketing plans. Although the project team members responded to questions raised by the transit managers about how to implement specific marketing actions, the team had no formal, coordinated approach to providing technical assistance. There was no other formal in-person contact between the project team members and transit managers until the follow-up site visits after the completion of all marketing activity.

The original schedule called for implementation to be initiated in July 1985 and completed by December 1985. The deadline for completion was eventually pushed back to February 1986, and some activities remained incomplete at the conclusion of the evaluation in April 1986.

In general, more activities were completed as defined in a timely fashion by TRANS IV than by either PUT or CART, although all three were slow in starting. PUT's major activities were repainting one bus (November 1985), placing approximately 100 service information posters around the community (February 1986), and installing 100 bus stop signs (March 1986). PUT also conducted a radio advertising campaign in January 1986, using its own funds. CART repainted four vehicles and ran paid and public service announcements on the radio and in the newspaper during fall 1985. Most of TRANS IV's marketing activities were undertaken in the period of August to October 1985. During this time, TRANS IV introduced new driver uniforms, ran newspaper advertisements, put up bus stop signs, distributed new schedules and maps, painted vehicles, and conducted a promotion with a radio station to transport riders to the Twin Falls Fair. The bus stop signs, newspaper advertisements, schedules, and maps were targeted to students at CSI. In addition, TRANS IV had an informational insert included in the college's fall registration material and staffed an information booth at registration. In February 1986, TRANS IV began airing public service announcements (PSAs) on radio and television.

Both PUT and CART experienced management and service disruptions. In Pocatello, a new city administration elected on July 1, 1986, cut PUT's budget by 20 percent, forcing comparable service reductions that went into effect on September 1. Further implementation delays were experienced as the general manager of PUT spent September and November contemplating other job offers. The assistant general manager left during this period and for budgetary reasons was not replaced.

In Idaho Falls, the administrator of CART resigned in August 1985 and was replaced in September. The new administrator needed to familiarize himself with the project, and in the process significantly altered the emphasis of CART's marketing plan. CART raised fares on March 1, 1986, and began planning to convert offpeak dial-a-ride service to fixed-route deviation. TRANS IV, on the other hand, had managerial stability throughout the project and initiated no service changes.

PROJECT IMPACTS

In this section, the effectiveness of the project in teaching transit managers how to market and in applying specific marketing strategies in rural and small urban settings are evaluated.

Teaching Transit Managers How to Market

As discussed at the outset, learning how to market means learning how to (a) evaluate the problem confronting the organization, (b) develop a plan to solve the problem, and (c) implement the activities of the plan. This project was fairly successful in achieving the first two objectives but less successful in achieving the third.

Interviews with the transit managers indicated that the review of survey data with the project team was useful in that it used numbers to demonstrate problems and opportunities that the operators had previously only suspected might be the case. The operators had always found it difficult to act on their perceptions because there was neither data nor documentation to support their beliefs. In addition to defining the problems facing their systems, the surveys also indicated that public support for transit was higher than the operators had believed. These findings encouraged the operators to believe that marketing activities might actually be worthwhile, a possibility that they had doubted at the outset of the project.

Thus this phase of the project exposed the managers to survey techniques, showed them how to analyze survey results, and demonstrated how to use these results to formulate and undertake specific action plans. The managers did not become experts in the design and administration of public opinion surveys, but they did learn that it is possible to quantify and define the problems facing an organization, and they became aware of the techniques that are available for doing so.

The second objective was to learn how to develop a marketing plan. None of the operators had ever approached marketing in a systematic fashion. Most thought of marketing in terms of media advertising or one-shot promotional gimmicks. At the Boise training session, the operators learned how to move from problem definition to strategic definition and to develop an organized coherent approach to marketing. They also learned the importance of targeting marketing activities to specific market segments, rather than using a scattershot approach.

This process might have been more successful if the project team had taken a stronger role in helping the managers to define the contents of their marketing plans. In attempting to obtain the managers' support for the goals of the project, a vast array of ideas was included in the marketing plans. This proved to be counterproductive in the implementation phase because the managers became overwhelmed by the large number of separate tasks with which they were confronted.

It appeared likely that the managers would continue to apply these lessons in the future, although planning will always be secondary to the pressures of day-to-day management at small transit systems. Future marketing plans are likely to be much less elaborate than the plans developed for this project, but that would be a positive development if the managers learn to focus their attention on a few critical objectives.

The implementation of marketing activities was the least successful aspect of the project due to several extraneous factors outside the control of the participants, as well as to certain aspects of the demonstration itself. The lessons learned from this failure were significant, however.

Extraneous factors that hindered implementation involved managerial and service disruptions. As discussed, managerial instability at PUT and CART significantly delayed implementation. Drastic budget and service cutbacks at PUT also distracted the attention of the manager. At CART, budgetary pressures led to a fare increase and the shifting of management's attention late in the project to a restructuring of services. Given these factors, it is not surprising that TRANS IV, which had managerial and service stability, also had the most successful implementation.

In addition to these independent factors, several factors inherent in the project may have hindered implementation. First, the project was administered by individuals who had no prior professional relationship with the transit managers. The managers were skeptical at the outset about the potential impact of the project. They did not really believe in marketing and feared that the demands of project administration would distract them from the day-to-day management of their systems. They all feared, to some extent, that the systems would never be fully reimbursed for expenses. The approach taken to project administration by both the ITD and the project team contributed to this situation. The project had been initiated by the transit consultant to the project, who essentially marketed the idea to both the ITD and UMTA. The ITD's role was thus passive from the start. The ITD accepted no project funds for administration and viewed the project as an opportunity to develop other community resources (i.e., academia) to support transit activities.

This approach might have been successful if not combined with the approach of the project team, which viewed the project as a high-level planning exercise for which they would provide free consulting in market research and in the development of marketing strategies but for which it would be up to the transit managers themselves to implement the plans. The ITD also strongly believed that responsibility for implementation lay with the transit managers. Although the long-term goal of a demonstration project is to transfer skills and responsibility to the appropriate operating agencies, it proved unrealistic to expect such a transfer to take place during the course of a short-term demonstration.

The transit managers believed that they needed a more structured approach, with an implementation schedule imposed and enforced from the outside, and more technical assistance on how to implement specific actions. For both types of intervention to have been effective, either frequent in-person contact between the project team members and operators or a stronger state presence would have been required.

Even if the operators had been held to a rigid schedule, they simply did not possess the skills and experience to successfully implement many of the actions on their own. By the end of the project, the project team members realized that they had overestimated the skills of the operators. Although the operators had limited experiences in conducting marketing activities, they did not have expertise. The operators, for their part, were frustrated that they had not received more detailed instructions on how to implement the actions in the marketing plans. They believed that the burden of obtaining more assistance had been placed on them, instead of having assistance vigorously offered by the project team. As mentioned, they were also overwhelmed by the large number of proposed actions in the marketing plans and had difficulty focusing on what was critical to their central objectives.

The reasons for TRANS IV's relatively successful implementation are again clear in this context. The TRANS IV manager was the most aggressive in seeking out help from the project team and also had the most prior marketing experience. In addition, the TRANS IV manager hired a local marketing consultant on a part-time basis. The consultant was particularly valuable in teaching the manager how to interact with the local technical community in such areas as securing PSA time on local television or laying out and printing a brochure. These were the kind of skills that the project team took for granted that all of the operators already possessed.

Despite all of these problems, many actions did get implemented, although often too late to generate changes that could be quantifiably measured during the second phase of the evaluation. Through this difficult process of trial and error, the operators, particularly the manager of TRANS IV, picked up valuable marketing skills. The managers also learned which types of marketing activities they thought were effective and were comfortable implementing. All of the managers came to appreciate that marketing is a science, not an art, and that certain skills must either be learned or acquired.

The Impact of Marketing Activities

In this section, the effect of the marketing activities undertaken by the three transit systems is evaluated.

Ridership

Major ridership changes were not expected to result from this project. Small urban and rural transit system ridership tends to be drawn from captive market segments. Most riders already have no choice but to ride because of income levels, lack of automobile availability, or personal disability. Among the public as a whole, these systems had low market penetration (2.5 to 7 percent), as indicated by the predemonstration telephone survey. It is particularly difficult to increase general public ridership in communities in which the major incentives to transit use do not exist, that is, in which there are no significant traffic, parking, or air pollution problems, the price of gasoline is falling, and there is little tradition of transit ridership.

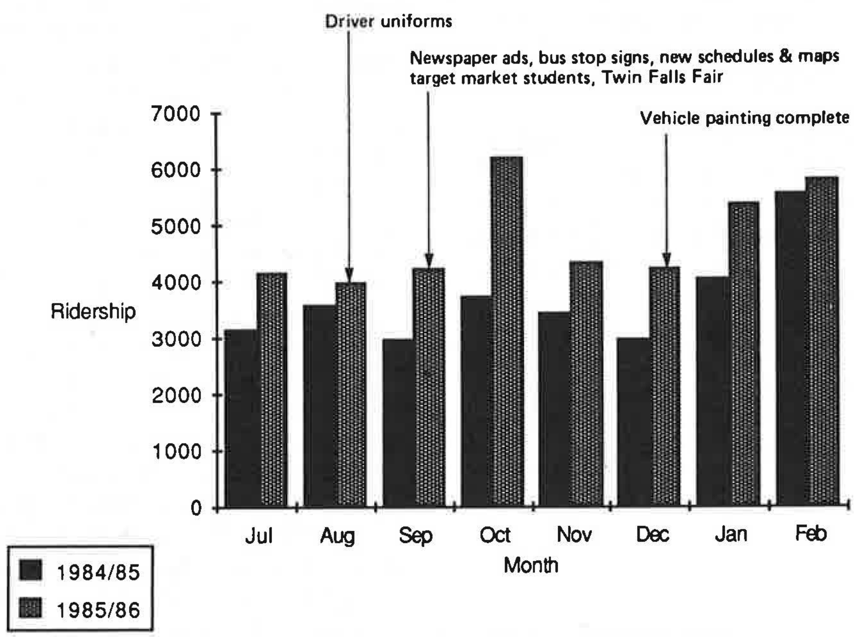
On the basis of the predemonstration on-site interviews and surveys, it was hypothesized that ridership levels would be most responsive to marketing activity at PUT. PUT was better known in the community than either TRANS IV or CART. The system had made a transition from special needs to general public carrier several years earlier and had more of the attributes of a general public system, such as fixed routes, full-sized buses, published schedules, and uniformed drivers. As indicated by the predemonstration telephone survey, PUT had already achieved much higher market penetration (7 percent) than either TRANS IV (4.5 percent) or CART (2.5 percent). The hypothesis was that because PUT was already somewhat accepted as a general public provider, it would be relatively easy to increase its market share.

On the other hand, TRANS IV and CART needed to either increase ridership among captive groups, in which there was presumably less room for growth than among the general public, or break into the general public market in a significant way. TRANS IV targeted much of its marketing activities at college students. College students have some of the attributes of captive transit markets, such as low income and automobile availability. However, they are not completely captive because they have many more travel options (such as bicycle riding, hitchhiking, or walking) than do true captive groups like the elderly and disabled. Although the college student population in Twin Falls was only 20 percent smaller than in Pocatello, TRANS IV carried only about 1,000 monthly student trips compared to 3,500 by PUT (according to data provided by the transit managers). Expectations for ridership growth at CART were lowest because almost all of CART's ridership was concentrated among traditionally captive transit markets.

The service disruptions and implementation delays made it impossible to adequately test this hypothesis with regard to PUT. Ridership dropped by 20 percent upon initiation of service cutbacks in September 1985 and remained at this level throughout the demonstration. PUT did not begin aggressive marketing activities until January 1986, and no impact was apparent at the completion of the evaluation in April 1986.

As expected, there was no ridership impact as a result of the formal marketing activities undertaken by CART. However, involvement in the project did convince the new manager of the need to reach out into the community more aggressively. As a result of these efforts, the manager obtained two new human service contracts for the system, which increased ridership by some 27 percent.

TRANS IV was the only system that appeared to have increased ridership directly as a result of its marketing activities. As shown in Figure 2, between September 1985 and February 1986, TRANS IV ridership grew at an average rate of 25 percent, with a low of 5 percent in February and a high of 40 percent in October. As shown in Figure 3, this growth rate



Source: C. Chambers, General Manager, TRANS IV, 4/86

FIGURE 2 TRANS IV ridership.

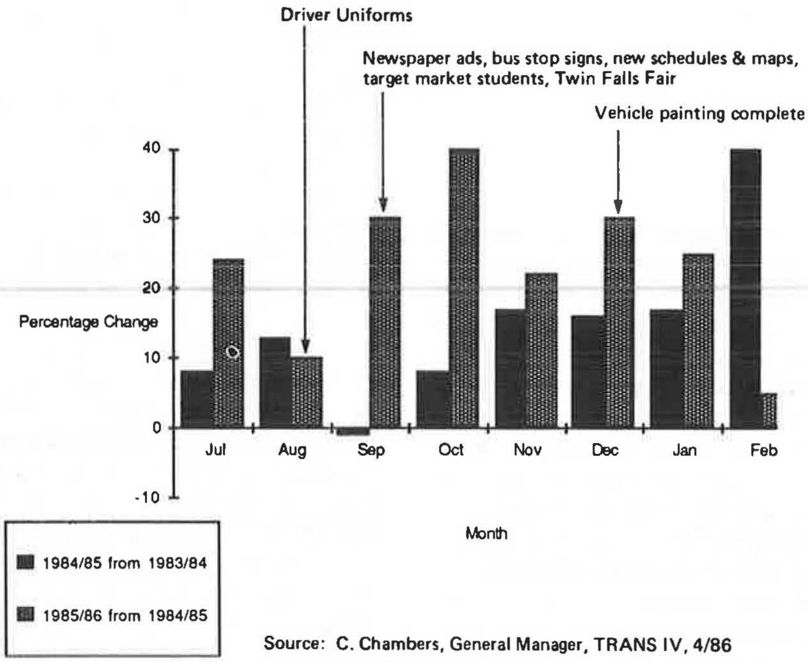


FIGURE 3 Percentage change in TRANS IV ridership.

contrasted with a growth rate of only 14 percent during the same period in the preceding year. If one assumes that the 14 percent growth of the previous year represented TRANS IV's underlying growth rate, then there was an additional 11 percent growth during the period of the demonstration. During the 6 months of the demonstration, TRANS IV initiated no significant service changes.

Available data do not permit making a definitive claim that the ridership change was due to the marketing activities in general, to any one specific activity, or that it occurred among any specific group, such as college students. However, there are no readily apparent alternative explanations, and the ridership increase coincided with the bulk of TRANS IV's marketing activities, which were undertaken in early fall 1985 and which together served to create a more uniform and professional image for the system.

The most likely alternative factor is the weather, which is the major variable affecting ridership at all three systems. Ridership typically increases in the winter and declines in the summer. Winter ridership varies with the severity of the weather. During the period of the demonstration, winter weather set in unusually early, in late November and early December. However, the largest ridership increase (40 percent over the previous year) occurred in October. Any ridership increase caused by severe weather in fall 1985 was probably counterbalanced by the mild weather in February 1986, which appeared to minimize any tendencies toward increased ridership in that month.

Public Image

It was expected that marketing activities at all three systems would make the general public more aware that transit existed in their communities and more knowledgeable about how to obtain information regarding these services. It was also expected that the activities would correct misperceptions about the systems. For example, there was a widespread belief in all three communities that the transit systems were open only to special needs groups such as elderly and handicapped riders.

Specific survey questions were selected for analysis, depending on the marketing activities undertaken at each system. These questions, as well as the anticipated direction of change in the responses, are given in Table 1.

For example, Question 1 asked people whether they were aware of a transit system in their community. It was hypothesized that in response to the increased level of marketing activity, more people would become aware that there was a transit system in the community. For a change in response from the pre- to the postdemonstration surveys to be considered statistically significant, a tolerance of 0.05 was required.

Questions 1–3 tested people's general awareness of the transit system by asking if they knew basic facts about the system. Question 6 tested people's awareness of news reports about the transit system and whether or not they thought the reports were favorable. Both TRANS IV and CART had become more active in issuing news releases.

Question 7 tested people's awareness of specific marketing activities undertaken at the three systems. When a system undertook an activity, the number of positive responses was expected to increase. Question 14 tested agreement with value statements regarding public transit. The largest change was anticipated for Question 14d, "Do you agree that people like you ride the bus?" PUT actually used this as a slogan in its media advertising, while TRANS IV stressed the general public aspect of its service. Questions 14f and 14j tested support for the concept of public transportation. It was thought that as people became more aware of the services provided by public transit through the various marketing activities, they would

TABLE 1 ANTICIPATED CHANGES IN TELEPHONE SURVEY RESPONSES

Question	Anticipated Change in Response
1. Aware of transit system?	Increase in positive responses
2. Know the name of system?	Increase in correct responses
3. Know the color of vehicles?	Increase in correct responses
6a. Aware of news reports?	Increase in positive responses
6b. Think reports are favorable?	Increase in positive responses—TRANS IV/CART
7. Aware of—	
a. Printed schedules?	Increase in positive—TRANS IV/PUT
b. Brochures?	Increase in positive—TRANS IV
c. Bus stop signs?	Increase in positive—all
d. Radio advertising?	Increase in positive—all
e. Newspaper advertising?	Increase in positive—all
f. Telephone information?	Increase in positive—TRANS IV
g. Television advertising?	Increase in positive—TRANS IV
h. Information displays?	Increase in positive—TRANS IV/PUT
i. Route maps?	Increase in positive—TRANS IV/PUT
14. Do you agree that—	
d. People like you ride the bus?	Increase in positive—TRANS IV/PUT
f. There should be more funding for transit?	Increase in positive—all
i. Transit company should provide more information?	Could go either way—all
j. Transit is not local government role?	Increase in negative—all
17. Age of respondents.	No change
18. Education level of respondents.	No change
23. Employment status of respondents.	No change
24. Income level of respondents.	No change

become more supportive of it. The demographic questions were included as a control to confirm that the sample groups in both the pre- and postdemonstration surveys reflected consistent survey populations.

The primary purpose of the cross tabulations was to measure the association between awareness of specific marketing activities and perceptions of transit. The two key variables tested were knowledge of system name and agreement that "people like you ride the bus." Cross tabulations were also used to examine the relationship between TRANS IV's marketing activities and changes in perceptions of different demographic groups, in particular college students.

Again, the most significant findings were in regard to TRANS IV, both in changes in people's awareness of transit and in their attitudes toward it. The percentage of respondents who could correctly name the system increased from 73 to 81 percent. Awareness of news reports about local transit increased from 16 to 26 percent, and the percentage of respondents who judged the reports to be favorable increased from 70 to 87 percent. Awareness of brochures increased from 5 to 10 percent, of radio ads from 24 to 37 percent, of TV ads from 16 to 37 percent, and of information displays from 16 to 28 percent.

The changes in attitude were even more dramatic. The percentage of those who agreed that "people like you ride the bus" increased from 34 to 50 percent. Support for more transit funding increased from 41 to 49 percent, although there was no change in support for the idea that transit is a local government responsibility. Agreement that the transit company should provide more information increased from 72 to 82 percent. Because TRANS IV provided more information, some of TRANS IV's marketing activities, most likely the media advertisements that were image- rather than information-oriented, may have stimulated a demand for more information on how to actually ride the system.

There were also some unanticipated changes that supported the hypothesis that TRANS IV had created a demand for information. The percentage of respondents who would be more likely to ride if they understood the service increased from 55 to 68 percent, and those who would be more likely to ride if signs provided service information increased from 70 to 79 percent.

Perhaps most significantly of all, TRANS IV appeared to have attracted the attention of the discretionary (or general public) ridership market. The percentage of respondents who agreed that they would only ride the bus if they didn't have an automobile available declined from 75 to 64 percent. Thus 11 percent more people would be willing to consider riding the bus by choice! In addition, the percentage of respondents who agreed that "they prefer riding in their own car," declined from 93 to 85 percent. These results were unanticipated.

The cross tabulations indicated that the change in perceptions just described was probably due to the radio and television advertising that TRANS IV initiated in February 1986 (after the reported ridership increases). However, although this trend was pronounced, this finding did not meet the statistical test for significance. The cross tabulations also indicated that these changes were most pronounced among middle-aged groups, although again the results were not conclusive. This phenomenon was unrelated to the described ridership increase, although if TRANS IV could follow up with a "how to ride transit" marketing campaign, additional ridership increases might well be possible.

The results at PUT and CART were less dramatic. At PUT, name recognition declined from 70 to 62 percent, although this appeared to be due to a change in the demographic composition of the two sample groups. As expected, the percentage of respondents characterizing news reports as "favorable" declined from 86 to 66 percent, reflecting the negative publicity that resulted from PUT's service cutbacks during this period. Interestingly, the percentage of respondents who agreed that "transit is not the role of local government" declined from 40 to 30 percent. Faced with the reality of local cutbacks in transit funding, more people came to see transit as a proper role of local government.

A strong impression was made by PUT's bus stop signs and information displays, the two activities that represented the sharpest departure from PUT's past marketing activities. Awareness of bus stop signs increased from 76 to 84 percent and awareness of information displays increased from 39 to 47 percent.

In Idaho Falls, knowledge of transit system name increased from 82 to 90 percent. The percentage of those who believed that news reports were favorable increased from 55 to 68 percent. Awareness of radio ads increased from 24 to 42 percent and of newspaper ads from 25 to 38 percent. The only attitudinal result that showed a significant change was the percentage of respondents who agreed that transit is not a local government responsibility; this declined from 48 to 38 percent. Thus CART's marketing activities may have created the groundwork for increased local support to transit.

RECOMMENDATIONS

As a result of the experience gained through this demonstration, several recommendations can be made regarding the implementation of marketing programs at small urban and rural transit systems in the future. These recommendations fall into three categories: site selection, project supervision, and project structure.

Site Selection

A project of this type will not work well at all rural and small urban transit systems. Critical success factors include managerial and funding stability and market segments, such as college students, that may contain latent demand for transit service.

Project Supervision

Successful implementation of special-purpose projects requires a strong supervisory commitment. In this project, that role could have been played by the project team or the ITD. Although the ITD received no administrative funds from this project, its role as Section 18 administrator (for which it receives 15 percent of the state's funding allocation) could have funded a small commitment of staff time. The major failings of this project occurred in the implementation phase, in which the managers proved unable or unwilling to implement the project activities in a timely manner. The ITD could have played a credible role in alleviating the managers' fears of not being reimbursed, in establishing and enforcing deadlines, and in bridging the gap in perceptions about the project team and transit managers.

Project Structure

Three elements of project structure need to be reconsidered, as follows:

1. Project Focus. Much greater emphasis should be placed on implementation of project activities. The project must be tactical as well as strategic. An implementation calendar should be established, with dates for the initiation of actions, delivery of products, and contacts between the project team and transit operators. Frequent on-site technical assistance should be provided by an independent project team, state officials, or consultants or by allocating project funds to hire support locally, as was done by TRANS IV.
2. The Structure of Marketing Plans. The marketing plans should be reduced to a few critical objectives and solutions.
3. Project Team. It is important to have people in active roles on the project team that have expertise in public transit. This project was structured so that the transit expert was a consultant to the project team and was thus less directly involved in project implementation than were the other two members of the team. The other members of the project team made significant contributions to the project due to their expertise in marketing, but greater insight into public transit management issues would also have been useful at the project team level, particularly because managers of small rural transit systems tend to have little formal training or experience in the field themselves.

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The information contained in this paper has been reviewed for accuracy by all of the Idaho project participants. The opinions expressed in this paper represent only those of the author.

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A Comparison of Telephone and Door-to-Door Survey Results for Transit Market Research

ROBERT A. HITLIN, FRANK SPIELBERG, EDWARD BARBER, AND STEPHEN J. ANDRLE

Any sample survey design involves a trade-off between funds available, sample size desired, and degree of precision required. Early in 1986, the Northern Virginia Transportation Commission sponsored a research project in Northern Virginia conducted by Robert Hitlin Research Associates, Inc., and SG Associates, Inc., to estimate demand for two proposed transit services. The two companies developed an estimation technique based on door-to-door sample surveys and small-scale telephone surveys. In this paper, the costs, findings, and advantages and disadvantages of the two types of data collection are compared. The telephone survey was approximately three and one-half times as expensive per interview as the door-to-door survey, but the results of the two surveys were virtually identical in each location. There were major differences in ease of administration, speed, required personnel, and other factors that may determine which approach to use in the future. A self-administered, door-to-door survey with a large enough sample size to allow analysis at the subarea level and therefore in narrow confidence intervals, which costs considerably less than a telephone survey, is a cost-effective and viable option.

Early in 1986, the Northern Virginia Transportation Commission sponsored a market research project to estimate potential patronage on transit feeder services for several soon-to-be-opened stations on the Washington, D.C., area Metrorail system. One of the proposed services is a neighborhood feeder minibus system to two Metrorail stations. This service would operate in the city of Falls Church, which is an established, close-in, Washington, D.C., suburban area. The other new service is a Metrobus route connecting Metrorail and Centreville, a newer and rapidly growing suburban community further out from Washington, D.C.

A major constraint in designing this transit market research project was the trade-off between available funds and the need for large sample sizes. These large sample sizes were desirable because patronage estimates were needed for subareas within each jurisdiction. The available funds were not adequate to consider an in-depth door-to-door survey. The project budget would have allowed the use of telephone surveys in the two areas. However, the sample sizes possible for the funds would have been too small to provide reliable estimates with acceptable confidence intervals, especially when the data were divided into subareas or subgroups within Falls Church or Centreville.

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The approach taken by Robert Hitlin Research Associates, Inc., and SG Associates, Inc., was to conduct a self-administered, door-to-door survey of every household in the target areas, followed by a small (200-household) telephone survey of nonrespondents to check for possible response bias in the first survey. This approach presented a number of challenges and problems but resulted in large enough sample sizes to produce ridership estimates that proved highly accurate in Centreville and have been accepted as reasonable by Falls Church.

A companion paper in this Record has described in detail the statistical screening and estimation process used to estimate potential demand in these two locations. In this paper, the results, costs, and advantages and disadvantages of these two data gathering techniques in transit market research are compared, and some of the criteria that can be used to decide whether this approach will work in other locations are outlined.

Other studies designed to test alternative data collection techniques are found in the literature *(1–4)*.

METHODOLOGY

A self-administered, door-to-door household survey was conducted to collect data from as many potential riders as possible. Questionnaires were placed on doorknobs in clear plastic hanger bags with the instruction that all workers in the household fill them out and replace them on the doorknob for collection 2 days later. The goal was to obtain a larger sample size for less money than could have been achieved with a telephone survey. Falls Church has approximately 4,500 households, Centreville has approximately 4,000 households.

However, there was a potential for self-selection bias in the survey responses. Such bias would have meant that people who favored the new transit services would be more likely to return the surveys. Therefore, to serve as a check on nonresponding households, small-scale telephone surveys were conducted. The households that did not return the door-to-door survey constituted the universe for the telephone survey. The procedure permitted comparison of results from the two surveys to bear on the question of whether the two independent, nonoverlapping samples drawn from the different universe would differ. In other words, did the transit needs of the self-selected respondents to the door-to-door survey differ from those of the nonrespondents?

Some general works on survey techniques are found in the literature *(5–11)*.

RESULTS

The return rates for self-administered household surveys were 22.8 percent in Falls Church, 24.4 percent in Centreville. The questionnaire allowed for responses on one form from all workers employed outside the home; 1,162 workers in Falls Church and 1,733 workers in Centreville responded. These sample sizes were large enough that detailed statistical analysis could be performed. The smaller number of responses from a comparably priced telephone survey would have limited the ability to analyze subsets within the sample with an acceptable level of statistical confidence.

The greatest danger in this type of self-selected survey is the potential for response bias in the sample of respondent households. If the survey showed strong demand for the new services, would that finding be reliable? The findings of the telephone survey, however, completely confirmed the findings of the door-to-door self-selected samples. Figures 1 and 2 compare the response data for the two research sites and the two techniques. Self-selection bias did not materialize. For every question, the results for the two modes of data collection were almost identical.

	HOUSEHOLD	TELEPHONE
PEOPLE IN HOUSEHOLD.....	2.7	2.8
ADULTS IN HOUSEHOLD.....	2.1	2.1
EMPLOYED OUTSIDE THE HOME..................	1.9	1.8
VEHICLES AVAILABLE FOR COMMUTING.............	1.9	2.0
REPORT TO WORKPLACE MOST OF THE TIME?...........	97%	98%
SEX (MALE).............	52%	50%
WORK WITHIN WALKING DISTANCE OF SUBWAY?....	48%	48%
EVER REGULAR TRANSIT USER?.................	50%	48%
WILL YOU USE NEW METRORAIL TO COMMUTE?..	51%	53%
NEED CAR AT WORK?.......	21%	29%
DO YOU DROP OFF KIDS WHEN COMMUTING?........	13%	11%
USE MINIBUS WITH 10 MINUTE FREQUENCY?......	55%	59%
USE MINIBUS WITH 20 MINUTE FREQUENCY?......	40%	46%
USE MINIBUS IF FREE?....	62%	64%
USE MINIBUS IF 25 CENT FARE?.................	61%	62%
USE MINIBUS IF 50 CENT FARE?.................	35%	43%
USE MINIBUS IF 75 CENT FARE?.................	13%	24%

FIGURE 1 Comparison of in-home and telephone surveys, Fall Church, Va.

	HOUSEHOLD	TELEPHONE
PEOPLE IN HOUSEHOLD.....	3.0	3.2
ADULTS IN HOUSEHOLD.....	2.1	2.1
EMPLOYED OUTSIDE THE HOME..................	2.0	1.9
VEHICLES AVAILABLE FOR COMMUTING.............	2.1	2.1
REPORT TO WORKPLACE MOST OF THE TIME?...........	97%	96%
SEX (MALE).............	55%	49%
WORK WITHIN WALKING DISTANCE OF SUBWAY?....	25%	21%
EVER REGULAR TRANSIT USER?.................	27%	25%
WILL YOU USE NEW METRORAIL TO COMMUTE?..	34%	30%
NEED CAR AT WORK?.......	32%	46%
DO YOU DROP OFF KIDS WHEN COMMUTING?........	13%	23%
WILL YOU USE THE NEW BUS SERVICE?..............	32%	29%
WANT AN EARLIER MORNING BUS?..................	8%	2%
WANT A LATER MORNING BUS?..................	15%	6%
WANT AN EARLIER EVENING BUS?..................	16%	6%
WANT A LATER EVENING BUS?..................	12%	4%

FIGURE 2 Comparison of in-home and telephone surveys, Centreville, Va.

COST

The following discussion is from the perspective of the contractor, not the sponsoring agency. It assumes that the telephone survey is subcontracted to a commercial telephone interviewing company, and that the door-to-door survey is organized and supervised by in-house personnel of the prime contractor.

Because the data obtained using the two techniques were so similar, the cost of data collection becomes an important factor in distinguishing the techniques. Telephone survey costs vary significantly according to length of questionnaire, ratio of long distance to local tolls, amount of screening required to qualify respondents, type of sampling done within households, ratio of random digit dialing to other sampling methods, and specific interviewing company.

Temporary labor rates for door-to-door surveys, housing density, and the existence of high-rise apartments also vary from area to area. The speed with which the temporary workers cover an area and efficiency of the plan for distribution and collection of survey materials also influence costs.

Obviously, data on comparative costs from previous projects can only be used to indicate general guidelines, not firm estimates, for other projects. As a rule of thumb, however, each telephone interview cost three and one-half times as much as each door-to-door response; that is, costs on the Northern Virginia projects were approximately $7 per respondent for the household survey and $25 per respondent for the telephone survey.

These figures included all project costs: questionnaire development, sampling, editing, data entry, extensive computer analysis, and written reports. Costs of door-to-door surveys included labor costs for distribution and collection of the surveys, art work, layout, and typesetting charges, supervisory costs, and mileage charges. The interviewing for the telephone interviews entailed a fixed price per respondent.

In comparison, the FHWA Office of Planning estimates total project costs for door-to-door, random (in-person) interviews at $100 per respondent and $50 per respondent when the housing units are highly clustered. Telephone interview total project costs are estimated to run as high as $50 per respondent. When the comparative cost and the similarity of the results are considered, the household door-to-door approach becomes a very attractive data collection option.

OTHER FACTORS

Cost is not the only consideration when designing a research project. The survey approaches have other significant factors associated with them.

Advantages of Telephone Surveys

Discussion of telephone survey techniques is found in the literature *(12–14)*.

1. *Ease of administration.* Once bids have been solicited from several commercial telephone interviewing companies and the contractor has been selected, the researcher need only wait for the completed surveys to be delivered. It is advisable for the researcher to take an active role in the interviewing process by conducting part of the training for the interviewers, by monitoring some of the calls, and by keeping in daily contact to assess progress and any problems with the sampling techniques or with the questionnaire. These tasks are comparatively simple however. They should remain simple because the contractor is being paid to do most of the work.
2. *Schedule easier to control.* Telephone survey companies should be able to estimate how long it will take, depending on their workload, to complete the job. If a company is overloaded and can't meet the schedule, a different company should be used. If firm deadlines are insisted upon, they can be met.
3. *Less planning.* The facilities, recruitment of personnel, training, paperwork, supervision, and so forth, of a door-to-door survey need not be planned. Door-to-door surveys are cost-effective for a prime contractor only if in-house personnel take on these tasks.
4. *Fewer personnel.* Subcontracting a telephone survey requires dealing with few people, whereas organizing a door-to-door survey requires dealing with many people, which takes time, patience, and understanding.

Disadvantages of Telephone Surveys

1. *Cost.* The telephone survey costs approximately four times per respondent what the door-to-door survey costs, and possibly more.
2. *Sample size limitations.* Increased cost results in smaller sample sizes and larger confidence intervals for given probabilities. This can be especially critical in the case of transit research because it focuses on a statistical rare event (i.e., transit usage). Any attempt at further analysis (for example, geographical breakdowns) will be especially hindered by sample size problems.
3. *Number of respondents per household.* The telephone approach actually allows the collection of data for only one respondent per household, because asking a respondent to provide data for others in the household may result in inaccurate information.

Advantages of Door-to-Door Self-Administered Survey

Discussion of in-home interview surveys is found in the literature *(15–17)*.

1. *Number of respondents per household.* Door-to-door questionnaires can be designed to allow several people to respond on the same form. If the goal is to collect information about the commuting habits of all workers in a household, for example, this can be a real advantage.
2. *Cost.* Many variables can affect comparative pricing, but the experience in two suburban areas was that door-to-door surveys were approximately one-fourth the cost of telephone surveys per respondent.
3. *Sample size.* The lower unit cost and ability of several people per household to respond lead to increased sample size, which reduces confidence intervals. The larger sample may also be divided into subgroups for further analysis.
4. *Use of maps and graphics.* Questionnaires can include maps, potential routes, proposed schedules, and other forms of presentation that cannot be used over the phone. These advantages may contribute to more reliable responses.
5. *More considered responses.* Because people can answer the questionnaire whenever they have time (not just when the telephone rings), the responses may be more thoughtful and reliable.
6. *Advertising value.* During the introduction of a new or potential service, the door-to-door survey technique has great value in the advertising of the service. For example, a community can be informed of a new bus route in a direct and inexpensive way while research is conducted at the same time. Information collected in the survey can be used to adjust the bus service to improve its effectiveness.
7. *Political value.* In some situations, government officials may react favorably to the idea of direct community involvement in a research project. The cover letter signed by some local officials, media coverage stimulated by the research project, and informational telephone calls in response to the survey can all be of political value to officials involved.

Disadvantages of Door-to-Door Household Surveys

1. *Potential self-selection bias.* In the two projects described, self-selection bias was not a problem. In other circumstances, however, this possibility must still be included in design considerations. Circumstances in a particular community or subarea may lead people who have a great deal to gain from the new services to return the surveys at a greater rate than people who have less to gain.

2. *Difficulty in organization and administration.* Door-to-door surveying is a labor-intensive approach to data collection that requires 15 to 40 people, depending on geography and sample size. Recruiting so many people (through colleges, high schools, temporary agencies, the Boy Scouts, etc.) is a major effort. Many people who say that they will work do not come or are late. In general, designing routes, recruiting people, supervising efforts, and handling paper are big tasks.

3. *Weather.* This type of data collection should not be done during the winter or hottest part of the summer. Weather problems can disrupt the schedule; heat or ice can make the work dangerous.

The following list summarizes these advantages and disadvantages:

Advantages	*Disadvantages*
Telephone	
Easier to administer	More expensive
Schedule easier to control	Smaller samples because of cost
Less planning	Only 1 respondent per household
Fewer personnel	
Household self-administered	
Multiple respondents per household possible	Potential self-selection bias
Larger sample likely	Difficult to organize and administer
Low per unit cost	Weather problems
Use of maps, graphics	
More considered responses	
Advertising value	
Political value	

The best approach for a given project depends on a combination of several factors. If money is no object, a telephone survey can certainly be conducted more easily. In most cases, when money is a trade-off with sample size, the door-to-door approach is a viable alternative that yields reliable results.

FINAL ESTIMATES BASED ON SCREENING PROCESS

Final estimates were based on a computerized screening process described in detail in a companion paper in this Record. The screening process removed any respondent from the final estimate who failed any one of a number of screens designed to identify people who, although they indicated that they would use a new transit service, would really be unable to do so. Some of the reasons for screening out potential riders included (a) having a work start time that was not included in the hours of service, (b) needing a car to drop children at school or day care, (c) working in an area not served by Metrorail, and (d) needing an automobile at work.

When the data from the two types of survey were run through the screening process, the resulting estimates differed only slightly between the two techniques in each location. However, the patterns of those screened out in the two locations were not totally consistent. Table 1 presents the impact of the screening process on the data collected using the two different types of survey.

Several conclusions can be drawn from the comparison of the impact of the screening process on data from these two types of survey.

1. The percentages of people responding to the two types of survey in each location who indicated an initial interest in using the new services were within the overlapping confidence intervals (not shown in Table 1) of the two surveys at the 95 percent confidence level. However, the rates at which people were screened out show no clear pattern between the two locations and the two types of surveys.

One initial expectation was that self-selected respondents to the door-to-door survey would respond out of clearly understood self-interest in the new transit service. Therefore they would be unlikely to be screened out by such factors as use of automobiles to drop off children at day care, needing an automobile at work, and so forth. On the other hand, the telephone respondents who indicated an interest in the new service (who had not taken the trouble to respond to the first survey) were expected to be less certain in their indicated needs. Therefore it was assumed that they would be more likely to be screened out as potential transit users through the factors identified as disqualifying characteristics. As Table 1 shows, this expected difference occurred in Falls Church but not in Centreville.

More research and experience are needed to understand the comparative reliability of the two types of survey. It may be possible eventually to demonstrate that this kind of screening process can be applied to only one type of survey without conducting the other type as confirmation. Whether a tendency of some people to give socially acceptable responses (and then be screened out because they really cannot use the new service) differs from one transit survey to another is a question is a question not answered by these data.

2. In both locations, relying on the screened data from the telephone survey would yield a slightly lower estimate of patronage than the door-to-door survey results. Transit research often cannot be validated by observation of actual usage, but in this case such validation is possible because service on the new Centreville bus route has begun. Initial data from the early weeks of the Centreville bus route indicate that estimates based on postscreen respondents to the door-to-door survey would be more accurate than telephone survey estimates.

3. At the outset of the project, it was expected that respondents to the door-to-door survey (who were self-selected would be much more likely to want to use transit than people in the telephone survey would. The expectation was that self-interest would prevail in most decisions on whether or not to return the form. However, with the results in both locations having been so similar, it appears that propensity to return the form was unrelated to desire for new transit service.

TABLE 1 THE EFFECT OF THE SCREENING PROCESS ON DOOR-TO-DOOR AND TELEPHONE SURVEY DATA

	FALLS CHURCH		CENTREVILLE	
	Household	Telephone	Household	Telephone
Percentage of Workers Expressing Interest in Public Transit	55.3%	58.8%	32.2%	28.6%
Percent Screened Out	-33.1%	-42.0%	-25.6%	-26.7%
Percentage of Workers Passing All Screens	22.2%	16.8%	6.6%	1.9%
Confidence Interval of Screened Estimate	+/-2.4%	+/-5.2%	+/-1.2%	+/-1.8%

It appears that there were simply two kinds of people in these two Northern Virginia areas: those who fill out questionnaires and those who do not. There were few if any differences between the travel characteristics of the respondents and those of the nonrespondents to the door-to-door surveys. This sameness suggests that the door-to-door survey technique is a cost-effective and reliable approach to gathering information from larger numbers of residents in a small area. It allows data to be collected at a comparatively low cost per interview and results in estimates based on large enough sample sizes that the confidence intervals around the estimates are relatively small.

CONCLUSION

Without further testing of the methodology, it cannot be concluded that these two techniques will always yield similar results. However, in both of the test locations the results are strikingly close. These techniques will continue to be tested and refined in the future; eventually, the similarities (and differences) between the results of these two types of data collection may become fully documented.

Each type has some major advantages and disadvantages. The appropriateness of each approach must be decided on a case-by-case basis. However, the self-administered door-to-door approach will work as well as a telephone survey in most cases and will cost less while yielding a much larger sample size. Although the door-to-door survey requires more work to design and implement than does a telephone survey, it has a number of advantages that make it a viable alternative to consider for transit market research.

REFERENCES

1. I. M. Sheskin and P. R. Stopher. Pilot Testing of Alternative Administrative Procedures and Survey Instruments. In *Transportation Research Record 886*, TRB, National Research Council, Washington, D.C., 1982, pp. 8–22.
2. P. R. Stopher. Small-Sample Home Interview Travel Surveys: Application and Suggested Modifications. In *Transportation Research Record 886*, TRB, National Research Council, Washington, D.C., 1982, pp. 41–47.
3. P. R. Stopher and I. M. Sheskin. Toward Improved Collection of 24-hr Travel Records. In *Transportation Research Record 891*, TRB, National Research Council, Washington, D.C., 1982, pp. 10–17.
4. E. G. Ohstrom, J. B. Ohstrom, and P. R. Stopher. Successful Administration of a Mailed 24-hr Travel Diary: A Case Study. In *Transportation Research Record 987*, TRB, National Research Council, Washington, D.C., 1984, pp. 14–20.
5. E. R. Babbie. *Survey Research Methods*. Wadsworth, Belmont, Calif., 1973.
6. C. H. Backstrom and G. Hursh-Cesar. *Survey Research* (2nd ed.). John Wiley, New York, 1981.
7. D. P. Warwick and C. A. Lininger. *The Sample Survey: Theory and Practice*. McGraw-Hill, New York, 1975.
8. F. F. Stephan and P. J. McCarthy. *Sampling Opinions*. John Wiley, New York, 1958.
9. K. Webb and H. P. Hatry. *Obtaining Citizen Feedback: The Application of Citizen Surveys to Local Governments*. Urban Institute, Washington, D.C., 1973.
10. G. Kalton. *Introduction to Survey Sampling*. Sage Publications, Beverly Hills, Calif., 1983.
11. S. Sudman and N. M. Bradburn. *Response Effects in Surveys: A Review and Synthesis*. Aldine, Chicago, 1974.
12. A. B. Blankenship. *Professional Telephone Surveys*. McGraw-Hill, New York, 1977.
13. D. A. Dillman. *Mail and Telephone Surveys: The Total Design Method*. John Wiley, New York, 1978.
14. J. H. Frey. Survey Research by Telephone. Sage Publications, Beverly Hills, Calif., 1983.
15. F. W. Memmott, III. Home Interview Survey and Data Collection Procedures. In *Highway Research Record 41*, HRB, National Research Council, Washington, D.C, 1963, pp. 7–12.
16. D. A. Aaker and G. S. Day. *Marketing Research*. John Wiley, New York, 1983, p. 159ff.
17. C. H. Lovelock, R. Stiff, D. Kullwick, and I. M. Kaufman. Evaluation of the Effectiveness of Drop-Off Questionnaire Delivery. *Journal of Market Research*, Vol. 13, Nov. 1976, pp. 358–364.

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Public Transportation Development and Coordination: San Diego Case Study

THOMAS F. LARWIN

The San Diego Metropolitan Transit Development Board (MTDB) was created by the California state legislation in 1975 and empowered to plan, construct, and operate mass transit guideways and to perform near-term planning. The agency has evolved into an umbrella organization that has broad transit development, planning, programming, and financing powers. Operations of transit services are performed by a variety of operational units controlled by MTDB in a unified system. This system has been officially called the Metropolitan Transit System (MTS). Made up of six fixed-route bus carriers, one light rail transit (LRT) operator, and four general-purpose dial-a-rides, the MTS is characterized by unified fares, transfers, passes, and route numbers.

The San Diego metropolitan area contains 10 cities, of which the largest is the city of San Diego. The current population for the metropolitan area (Figure 1) is just under 1.6 million people, with nearly two-thirds of these residents living within the city of San Diego. The area has faced considerable growth since World War II, and population forecasts show an approximate 30 percent increase over today's levels by the year 2000, resulting in an expected population of about 2.1 million residents *(1)*.

The public transportation system for the area includes a variety of services. The basic system is a fixed-route bus network that has local/feeder, urban arterial, and express/commuter runs and is supplemented by light rail transit (LRT) service in two corridors and a number of general- and special-purpose demand-responsive systems. Approximately 130,000 total passengers are carried by these systems daily. As presented in Table 1, specific operators include six that provide fixed-route bus service, the LRT operator (San Diego Trolley, Inc.), and four general-purpose dial-a-rides. Over 350 transit vehicles—buses, taxis, vans, and light rail vehicles—are deployed during the peak periods to operate this system (Table 2).

This overall public transit network is officially called the Metropolitan Transit System (MTS). However, MTS itself is not an agency, but is the unifying name, logo, or acronym used to represent all of the publicly subsidized transit operators in the San Diego metropolitan area. The purpose of this paper is to explain how the San Diego MTS is organized and governed.

FUNCTIONS OF THE METROPOLITAN TRANSIT DEVELOPMENT BOARD

The San Diego Metropolitan Transit Development Board (MTDB) was created in 1975 by California state legislation (Senate Bill 101) *(2)*. The board is empowered to plan, construct, and operate mass transit guideways and to perform near-term planning and programming in its area of jurisdiction. MTDB is an independent agency governed by a 15-member board of directors: four council members from the city of San Diego, one council member each from nine suburban cities, one supervisor from the county of San Diego, and one representative appointed by the governor of California.

The organizational basis for MTDB took hold with a concept presented to the MTDB board of directors in January 1979 *(3)*. This concept described an agency that

> ". . . would determine overall transit service levels, fares, schedules, and be responsible for public information about transit in the MTDB area of jurisdiction. . . . The LRT operator is but one of several contract operators for transit and freight service operating to specifications established by the regional transit agency. All of these contract operations would thus fit together into a unified system from the point of view of the public.

In a somewhat gradual and incremental way, the concept came together in 1984 after several studies of the matter were completed *(4, 5)*. These studies paved the way for legislative changes completing organization of MTDB in its current form *(6)*. As such, the concept mirrors what has been referred to *(7)* as a "public marketing agency approach" and has parallels to the transit federations of some systems in the Federal Republic of Germany *(8–10)*.

Over MTDB's first 10 years, the agency was best known as a guideway development organization. MTDB planned, designed, and constructed the 16-mi LRT line between Centre City San Diego and the International Border (i.e., Tijuana) in San Ysidro, followed by the first 4.5-mi leg of the eastern extension, which runs from Centre City to Euclid Avenue. This LRT system initiated revenue service on the South Line in 1981 and on the East Line in March 1986.

In addition to these development functions, MTDB is also responsible for short-range planning and financing for bus and rail transit systems in its area. As depicted in Figure 2, MTDB effectively functions as an umbrella agency. MTDB owns the assets of San Diego Transit Corporation (SDTC) and San Diego Trolley, Inc. (SDTI), the area's two largest transit operators. These two transit units were formed under California law as nonprofit public corporations. In addition, MTDB owns the San Diego and Arizona Eastern Railway Company (SD&AE), a Nevada railroad corporation that covers 108 mi of line and over 2,000 acres of property. The operations and maintenance

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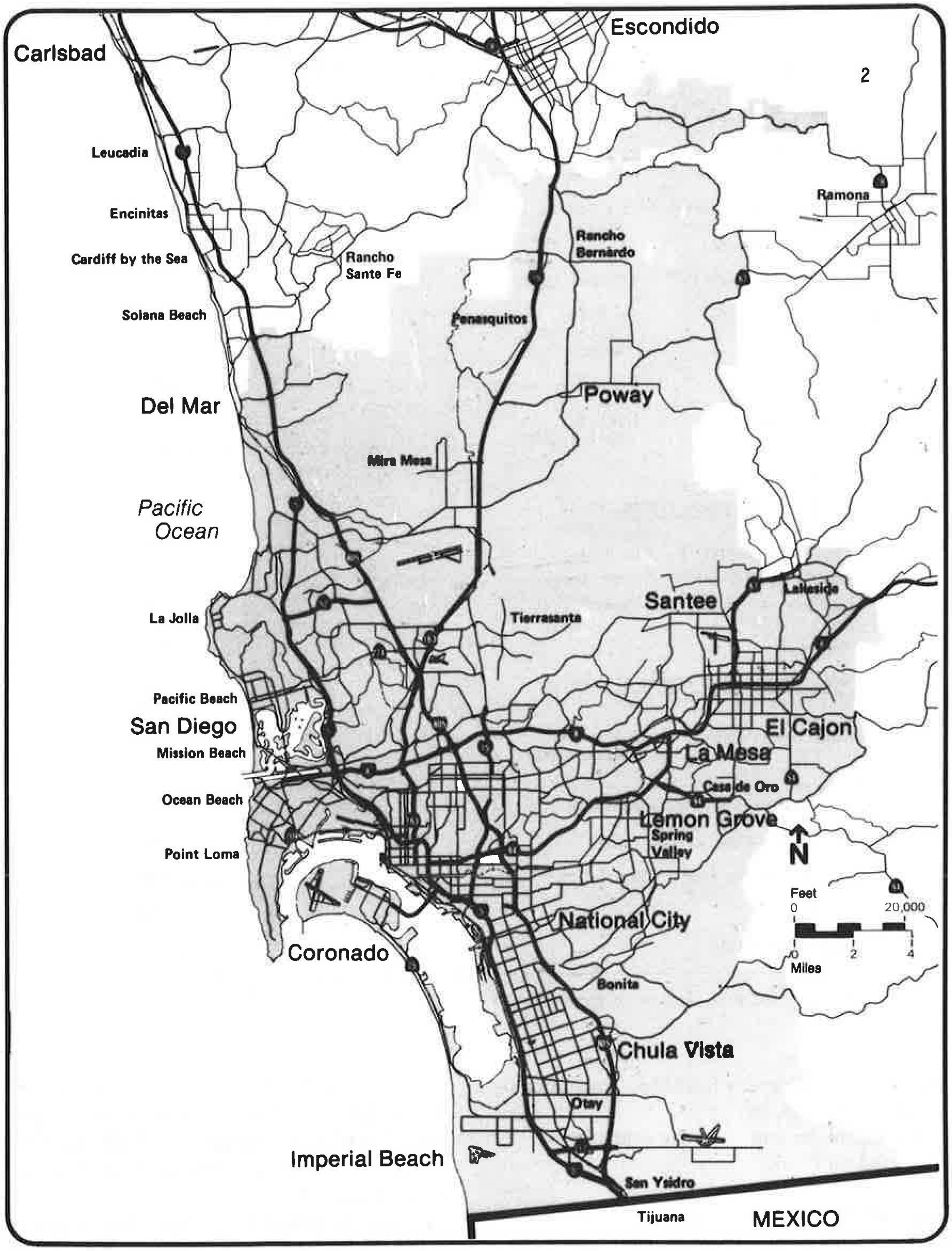

FIGURE 1 MTDB area of jurisdiction.

of these two transit services and for the freight railroad are all handled under separate operating organizations. Essentially, the day-to-day functions, labor matters, and maintenance of facilities are managed by these individual operating corporations.

Outside of MTDB's ownership responsibilities, but essential to the cost-efficient operation of public transit services in the area, are MTDB's coordination powers. These functions are specified through California state legislation *(11)* that provides state transit fund administration, planning and programming roles for MTDB over any public transit operator in the area that receives state operating monies. These powers are translated into various formal MTDB controls over public transit services through these means:

- Policies, for example, on fare setting and transfers.
- Plans and programs, for example, the annual Short-Range Transit Plan and the annual Transportation Improvement Program.

TABLE 1 SUMMARY OF MTDB AREA PUBLIC TRANSIT OPERATORS

Operator	Service Area	Number of Routes	FY 86 Total Passengers	FY 86 Revenue Miles
FIXED ROUTE				
Chula Vista Transit	Chula Vista	6	868	538
County Transit Express	North County, Centre City	3	99	128
County Transit Suburban (Includes East County and Poway service)	East County, Poway	8	696	903
National City Transit(1)	National City	3	670	274
San Diego Transit	San Diego, South Bay East County, Centre City	29	24,989	9,898
San Diego Trolley	South Bay, Southeast	2	7,003	1,798
Strand Express	South Bay, Centre City	1	893	423
Subtotal		52	35,218	13,962
GENERAL PUBLIC DEMAND RESPONSIVE				
El Cajon Express	El Cajon	1	157	318
La Mesa Dial-a-Ride	La Mesa	1	150	288
Lemon Grove Dial-a-Ride	Lemon Grove	1	40	70
Poway Dial-a-Ride	Poway	1	6	17
Subtotal		4	353	693
SENIOR AND DISABLED DEMAND RESPONSIVE				
Chula Vista HandYtrans	Chula Vista	1	48	121
County Transit WHEELS	South Bay, East County	1	38	249
National City Dial-a-Ride	National City	1	7	21
Poway Call-a-Ride	Poway	1	9	43
San Diego Dial-a-Ride(2)	San Diego	1	214	698
Subtotal		5	316	1,132
MTDB Area Total		64	35,887	15,787

Passenger and mile amounts in thousands

- Approval of annual budgets for San Diego Transit Corporation and San Diego Trolley, Inc.
- Approval of claims for state operating assistance.
- Grantee for federal funds.

Thus, although MTDB does not have direct control of the suburban fixed-route bus operations nor the public dial-a-rides, it has direct influence over the route/service definition and fare structure for each of the operators through these powers.

As noted, MTDB's enabling legislation has been amended in recent years to clarify and strengthen the various coordination roles. One amendment provided for a separate fund of state operating monies to be established and available to MTDB for so-called "regional" services *(12)*. These regional transit services are those that are defined to be intercity and generally have a longer passenger trip length than local services. Currently, MTDB uses these regional monies to provide service under contract with three operators. Further, in accordance with state law, a board policy that would require competitive award of new regional services was prepared and adopted *(13)*. Another piece of legislation granted MTDB authority to administer and resolve disputes with regard to regional service and funding matters *(14)*.

Finally, an important legislative change was one that required maintenance of an areawide farebox recovery rate (FRR) *(15)*. Before this legislation, each operator receiving state transit operating subsidies was bound to maintain a certain individual FRR or possibly face the loss of funds. This legislation aggregated all subsidized transit operations together statistically under MTDB to come up with a unified FRR for the metropolitan area. In this way, an individual operator would not be faced with possible fare structure changes, to the detriment of a unified metropolitan system. Of interest, and of importance locally, is that the areawide FRR has increased from a historical low of 30.85 percent in Fiscal Year 1976–77 to 44.74 percent

TABLE 2 MTDB AREA TRANSIT VEHICLE FLEET DESCRIPTION

Operator	Number of Vehicles/ Peak Vehicles	Type of Vehicle	Owned by Operator or Contractor	Air Conditioned	Wheelchair Lifts
Fixed-Route					
Chula Vista Transit (SCOOT)	13/9	Bus	Operator	0	13
County Transit System Express Bus	10/7	Bus	Contractor	10	0
County Transit System Suburban Bus					
- East County	9/6	Bus	Operator	9	9
- East County	6/5	Van	Contractor	6	0
- Poway	5/4	Bus	Contractor	5	0
National City Transit	11/7	Bus	Operator	8	8
San Diego Transit	298/223	Bus	MTDB	297	110
DART	15/15	Taxi	Contractor	15	0
San Diego Trolley	30/24	LRV	MTDB	6	30
Strand Express	12/12	Bus	Contractor	9	0
Total	358/268	Buses		338	140
	30/24	Light Rail Vehicles		6	30
	15/15	Taxis		15	0
	6/5	Vans		6	0
General Public Dial-a-Ride					
El Cajon Express	25/25	Taxi	Contractor	0	0
La Mesa Dial-a-Ride	15/15	Taxi	Contractor	0	0
Lemon Grove Dial-a-Ride	3/3	Taxi	Contractor	0	0
Poway Dial-a-Ride	2/1	Station Wagon	Contractor	2	0
Total	45/44			2	0

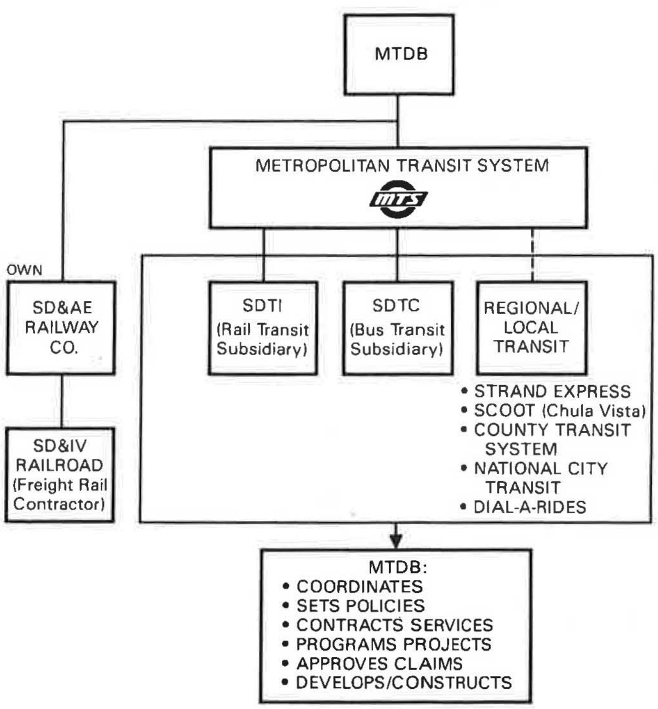

FIGURE 2 MTDB functional organization chart.

in Fiscal Year 1985–86 *(16)*. This increase paralleled MTDB fare policies initially adopted in 1977 and strengthened by the legislation previously mentioned.

DESCRIPTION OF ORGANIZATION

MTDB is divided into three basic departments: engineering and construction, planning and operations, and finance and administration. These departments are augmented by in-house legal counsel and a public information office. All design and construction management activities are handled by the engineering and construction department. Included within the planning and operations department are short-range transit planning activities, special fare and operational studies, LRT project planning, area transit marketing, environmental studies, and monitoring of MTS performance. Basic support services for the organization are contained in finance and administration, in addition to grants management and regional transit pass sales administration.

ANNUAL PLANNING PROCESS

The annual planning process, as shown in Figure 3, weaves the following within the Short-Range Transit Plan (SRTP) *(16)* annual update: the Transportation Improvement Program (TIP), individual operator budgets, claims for state and federal operating assistance, and receipt of state and federal grants. Adoption of transit development goals and objectives takes place in fall each year and leads to the update of the SRTP by the following August. This plan is drafted in the spring to guide final procedures of the TIP, operator budgets, and claims. The SRTP, adopted in the summer, leads to the submittal of grant applications.

In close cooperation with the short-range planning is the long-range planning, as carried out by the metropolitan planning organization, the San Diego Association of Governments (SANDAG). SANDAG is responsible for development and adoption of a Regional Transportation Plan (RTP), which contains the long-range multimodal plan for transportation improvements in the region. The metropolitan SRTP must be found consistent with this long-range RTP. To promote this coordination, two key agreements define the separation and coordination of mutual responsibilities in planning and programming between MTDB and SANDAG *(17, 18)*. As a result, specific planning and programming responsibilities define a partnership to cooperatively establish common goals and objectives.

UNIFIED MTS SERVICES

A number of devices are used to coordinate services and projects among the affected agencies and MTS operators. A primary method for communication is through the General Managers' Group. This group, composed of the general managers of all fixed-route operators, normally meets twice monthly. The intent of this body is to foster high-quality MTS services through communication and cooperation, as well as to attempt to resolve any differences at the management level rather than at the board level. Supporting the general managers' group are other committees:

- Fare pricing and operation task force
- Regional transit marketing group
- Regional transit service advisory committee

The following are examples of key aspects of the MTS that serve to coordinate and unify services:

- Fare structure: an agreement that establishes a uniform fare structure for the metropolitan area providing basic fares and transfers between operators.
- Monthly passes: an agreement *(19)* that establishes monthly passes valid on all fixed-route transit services in the metropolitan area and a formula for distribution of pass fare revenue.
- Telephone information: a service that provides a central transit telephone information system for all fixed-route operators.
- Route numbering: a system of uniform route numbers established to avoid duplication and confusion between operators.

CONCLUSIONS

Because each urban area is unique, it requires a unique approach to the institutional aspects of providing public transportation service. Although the specifics of what works in San Diego may not be transferable to other regions, the ingredients that are needed for providing cost-efficient public transportation services and for programming future developments appear to be transferable. The San Diego MTDB organizational form, through having different organizational units, also possesses the following characteristics:

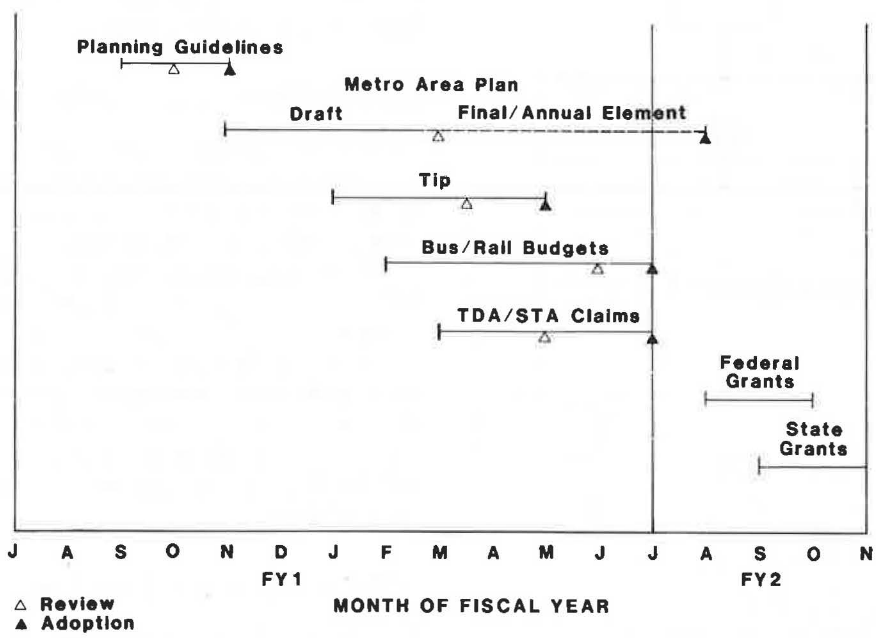

FIGURE 3 MTDB planning process and schedule.

1. *A central, single legislative body that makes all metropolitan transit policy decisions.* The objective of such a body is to set consistent service, development, and investment policy across all transit providers to effect system uniformity and ease of use by all community residents.

2. *A clear and efficient decision-making network.* There must be a conscious effort to coordinate and communicate with all affected agencies. Final decision-making authority must be clearly identified and the decision processes outlined. Ownership of the two major operators and legislated coordination powers solidify the MTDB and force it to have such a network.

3. *The power of financing projects and services.* Primary planning and regulatory authority comes by virture of holding the funding powers. The management and allocation of financial resources are necessary to carry out required explicit and implicit authorities.

4. *Board members who are locally elected officials and appointed by their city councils.* This board form encourages MTDB management to work closely with counterparts at the local level and promote joint, cooperative MTDB-city actions.

5. *Separation of development functions from operations.* Significant management attention and energies are needed for effectively carrying out both functions—this organization form allows it.

From the San Diego metropolitan area experience, the following are advantages and disadvantages of this organizational form:

Advantages

1. Significant attention is devoted to medium- and long-range planning and tying in future transit project services and programs with land use decisions.

2. Apparently because it functions as a development agency and not an operator, unbiased attention can be given to the financial management of operating resources.

3. The separation of planning and development from operations allows operating management to remain closer to the day-to-day operations and maintenance of transit services.

4. Lobbying for operations and capital funds at the local, state, and federal level is on an areawide basis and effectively includes all local jurisdictional units.

5. Inclusion of multiple operating agencies, through constructive competition, sharpens operating decisions as well as policy decisions, leading, it is hoped, to improved cost efficiencies in the provision of service. In addition, the existence of multiple operators forces more attention on the coordination of transfers between routes.

6. The engineering and short-range planning activities for area transit services and projects are centralized and directly related to each other.

7. Independent operator identities create spirit and pride in the individual organizations, promoting innovation and cost-effectiveness.

Disadvantages

1. Independent operator identities create spirit and pride in their individual organizations, promoting rivalry and jealousy.

2. Despite what may be clear lines of authority, the existence of multiple operator governing boards has the potential for delaying decisions and promoting jealousy.

3. There is the potential for duplication of work when the paths of authority and decision-making powers are not clearly outlined.

4. To work smoothly requires the cooperation of top management from all agencies, with a corresponding commitment to a unified operation.

5. Financial decisions that might be in the best interest of the region will have different impacts on each of the operating agencies, causing those that receive negative impacts to react adversely to such decisions.

REFERENCES

1. *Regional Transportation Plan.* SANDAG, June 1986.
2. *California Public Utilities Code.* §§120050 et seq., Sacramento, 1986.
3. MTDB. Organization Plan. Presented to MTD Board of Directors, San Diego, Jan. 8, 1979.
4. *Report from the Task Force.* City of San Diego Transit Advisory Task Force, Aug. 1982.
5. Booz, Allen & Hamilton, Inc. *South San Diego County Transit Organization Structure Analysis,* SANDAG, Feb. 1984.
6. *California Senate Bill 1736.* 1984.
7. B. E. Sullivan. Institutional Arrangements and Public Transit Performance: The Public Marketing Agency Approach. *Transit Journal,* Winter 1980, pp. 55–70.
8. P. J. Goldsack. Hamburg: Transit At Its Best. *Mass Transit,* June 1979.
9. P. J. Goldsack. West Germany's Economic Miracle Aids Transit. *Mass Transit,* July 1980.
10. A. Naftalin. Mass Transit in Hamburg. *Transportation Engineering,* Dec. 1977.
11. *California Public Utilities Code.* §§99200 et seq., Sacramento, 1986.
12. *California Public Utilities Code.* §120265, Sacramento, 1986.
13. MTDB. *Contracting Out Transit Services.* Policy 32, April 1987.
14. *California Public Utilities Code.* §120477, Sacramento, 1986.
15. *California Public Utilities Code.* §99269, Sacramento, 1986.
16. MTDB. *Metropolitan San Diego Short-Range Transit Plan for FY 87–91.* Aug. 1986.
17. MTDB and SANDAG. *Memorandum of Understanding.* Nov. 1984.
18. MTDB and SANDAG. *7th Supplemental Agreement.* 1984.
19. E. Lerner-Lam. Regional Transit Pass for San Diego: A Key to Operating Efficiencies and Rider Convenience. In *Transportation Research Record 947,* TRB, National Research Council, Washington, D.C., 1983, pp. 41–44.

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