Evolution of Transit Investment Measures in Minnesota

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The Office of Transit Administration (OTA) of the Minnesota Department of Transportation has been administering state funds for transit services since 1977. Since the programs started, a data base has been maintained so that OTA could monitor and evaluate system performance. Monitoring involves checking expenses, revenues, and operating statistics monthly so that systems remain in accordance with a formal management plan. Evaluation work is geared to an annual review of the system prior to grant renewal and identifying potential areas of improvement. The evaluation work, which uses a five-year time horizon study and a peer group review, has produced results appropriate to measuring system performance only against local goals. Two levels of performance measures are applied to all systems. An aggregate measure review looks for potential trouble areas, and a disaggregate measure review confirms the source of concern. A very detailed disaggregate review may follow to pinpoint troubles. In order to rationalize and justify the state expenditure of funds, OTA has developed transit investment measures. Benefit and cost measures are used to evaluate the performance of all systems. The measurement systems used by OTA are identified, and reasons why the transit investment measures evolved are discussed.

The Office of Transit Administration (OTA) of the Minnesota Department of Transportation (Mn/DOT) has been administering state transit and paratransit funds since 1977. From 1977 to 1981, the funding increased from some $20 million to about $30 million/year and the number of systems receiving state assistance grew from 20 to 70. Most of the funding has been restricted to operating assistance, which has been distributed according to a discretionary deficit-based method. Generally, the state covers two-thirds of the operating deficit, and the remaining one-third is covered by the grant recipient.

The rapid expansion of public transportation services and the failure of user fees to keep pace with increased operating costs have led to an increasing dependence on state subsidies. In recent years, local budget overruns, caused in part by rapidly escalating labor and fuel costs, have been covered by Mn/DOT so that service cuts have been avoided. This practice has promoted the impression that there is a never-ending supply of state subsidy dollars.

The 1981 Minnesota Legislature abruptly changed that impression when it held the 1982-1983 biennial transit funding package at about the same level as that for the previous biennium. This amount of funding will not allow for the continued growth of public transportation services in Minnesota.

This paper identifies the monitoring and evaluation work conducted by OTA. The transit data base and the evaluation strategies used are described. Finally, a set of measures is proposed that will enable the state to quantify the investment performance of the Minnesota transit systems.

TRANSIT GRANT HISTORY

The State of Minnesota has been providing funds for the operation of public transportation services since 1974. In July 1977, the grant administration duties formerly held by the State Planning Agency were turned over to OTA.

During the first three years that OTA administered federal and state transit and paratransit funds, there was almost unrestricted growth in the number and size of public transportation providers in Minnesota. An abundant supply of operating dollars was available, and OTA embarked on an aggressive campaign to expand its public transportation network. Some 45 paratransit demonstration projects were funded between 1977 and 1980, and several intercity carriers received route subsidies. Through this effort, almost all of the major cities were able to initiate public transportation systems, and 55 counties of the 87 statewide, representing about 85 percent of the state population, had some form of state-subsidized public transportation within their borders.

During 1980, however, OTA began to pull back from the expansion program in anticipation of future budget constraints. No new systems were funded, and extensive effort was put into developing a new cost-based funding allocation mechanism (1). The previous funding allocation method was deficit based and had no upper limit for subsidy dollars. As inflation and system expansion pushed the total operating costs upward and farebox revenues remained almost static, the demand for state subsidy dollars began to spiral upward.

The substantial level of state subsidy has led to growing concern about the worth of the state investment in public transportation services. Subsequently, OTA has undertaken an effort to quantify the performance of transit systems so that the return on the state investment according to state program goals can be measured.

DATA BASE

OTA requires each grant recipient to submit operating data on a monthly basis. A uniform reporting system has been in place since 1978, and the monthly reporting form is self-coded so that the data can be processed through an interactive computing system. Each line item on the reporting form had a corresponding definition for clarity and to ensure as far as possible the uniform reporting of data.

Annual on-board user surveys are conducted for all of the non-urbanized-area systems to supplement the routine operating data. At the time of the user survey, the average passenger trip length is also calculated. Obtaining a significant sample for rural-area systems sometimes requires a full week of sampling. The survey format has been developed so that the responses can be assumed to be normally distributed. At least a 90 percent degree of confidence in the estimates is required before the results are considered to be statistically significant.

OTA developed its own reporting system because there are only five urbanized-area transit systems in the state that use the reporting system dictated by Section 15 of the Urban Mass Transportation Act of 1964, as amended. In addition, Section 15 data are reported annually, and it was determined that greater frequency of reporting was necessary to monitor a system effectively. The Section 15 data are reviewed by OTA and do offer a greater level of detail than is required by OTA, but the major monitoring efforts are conducted by using the OTA data base. Uses of the Section 15 data, as suggested by earlier research (2), are severely limited in Minnesota.

MONITORING SYSTEM PERFORMANCE

The data base provides timely and adequately detailed information on how each system is functioning. Each system is tracked on an ongoing basis by local and state project managers so that, if neces-

sary, problem areas are identified and remedial action is implemented.

The need for information is very different at the state level than at the local level. State officials are generally concerned with overall system performance, whereas system managers must deal with very detailed indicators of system operations. Such detailed information is generally not available from state-generated reports.

OTA has decided not to act as an information clearinghouse for day-to-day operations as proposed in Iowa (3). The state does not need such information for its purposes, and it would be impossible to offer the data processing services required for all systems given the data processing budget limitations. OTA does provide technical assistance to local operators for information gathering and processing, but each operator decides what information is necessary for local system operations.

DATA MONITORING EXAMPLE

The state does require consistent reporting of data on an aggregate level so that the health of each system can be gauged. Routinely, OTA project managers review the operating data, financial and nonfinancial, to check the operation against the grant-year management plan. Each system must be operated according to a management plan submitted to OTA. This plan describes the service levels and the anticipated costs and benefits for a one-year period. A budget is submitted in the same format that is later used to report the actual operating data.

Operating data that are consistent with the original management plan do not draw any other action from OTA. The data are transferred to the computer files, and a comprehensive report is produced on completion of the grant year. If a significant problem appears in the operating data, an interim computer report is produced.

The interim report contains very basic performance indicators that can be used to detect some operational problems. Costs are broken down into the four general categories of vehicle operations, maintenance, administration, and other charges. The individual components of each category are then identified. Measures of produced and consumed outputs are reported, and running averages are calculated for the performance ratios in order to smooth out any abnormalities in data. Local project managers should maintain similar records, but few outside of the urbanized areas do. Operational problems are examined, and remedial action can be suggested by OTA. The monitoring of data continues throughout the grant year. Before the grant is closed out and a new grant is awarded, a comprehensive evaluation is completed.

EVALUATING SYSTEM PERFORMANCE

System evaluation should determine the extent to which a system is meeting its objectives and whether or not different service delivery options should be considered (4). Based on past performance and projections for the future, Mn/DOT and local decisionmakers need to be able to critically evaluate system performance by comparing travel impacts and costs with other similar projects. The task is to search for a service type, management structure, or operating procedure that might be better in terms of travel benefits and costs than the existing service. The key element necessary before any such evaluation work can be undertaken is the existence of quantifiable system objectives. Since local system managers have done a poor job in establishing these objectives, the traditional performance evaluation work suggested in previous research (5,6) cannot be applied. Therefore, OTA has started using an alternative evaluation strategy composed of a time-horizon study and a peer-system review.

Time-Horizon Study

The time-horizon study is used to measure a system against itself over time. Typically, a system is placed in a five-year time horizon: Actual operating data represent the first three to four years and a detailed local projection completes the time horizon. The financial and nonfinancial data that make up the OTA data base are typically used. Section 15 data are used to supplement the OTA data base for urbanized-area systems. The five-year time horizon was selected so that the effects of changes in system operations could be smoothed out. Each year in the horizon is then split into quarters so that seasonal effects can be traced.

All actual financial data are then reviewed in constant dollars and current dollars. The constant-dollar review indicates growth or decline with respect to inflation. The consumer price index for all urban consumers (CPI-U) is used to align all expenditures and revenues to the chosen base year for the constant-dollar review. Comparison of data between systems requires that the unit of cost measurement be the same. Therefore, the time stream of dollar expenditures is adjusted to constant dollars.

A comparison of the actual current and constant dollars data and the projected operating data is then completed. The base year is identified generally as the first year of the time horizon. All actual operating data are discounted back to the base year by using the CPI-U. All projected operating data for the last years of the time horizon are aligned with the base year by using a present-worth adjustment and an assumed inflation factor. The inflation factor is consistent with that found in Office of Management and Budget Circular A-94 (revised) (7).

Peer-System Review

Peer groups are established according to the service-area population and the travel market served. Figure 1 shows the peer-group matrix. Each system is assigned to one of the cells, and peer groups can be generated for systems by rows, columns, or individual cells. Generally, when a study cell has few systems, a row or column peer group is established.

The peer-system review lends a broader perspective to the evaluation work than is possible by using only the single-system time-horizon approach. Systems can be ranked according to performance criteria by using this technique.

The criteria used to develop the peer groups--service-area population and travel market served--were established through earlier research in Minnesota (4). OTA has subsequently analyzed the financial data of systems grouped by service-area population and travel market for 1980 and for the 1982 projections. The results indicate that the revenue/cost ratio of systems varies directly with the service-area population.

These results suggest that the peer-group-matrix criteria are appropriate for financial data. Nonfinancial operating data of systems grouped by service-area population have also been studied (8), and the results also suggest the appropriateness of the grouping criteria.

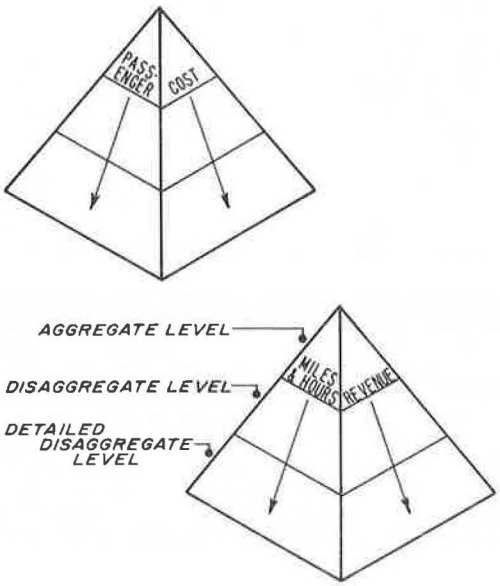
Data Analysis

The time-horizon study and the peer-system review

Figure 1. Peer-group matrix.

POPULATION / TRAVEL MARKET	URBANIZED	SMALL URBAN	RURAL
HOME TO WORK			
GENERAL			
ELDERLY AND HANDICAPPED			

Figure 2. Performance measure pyramid.



can be applied with different levels of intensity. Three distinct levels of evaluation are available with these techniques: the aggregate measure review, the disaggregate measure analysis, and the detailed disaggregate measure analysis. This represents a pyramid approach to performance evaluation, as shown in Figure 2. Each of the four faces of the pyramid represents a different measure: system costs, revenues, passengers, and service output as measured by miles and hours. These four elements represent the aggregate-level measures, which can be used to describe a service in very general terms. Should greater detail be required for the evaluation, the disaggregate-level measures for any of the faces can be applied. If still more detail is required, the third-level measures can be applied. The theory is to apply only as much analysis as is needed to adequately evaluate the service. In some cases the first level is sufficient, but in others all levels for all faces will have to be examined.

Data elements are first analyzed at the aggregate level--i.e., total cost, total revenue, total passengers, total vehicle miles, and total vehicle hours. From this information, a set of basic performance indicators is developed. These include cost per passenger, per hour, and per mile; revenue per passenger, per hour, and per mile; passengers per hour and per mile; and the revenue/cost ratio. These data are checked for trends and for significant variations. Significance is generally regarded as at least a 10 percent variation from the previous time point. This rule is applied only after the effects of inflation are discounted. Both the trends and the significant variations are held over for the next level of evaluation.

The second level of evaluation, the disaggregate analysis, is intended to identify the major effects of action or inaction at the local level. Therefore, this level checks the system for operations, maintenance, and administrative costs and the elements that contribute to those charges. For example, direct labor charges are identified as a percentage of the total operations cost. The interpretation of that percentage as being high, middle, or low is possible once a substantial data base is developed, but to identify what element contributed to that percentage is not possible unless a very detailed evaluation is conducted.

In addition to a semidetailed analysis of expenditures, the second-level evaluation checks the sources of revenue, such as passenger fares, advertising, and other auxiliary revenues. Revenue miles and revenue hours are checked as a percentage of the total vehicle miles and hours. Performance indicator ratios are developed on a per-passenger, per-hour, per-mile, and passenger-trip-mile basis. In addition, system user profiles are constructed from on-board surveys.

As in the first-level approach, trends and significant changes are noted and, it is hoped, these will respond to any concerns raised in the aggregate-level review. If a new area of concern is identified and is deemed to have major significance for the system, OTA will conduct follow-up research. If the area is relatively minor, the local system manager is requested to handle all follow-up.

After the second-level analysis is completed, a very detailed disaggregate analysis may be required. Generally, such work requires information not found in the OTA data base. For example, labor costs could be identified in the second level as being extraordinarily high for operations. Follow-up could determine that this is due to significant amounts of overtime pay, which are due to a high absenteeism rate, which in turn is caused by a very liberal sick leave policy.

No format exists for the third-level evaluation work because the analysis direction is dictated by the areas of concern identified at the previous level. Route-specific data may be required, and special surveys are sometimes essential for data gathering. At this level, OTA must work extensively with the local system managers. Nonuser profiles and origin-destination surveys may be required.

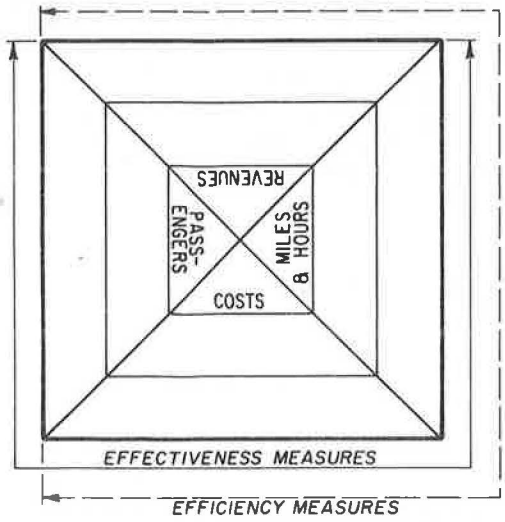
Figure 3 shows a top view of the performance measure pyramid. During the evaluation work, any single face or combination of faces can be chosen. The performance measure pyramid is a unique tool for transit system evaluation work. By combining the measures of several different faces, the efficiency and effectiveness of the system can be measured. As shown in Figure 3, there is overlap between efficiency and effectiveness measures. Therefore, it is very possible to have an effective system and at the same time have one that is very inefficient.

SHORTCOMINGS OF EVALUATION STRATEGY

The evaluation strategy that OTA applies has been developed to evaluate system performance against local goals and to gauge system health for state grant administrators. Modifications are necessary before system performance can be measured against state goals.

The rapid growth of public transportation services in Minnesota came about because of a general feeling at the state level that transit services

Figure 3. Top view of performance measure pyramid.



were good for the state. A need to provide these services was seen and state subsidies were acceptable. Unfortunately, the demand for state subsidies began to spiral upward at the same time that the supply of dollars had to be constrained because of the overall economic position of the state. Thus, OTA is proposing a streamlined set of benefit and cost investment measures that will enable the state to quantify its investment performance in public transportation services.

TRANSIT INVESTMENT MEASURES

The goal developed by OTA for its programs is to increase the efficiency and productivity of and benefit from public investments in transit services in Minnesota. Objectives have been adopted annually, but a formal measurement system has not been in place to evaluate performance against those objectives. Because of the tight money conditions facing state government and, specifically, the transit program, OTA decided in 1981 that a method had to be developed to measure the costs and benefits of transit services in terms of specific program criteria. It is hoped that this work will provide the Minnesota Legislature over time with a performance report for the investment they have made. Similarly, OTA can direct its annual work, at both the program and system levels, to respond to new policy directions.

Before judging how well public transportation services are doing, the major task is to monitor impacts on travel behavior. The impact could be a change in the number of trips being made, the purpose of trips, the time trips are made, or trip origins and destinations. From this information, changes in gasoline consumption, air pollution, and mobility can be determined. Most of this information can be obtained from a simple user survey.

The intent is to develop a set of measures that will accentuate the positive aspects of transit services. This area has generally been skipped over in the recent past in favor of cost criteria. Because of rapidly escalating costs and deficits, transit services have been looked at in less than favorable light. It has not been easy to rationalize the investment in terms of tangible benefits because modal shifts, improved air quality, and less congestion are not necessarily the sole work of transit. To develop the appropriate transit share is a difficult task in urban areas, and similar work would be meaningless in the rural setting. Therefore, a new approach is needed in order to gauge the success of state investments in transit services.

Each system has a primary target group of either home-to-work, elderly and handicapped, or general-purpose travel. In measuring benefits, therefore, each target group requires a different perspective. For example, projects aimed at the home-to-work market are mainly interested in reducing the adverse effects of single-occupant automobile use. The primary measure of effectiveness in this case is the reduction in vehicle miles of travel (VMT). From the state perspective, reduction in VMT and cost per VMT reduced are the investment measures that relate directly to the state goal. The user in this case is also realizing some benefit from the system. Direct monetary benefits such as reduced commuting cost and secondary benefits such as no need for a second car at home may be realized. These benefits, which are quite difficult to quantify, should not be needed to justify the state investment in the service. The intent with regard to the investment measures is to keep them very simple and to be able to apply them uniformly to all services within the same travel market.

The primary transit benefit investment measures OTA proposes are (a) total ridership, (b) trip purposes and user characteristics, (c) passenger trip lengths, and (d) VMT reduction. The primary transit cost investment measures OTA proposes are (a) total cost, (b) cost per passenger, (c) cost per passenger trip mile, and (d) cost per VMT reduced.

This set of transit investment measures should provide sufficient information to rationalize and justify state expenditures. This work is not intended to replace the traditional evaluative work conducted on individual systems against local goals and objectives but merely to link the state goals and objectives more closely with the systems that exist. Since the state has been providing a substantial sum for local transit services, some indication of the effectiveness of that investment is needed. Subsequent shifts in policy direction will automatically require a new set of investment measures, but the process identified in this work should provide an excellent starting point.

SUMMARY

The state contribution to the operation of transit services in Minnesota has escalated dramatically in recent years. The overall state economy has not fared as well, and transit service investment must be rationalized and justified so as to remain viable. Traditional work on performance evaluation does not provide the necessary information.

OTA has developed a formal evaluation method for its transit grant program. This method is an extension of the data monitoring system that was developed during the early stages of the grant program. Unfortunately, sophisticated system performance evaluation work does not necessarily provide policymakers with timely information. Therefore, the transit investment measures were developed to try to better link state goals with ongoing transit services so that the state investment in these services can be guided according to legislative policy direction.

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Public Transportation and Urban Decentralization: Conflict or Accord?

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The implications for public transportation of population and employment decentralization within the nation's urban areas are examined. Five case studies are viewed in terms of growth patterns, land use policies toward growth and decentralization, and the types of public transportation projects planned and implemented. It is found that most projects were planned with an incomplete or inaccurate understanding of decentralization patterns, that most projects were not usually in concert with land use objectives (which themselves were rarely enacted), and that projects often reflected unrealistic expectations of what public transportation services can perform. Recommendations center around a future reformulation of the relation between land use policy and public transportation.

A most likely scenario for the near (year 2000) future indicates that low-density population dispersion will continue to occur in the United States despite significant changes in demographic patterns (lower birth rate and increased elderly population), energy prices (a consistent rise in oil prices), economic conditions (worsening stagflation), and technological advances (in the areas of telecommunications and vehicle innovations) (1,2). This implies two things for transportation analysts to consider: (a) a greater reliance on personalized transportation (i.e., the automobile) for urban America and (b) a lesser proportion of the population capable of being served by conventional transit.

This is a general overview, however, and there are a number of specific events and issues that need to be examined within the context of this overall urban decentralization. Among these are the following:

1. It is important to examine the similarities and differences in population decentralization within separate categories of urban areas. To what extent have prior development patterns (pre-20th century and pre-World War II) affected decentralization characteristics? Is the shape of decentralization different in declining urban settlements than in growing areas? Does population and employment decentralization occur simultaneously in different urban types? The answers to these questions have obvious and relevant implications for public transportation policy formation.

2. In all urban areas, there is an understandable reluctance to let decentralizing patterns dilute the power and prominence of central-city areas. In some urban areas, this has meant an attempt to reverse decentralizing trends because of accompanying decline. In others, however, it has manifested itself in a desire to merely adapt trends to the benefit of the urban area. But in all cases urban areas are contemplating transportation and land use actions that are not entirely compatible with the scenario presented earlier.

3. Among the most prominent objectives of the Urban Mass Transportation Administration (UMTA) are to provide for basic urban mobility needs and to increase the modal share of public transportation. But given the urban decentralization scenario, these objectives are no longer harmonious with one another: In order to satisfy mobility needs of future urban areas, which are continually decentralizing, the emphasis on increasing conventional transit's modal share must be lessened. But objectives are only the visible outgrowths of implicit, evolving goals that UMTA adheres to. These goals include (a) reducing automobile use in urban areas to conserve energy and reduce air pollution; (b) redistributing income, especially to disadvantaged central-city dwellers; (c) redeveloping the nation's urban cores; and (d) reinforcing or stimulating dense urban development to conserve energy and other resources and provide accessible employment opportunities to the general population (3,4). Clearly, any alteration in objectives would first necessitate a shift in basic goals. The extent to which UMTA can be expected to shift basic goals must be examined, given on the one hand an understanding of future decentralization trends and on the other the current interests, intentions, and actions of urban areas, the prime recipients of UMTA aid.

These issues are explored in this paper in an effort to identify the opportunities and difficulties that will arise over the next 20-year transition period between the still prevalent notion of urban areas as densely packed hubs and the coming