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APPLYING PERFORMANCE INDICATORS
IN TRANSIT MANAGEMENT

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Any uniform set of transit performance indicators must be constructed with due regard to both their intended use, and to the limitations of available data. This paper presents and applies nine possible performance indicators which might be used for annual, comparative evaluation of transit system performance. The nine indicators comprising this set rely, with one exception, on generally available operating and financial data; they are able to reflect changes in system management and policy and they minimize the effects of differing operating environments. While minimized in their effect, environmental factors must be included in the case studies used to illustrate the application of the performance indicators.

Although transit operators are apprehensive about the use of performance indicators, they should appreciate the benefits. Performance indicators provide an opportunity to elevate the general understanding of transit's capabilities and costs by emphasizing the productive use of capital and labor, rather than focusing performance only on ridership and operating costs.

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Indicators can assist public policy evaluations by allowing study of the effect of programs over time or between different properties, and by indicating the return on public investment in transit. They also facilitate the establishment of clearly defined and measurable goals and objectives for public transit.

For management, performance indicators may serve to organize the volumes of data upon which decisions must be based and to signal areas which require special attention. In addition, indicators will assist in establishing performance goals for individual departments and routes within the property and the monitoring of such goals.

INDIVIDUAL INDICATORS

The selected performance indicators, their construction, and their focuses are summarized in Figure 1. Each of these indicators has been chosen to reveal different attributes of transit efficiency and effectiveness.

Revenue Vehicle Hours Per Employee: As an efficiency measure of labor productivity, this indicator will be affected by the size of the administrative staff of a property, its peak/off peak ratio, and hours of service. The use of a simple employee total in this measure introduces some error as workday and workweek lengths may differ significantly between properties and yet appear the same in this measure. Total employee hours would be a better denominator, but it is not generally available.

Revenue Vehicle Hours Per Vehicle: As an efficiency measure of vehicle utilization, this indicator is affected by the service hours of the property, the peak/off peak ratio, and the daily service vehicle/total fleet ratio. Both of the above indicators have the advantage of using only physical measures of production inputs, rather than dollar measures, and, hence, are both relatively independent of the differences in wage rates between cities. Also, since they both use Vehicle Hours as their measure of output, they are relatively independent of differences in speed, congestion, and trip length between cities.

Operating Expense Per Revenue Vehicle Hour: As an efficiency measure of total inputs per unit of provided service, this indicator is affected by

Indicator	Construction	Focus
Efficiency:		
Revenue Vehicle Hours Per Employee	$\frac{\text{Total Revenue Vehicle Hours}}{\text{Total System Employees}}$	Labor Productivity
Revenue Vehicle Hours Per Vehicle	$\frac{\text{Total Revenue Vehicle Hours}}{\text{Total Revenue Vehicles}}$	Vehicle Utilization
Operating Expense Per Revenue Vehicle Hour	$\frac{\text{Total Operating Expense}}{\text{Total Revenue Vehicle Hours}}$	Cost Per Produced Output Unit
Effectiveness:		
Revenue Passengers Per Service Area Population	$\frac{\text{Total Revenue Passengers}}{\text{Total Service Area Population}}$	Utilization of Service
Total Passengers Per Vehicle	$\frac{\text{Total Passengers}}{\text{Total Revenue Vehicles}}$	
Revenue Passengers Per Revenue Vehicle Hour	$\frac{\text{Total Revenue Passengers}}{\text{Total Revenue Vehicle Hours}}$	
Operating Expense Per Total Passenger	$\frac{\text{Total Operating Expense}}{\text{Total Passengers}}$	Cost Per Consumed Output Unit
Operating Expense Per Revenue Passenger	$\frac{\text{Total Operating Expense}}{\text{Total Revenue Passengers}}$	
Percent Population Served	$\frac{\text{Total Service Area Population}}{\text{Total Coverage Area Population}}$	Accessibility of Service

Figure 1. Selected Performance Indicators for Transit.

a property's peak/off peak ratio, hours of daily service, and labor unionization. Properties which share particular support facilities and services with other organizations, such as a municipal operator whose maintenance and accounting is done by the larger municipal organization, may achieve somewhat inflated efficiencies on this indicator if costs of such services are not fully billed to the transit operation.

Revenue Passengers Per Service Area Population: As an effectiveness measure of the penetration of transit into its potential market, this indicator is significantly affected by the definition of the property's service area, hence its size is subject to political considerations rather than management decisions. The "Revenue Passengers" statistic is synonymous with "passenger trips" or "linked trips."

Total Passengers Per Vehicle: As an effectiveness measure of system patronage and capacity utilization indexed to an average transit vehicle, this indicator is affected by average trip length, rate of transfers in the system, peak/off peak and daily service vehicle/total fleet ratios.

Revenue Passengers Per Revenue Vehicle Hour: As an effectiveness measure of system patronage per unit of produced service, this indicator is affected by the peak/off peak ratio, hours of service, vehicle capacity and average trip length of a property. The use of "revenue passengers" rather than "total passengers" corresponds to the evaluation of overall system performance on passengers served, not the segmented trips they may be required to make by virtue of system's route structure

Operating Expense Per Total Passenger: This is an effectiveness indicator of total inputs per unlinked trip. This indicator and the one which follows, Operating Expense Per Revenue Passenger, are overall performance measures for a transit system, combining efficiency (total operating costs) with the system's effectiveness (passengers). As such, they serve the function of bringing together the two aspects of performance evaluation into an integrated ratio. One significant problem with this measure is that it ignores operating revenues. A system that charged extremely low fares, thereby attracting more passengers, would look very good on this measure even though its operating ratio was very poor.

Operating Expense Per Revenue Passenger: This is an effectiveness indicator of total inputs per individual passenger or linked trip within a system.

Percent Population Served: As an effectiveness measure of accessibility of provided transit service to an area's residential population, this indicator may be affected by the definition of the property's service area. This indicator has the weaknesses of not considering frequency of service and of relying upon data elements which are not available from all transit properties at this time. A measure of walking accessibility to transit services will be required under the UMTA Section 15 requirements.

APPLYING THE INDICATORS

Operating and financial data was collected from 46 public transit properties throughout California for fiscal year 1975-1976. In order to receive tax monies from California Transportation Development Act, these

properties must submit annual reports to the state, including certain operating and financial data. These annual submissions were verified with, and additional data collected from, representatives of each transit property.

Although usable data was obtained through this collection effort, we discovered that operating and financial information available from public transit operators is generally inadequate and unreliable. Much less data was available than anticipated, and a significant amount of that which is available is actually dissimilar due to differences in definitions and generation procedures.

The performance indicators described above were computed for each of the 46 transit properties. Analysis of these achieved values has investigated the comparability of indicator values between properties operating different service modes (fixed-route versus demand-responsive), between types of organization (transit districts versus municipal operators), and between operators in service areas with different population densities. These analyses found that different types of organizations and properties with different population densities are generally comparable using these performance indicators. However, demand-responsive and fixed-route operators were not found to be comparable due to the character of services provided. Mean indicator values for demand-responsive and fixed-route properties are shown in Figure 2.

	Efficiency			Effectiveness					
	Rev Veh Hrs/ Employee	Rev Veh Hrs/ Vehicle	Oper Exp/ Rev Veh Hr	Rev Pass/ Svc Area Pop	Tot Pass/ Vehicle	Rev Pass/ Rev Veh Hr	Oper Exp/ Tot Pass	Oper Exp/ Rev Pass	Percent Pop Served
Total Sample (46 cases)	1,282.5	2,236.7	\$ 16.28	15.1	50,259.6	18.7	\$ 1.28	\$ 1.42	.82
Fixed Route (38 cases)	1,177.4	2,263.3	\$ 17.69	17.9	58,513.3	22.0	\$.87	\$.98	.79
Demand-Responsive (8 cases)	1,729.3	2,123.4	\$ 10.28	1.6	11,054.0	5.0	\$ 3.27	\$ 3.47	1.00

Figure 2. Comparison Between Fixed-Route
and Demand-Responsive Properties

INTERPRETING THE INDICATORS: THREE CASES

To illustrate the possible use of these indicators and to give a better feel for their relative uses, a sample analysis of three different transit properties is provided. Although public information was used in the calculation of these indicators, we have chosen not to disclose the identity of the properties.

Case 1:

Efficiency			Effectiveness					
Rev Veh Hrs/ Employee	Rev Veh Hrs/ Vehicle	Oper Exp/ Rev Veh Hr	Rev Pass/ Svc Area Pop	Tot Pass/ Vehicle	Rev Pass/ Rev Veh Hr	Oper Exp/ Tot Pass	Oper Exp/ Rev Pass	Percent Pop Served
1,082.8	2,498.8	\$ 23.20	8.3	60,678.8	20.8	\$.96	\$ 1.11	.75

Figure 3. Performance Indicators for a New Transit Property.

This property is a new transit district created through the acquisition of two municipal systems and serving a low density suburban area. It operates fixed route services for several cities and adjoining county territory.

When compared to the mean indicator scores for fixed route properties (Figure 2), this district rates unfavorably in 2 of 3 efficiency measures and 4 of 6 effectiveness indicators. These unfavorable indices for cost-related measures and Revenue Vehicle Hours Per Employee are to be expected. As a newly-created district, it can be expected to have higher costs and more employees than established systems because of the start-up costs and special demands (marketing, planning) connected with implementing service.

The two indicators based on service area population, Revenue Passengers Per Service Area Population and Percent Population Served, are also unfavorable--the first, appreciably, the second only slightly. These both are affected by the large size of the property's service area and the difficulty of developing ridership when population density is under 500 persons per square mile. Because of the extreme dispersion of population in this area, it is possible that patronage cannot be developed to the level achieved in other areas. The value of comparison with established properties is that such comparison provides objectives for such developing properties and guidance for estimating future ridership and equipment needs.

Case 2:

Efficiency			Effectiveness					
Rev Veh Hrs/ Employee	Rev Veh Hrs/ Vehicle	Oper Exp/ Rev Veh Hr	Rev Pass/ Svc Area Pop	Tot Pass/ Vehicle	Rev Pass/ Rev Veh Hr	Oper Exp/ Tot Pass	Oper Exp/ Rev Pass	Percent Pop Served
632.7	1,476.3	\$ 17.49	3.2	17,350.5	10.8	\$ 1.49	\$ 1.62	1.00

Figure 4. Performance Indicators for a Demand-Responsive Property

Case 2 is a municipal demand-responsive operator. When compared to other demand-responsive systems (Figure 2), this property receives unfavorable efficiency scores, but very favorable effectiveness scores. The unfavorable score on employee productivity, Revenue Vehicle Hours Per Employee, is due in part to a data error. The statistic was computed on a reported figure of 11 full-time drivers, which should actually be 3 full-time and 8 part-time. When employee productivity is recomputed counting 7 drivers (part-time drivers counted as $\frac{1}{2}$ a full-time driver) the indicator value is raised to 1265.4--still below average but much improved. This again reinforces the necessity of clearly defined data items if accurate data is to be obtained.

The unfavorable efficiency indicators, as a whole, reflect the limited service hours provided by this property. These indicator scores could be improved through lengthening of service hours, possibly with commensurate increases in patronage. However, this decision must take into consideration local travel desires, and the willingness of local agencies to contribute the additional matching subsidy.

Case 3:

Efficiency			Effectiveness					
Rev Veh Hrs/ Employee	Rev Veh Hrs/ Vehicle	Oper Exp/ Rev Veh Hr	Rev Pass/ Svc Area Pop	Tot Pass/ Vehicle	Rev Pass/ Rev Veh Hr	Oper Exp/ Tot Pass	Oper Exp/ Rev Pass	Percent Pop Served
1,177.6	2,338.8	\$ 19.41	35.2	91,410.1	36.2	\$.50	\$.54	.97

Figure 5. Performance Indicators for a Fixed-Route Property

This property is a municipally-owned fixed-route operator providing service over long-established routes in a high-density service area (6929 residents per square mile). When compared to other fixed route properties,

it scores favorably on two of three efficiency indicators and very favorably in all effectiveness indicators.

The one unfavorable efficiency score, Operating Expense Per Revenue Vehicle Hour, is approximately 10% above the mean cost for fixed-route properties (\$17.69).

The property's highly favorable effectiveness scores reflect its well-established routes, service area density, and the probable presence of a large segment of the population who are reliant upon transit.

The combination of a high rating on Revenue Passengers Per Revenue Vehicle Hour, only slightly-above-average scores on Revenue Vehicle Hours Per Employee and Revenue Vehicle Hours Per Vehicle, and the below average score on Operating Expense Per Revenue Vehicle Hour suggests that few unproductive hours of service are provided. Longer service hours could bring all scores above the mean, yet there is no indication that any real benefit would be achieved through such action.

The preceding cases have demonstrated the utility of performance indicators for the evaluation of transit performance as well as their shortcomings. It shows, further, that at the present state-of-the art interpreting performance indicators is not a simple task.

The effects of misreported and inaccurate data become evident when focusing on individual properties. The accurate reporting of uniform data must be achieved before systems for comparative performance evaluation can be implemented. The reports required by Section 15 of the UMT Act will provide the basis for an accurate, uniform data set.

These case studies present one side of another issue: the direct comparison of properties. In these evaluations, properties were compared against mean values of similar properties, not against specific properties. These mean values constitute a form of "par" against which comparisons may be made by either outside agencies or by the managers of a property. An alternative form of comparison would be to match similar properties and then compare achieved values on the performance indicators. Both these techniques are of value, yet our understanding of factors affecting performance indicators may be insufficient to safely permit direct comparison of properties on other than an informal basis at this time.