

APPLICATION OF GUIDELINES FOR IMPROVING TRANSIT SERVICE AND OPERATING EFFICIENCY

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Considerable public funds are being allocated for transit operations, and a method is needed to ensure improved quality of transit service and increased efficiency of operations. Operating guidelines and standards developed in Pennsylvania specify elements of service, such as speed, reliability, capacity, and comfort, that must be provided under different conditions. Transit agencies are also required to improve public information, undertake marketing, and collect technical, operating, and financial data and submit them to the state transportation department on a regular basis. The department uses the data to evaluate operations of each agency and bases distribution of funds among the applicants on their compliance with the guidelines. The department also provides all applicants with professional assistance for improvement of operations.

•THE POTENTIAL of transit systems to improve mobility in urban areas, provide reliable transportation, contribute to more desirable forms of urban development, reduce air pollution and other adverse environmental aspects of transportation, and use energy more efficiently is being recognized. Support by the public and among professionals for improving the systems is broadening.

On the other side, operating costs of transit systems have been rapidly increasing. The policy that the operating expenses must be covered exclusively by revenues from fares has been largely abandoned, for it proved to be self-defeating in terms of the social goals of public transportation. The required fare increases and service reductions lead to decreases in patronage, deterioration of service, and further need for fare increases. In many areas, transit has been eliminated or reduced to low-quality service at high fares and used nearly exclusively by captive riders.

Despite an increase in funds to public transportation at the local, state, and federal levels, the problem of financing is far from resolved, particularly the provision of operating expenses for transit agencies. The subject of this paper, however, is not the source of funds but their use in achieving improved transit service. The paper discusses guidelines that have been developed in Pennsylvania and are being applied, tested, and evaluated.

STATE TRANSIT PROGRAMS AND LEGISLATIVE POLICY

Since 1965, Pennsylvania has been financially assisting various urban areas in providing necessary transit services. This assistance, which has consistently received bipartisan support in the General Assembly, has been of 2 general types: (a) matching grants for transit capital improvement projects and (b) matching grants to help finance transit studies, demonstration projects, and advertising and promotion campaigns and to help maintain essential local transit services where fare-box revenues are insufficient to meet the actual costs of providing such services. As much as two-thirds of such annual operating losses have been financed by the state, and the remainder is paid from local public sources under what have been designated Purchase of Service agreements with the local transit agency.

The financial assistance contributed to transit by the state has been significant: More than \$100 million in state matching funds has been authorized by the General As-

sembly for transit capital improvement projects, and more than \$140 million in general funds has been spent in support of transit operations. Compared with other states, Pennsylvania ranks high with respect to the scope of the program and magnitude of the expenditures for transit.

Two other pieces of legislation spell out rather precisely the state's general policies with respect to public transportation. Expressed in Act 7 of the Pennsylvania Urban Mass Transportation Assistance Law of 1967 and in Act 8 of 1968, the legislative policy states:

1. The social and economic development in urban areas is dependent upon efficient and coordinated urban mass transportation systems, facilities, and services.
2. Mass transportation is essential to the solution of urban problems.
3. Mass transportation will promote the health, safety, convenience and welfare of the citizens of the Commonwealth.

Based on these policies, Act 120 of 1970 specifies the following powers and duties of the Pennsylvania Department of Transportation relating to public transportation systems:

1. To develop programs designed to foster efficient and economic public transportation services in the State.
2. To prepare plans for the preservation and improvement of the commuter railroad system.
3. To develop plans for more efficient public transportation service by motor bus operation.
4. To prepare and develop plans and programs for all modes of urban transportation, including in addition to commuter rail and motor bus, rapid rail, trolley coach, surface rail, corridor rail, and other innovative modes of urban transportation.

PRESENT CONDITIONS

Implementing this legislative policy is confronted by extremely difficult conditions in those urban areas that have transit operations. For several decades transit agencies and companies have had survival rather than progress as their main objective. Starved from any capital improvements, they tried to minimize the immediate costs of the system, thus developing gradually into highly undercapitalized systems with high operating costs per passenger. Urban transit systems are typically characterized by the following major deficiencies:

1. Obsolete equipment, inadequate fixed facilities, inefficient operations, and low level of service;
2. Partial or total neglect of transit services by other agencies, such as transportation planning bodies, traffic engineering departments, and public utility commissions;
3. Ineffective management that has become discouraged by many years of adverse developments for transit and no assistance from any side, is unaware of modern developments in public transportation, particularly in other countries, and is reluctant to initiate many changes, even some that would lead to improvements (for example, some transit agencies believe that improving public information about transit systems is a wasteful proposition!); and
4. Apathetic public that has been exposed to deteriorating service and increasing fares, is often unaware of potential improvements to the system, and is discouraged about the prospects for change in the downward trend.

In this situation, if transit agencies are simply provided with funds to operate their systems, they will likely use the funds to perpetuate the existing low-quality service. The required amounts of funds will thus steadily increase, and the quality of service and the ridership will remain constant or decrease. From the point of view of operating efficiency, there is a danger that eliminating the break-even requirement for systems operation might weaken the stimulus for efficiency unless the operations are controlled by certain standards and guidelines.

Despite the bleak picture of the present conditions of transit, several examples in Pennsylvania cities clearly indicate that improvement in service does result in a

favorable response by the public. First, commuter railroads in Philadelphia have had steady track deterioration and only limited rolling-stock renovation, but their high speed and constant high reliability have led to a steady increase in patronage from 23.7 in 1960 to 32.0 million annual riders in 1972. Second, the Lindenwold Line from Philadelphia into low-density, automobile-oriented suburbs of southern New Jersey has attracted 42,000 daily passengers. Third, free bus service provided after the flood of 1972 in Wilkes-Barre resulted in more than doubling (a 108.7 percent increase) of ridership. Although the emergency situation in the city has undoubtedly played a significant role in this increase, the continuing high ridership at the present 15-cent fare (still lower than the initial 35-cent fare) indicates that the response was not only forced but also induced by increased and improved services. Fourth, the city of Allentown introduced a new ride-and-shop service (transit-validation program), which was intensively promoted and recorded significant increases in ridership on several of its bus lines (exact passenger counts were not made). Fifth, in the city of Erie a highly competent transit authority management took over the private company in 1967, and ridership has been increasing steadily from 3.3 million to 4.0 million annual riders in 1972.

PROGRAM OBJECTIVES

The Pennsylvania Department of Transportation and a research team from the University of Pennsylvania developed a program for improvement of transit services and efficiency of operations (Fig. 1). The objectives of this program are

1. Determine the required quantity and quality of public transportation service in various urban areas;
2. Evaluate the efficiency of transit operations;
3. Analyze the effectiveness of transit management in implementing the policies, objectives, and procedures established for the administration and operation of the transit system;
4. Identify areas in which improvements could or should be made in the management and operations of the transit systems;
5. Provide a mechanism by which transit authorities and agencies can evaluate and analyze their operations;
6. Form the basis on which the department will allocate funds under the state's Mass Transportation Assistance Program; and
7. Assist the transit agency in defining its own realistic needs for capital improvements.

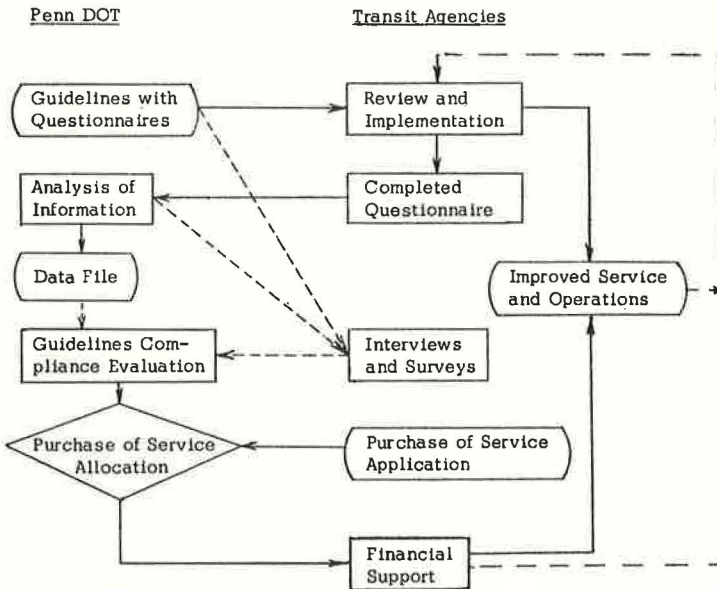
The program will provide tool for controlling the quality of transit service and efficient use of allocated funds and for obtaining operating and service data that in most cases are either inadequate or nonexistent but needed by management. In addition, the transportation department will provide to both public and private agencies expertise that they cannot afford to include on their staffs.

OPERATING GUIDELINES

The technical guidelines and standards were developed on the basis of practices of the best managed transit systems on this continent and in Europe. To define, largely in quantitative terms, transit service aspects that are valid for a considerable number of diverse cities is not an easy task. There are great differences in scale between the Philadelphia multimodal transit system, which accounts for some 65 percent of total transit ridership in the state, and a small-city system, which may have fewer than a dozen buses. Therefore, we had to specify policy and planning procedures in general terms only and to define service in relation to the demand and type of service required. Those requirements that could be precisely (usually quantitatively) specified were defined as standards, and compliance with them is mandatory. Other requirements are recommended. Some of the guidelines are summarized here.

1. The transit network service area is the area within a 5-minute walk from stop or

Figure 1. Public transportation improvement program.



station. The maximum frequency of stopping is 7 stops per mile.

2. Exact specifications are given for computation of offered capacity for both off-peak and peak hours.

3. Headways are specified with respect to their length as well as to their actual values. Except in special cases, headways must always be divisible in an hour so that they are repeated every hour and are therefore easily remembered by passengers.

4. Elements of vehicle design influencing speed are specified as well as a number of regulatory measures, such as optimal stop locations, preferential treatment at the intersections, reserved lanes, and private rights-of-way. In addition, information is given on increasing speed through different types of scheduling, express services, reduction of stop density, and improved fare collection methods.

5. Reliability of service is specified precisely in standards for peak, off-peak, and weekend services with different headways. The measurement is given in terms of percentage of trips on time where all departures between 0 and 5 minutes late are considered on time.

6. Passenger comfort and convenience are provided by requirements for vehicle maintenance, seating capacity, cleaning of interiors and exteriors, lighting, and passenger shelters.

7. Directness of service is discussed in general terms.

8. Fares are specified in considerable detail, including aspects of different fare structures, fare levels, and various potential promotional and experimental actions.

9. Standards for marketing activities specify the forms of public information in terms of maps, schedules, transit stop signs, and so on. Possible advertising and promotional schemes and required marketing analysis are also specified.

10. The guidelines specify the information that transit agencies must submit when they apply for Purchase of Service funds. The first requirement is that they specify the goals and objectives established by the local government and the transit agency. They must also submit detailed information on services. The agencies are also required to project Purchase of Service needs for the following year and to develop a plan for improvement in the transit service. Since the compliance with the guidelines will in some cases increase the cost of operation, the agencies are required to estimate these increased costs and inform the transportation department about this specific cost increment. The department will then review the planned improvements and approve

them or suggest modifications. The agency is required to define capital improvements and to develop a plan for their implementation. An increased emphasis in the evaluation of proposed capital improvements is the analysis of their impact on increased ridership and increased efficiency of service, which will be directly reflected in the compliance with the guidelines.

Data on Transit Services and Operations

Traditionally, transit companies were considered primarily as business undertakings, and their reports consisted of financial data only. The data were reported in a non-standard way so that comparisons among the companies are difficult to make. (UMTA is sponsoring a study (1) on standardizing the financial reporting of transit agencies and companies). However, reporting of data on service and operations has been extremely poor so that data are not available on basic operations such as the number of passengers carried, average trip length, commercial speed of vehicles on lines, and hourly fluctuations of demand. Analysis of system improvement is difficult without such data.

Data have been requested on 3 questionnaires that were sent (a) to city planning agencies for data about the city and metropolitan area, (b) to transit companies in large cities, and (c) to transit companies in medium and small cities.

The questionnaires were designed to obtain all the information required by the Pennsylvania Department of Transportation, the U.S. Department of Transportation, and the Public Utility Commission so that duplication of requests for information is avoided or minimized. Only the minimum data needed to compute various indicators were requested. The indicators are computed by the state transportation department to minimize the paper work of the transit agencies and to provide higher accuracy.

The questions are in 4 categories: (a) information on city and metropolitan area, including size of area, population, employment, automobile ownership, and parking capacity in CBD; (b) transit service offered to the passengers, including number and length of lines, cycle times, headways, number and characteristics of vehicles, fares, and reliability of service; (c) use of the system, including revenue and total number of passengers, daily fluctuations, average passenger trip length, and annual passenger-miles; and (d) organization and finance, including number of employees and their classification, number of garages and rail yards, and work performed in terms of vehicle-hours and vehicle-miles.

DATA FILE

When the completed questionnaires are received, their data are transferred to data file forms. In addition to this basic information, the data file contains a number of computed indicators. Examples include annual seat-miles offered per square mile of served area, annual revenue rides per capita, annual passenger-miles per mile of line, passenger-miles per seat-mile, average operating hours per vehicle per day, average miles per vehicle per day, average weekday passengers per operating employee, and total revenue per vehicle-hour.

Implementation of the Guidelines

The main purpose of the guidelines is to improve transit service and operations, but agencies may not voluntarily comply with them. Therefore, financial aid in the form of Purchase of Service can be used as a leverage for compliance. Consequently, the guidelines explicitly state that compliance will influence the Purchase of Service fund allocation by the transportation department. Thus, an objective method to evaluate compliance was needed.

The standards, i.e., the specific, exactly defined requirements within the guidelines were selected to be used as the major basis for rating an agency in the compliance evaluation. The evaluation items are divided into 4 categories: city, transit agency, planning and marketing; transit service; transit usage; and financial and administrative aspects. The data for the evaluation are taken from the data file, other reports submitted by the agencies, meetings and discussions with their officials, and field surveys. The most

important 24 items are selected for quantitative evaluation, and each item consists of several elements. A total of 400 basic points are distributed to the 24 items. Each item thus has the maximum number of points that can be allocated to it and exact breakdown of these points to all elements of that item.

In addition to the 400 basic points, a maximum of 100 bonus points can be allocated for changes that an agency implements. In the first year the agency is evaluated only on the basis of the 400 points. In each succeeding year the basic points are allocated not only on the basis of the status of the system but also on the difference in each item from the preceding year. This difference determines allocation of bonus points in the case of an improvement or subtraction of them in the case of deterioration.

If an existing deficiency is caused by forces outside the agency's control (such as traffic congestion or poor timing of traffic signals), the agency is required only to prove that it has done everything in its power to improve the condition. If it has done so, all points are given, regardless of performance. If it has not, the evaluation is based on the current performance exclusively.

Use of Compliance Evaluation

The total number of points given to an agency, divided by 400, represents its guideline compliance rating. This rating and the general evaluation, which includes some subjective elements, such as organizational conditions for implementing improvements and characteristics of the population and of the region, are used in the allocation of Purchase of Service funds based on the following 2 conditions.

1. There are adequate funds. If funds are available, an agency that obtains 400 or more points (more points may be obtained in the years in which improvements take place) is allocated the full amount required. If the agency has fewer than 400 points, downward adjustment in the amount of money is made.

2. Available funds are lower than the requested ones. If adequate funds are not available, money is allocated to agencies according to their ratings. The allocation formulas are being devised and tested.

PROGRAM EVALUATION AND FUTURE PERSPECTIVES

Already there are indications that the guidelines, including the technical standards, instructions, and suggestions, the data file, and a continuing program of evaluation of agency operations are useful tools in helping the agencies to improve their services, in equitably distributing Purchase of Service funds, and in ensuring their efficient use.

The major difficulty is that compliance with the guidelines in some cases increases immediate costs. Although the transportation department believes that these increased costs are justified and will eventually be recouped from increased ridership, higher revenues, and improved transit service, the fact remains that these funds must be found. If the funds appropriated by the legislature (as well as the required local matching funds) for this purpose are adequate to satisfy all requests for Purchase of Service and also contain a sum that could cover the additional costs of complying with the guidelines, the program will operate smoothly. But if funds are insufficient to cover all the requests, the problem of cutting the least necessary expenses will usually eliminate first any changes that will increase costs. This may defeat some portions of the program. However, compliance with the guidelines in some cities will result in actual demonstrable improvements in services, in ridership, and in mobility so that the usefulness of the guidelines will thus be proved and their acceptance by transit and other agencies will be facilitated.

The basic question about the permanent financing of contributions to operating expenses of transit agencies is outside the scope of this paper. The solutions may be found in forming metropolitan area transit districts that have taxing powers, in continuing the state contribution of two-thirds of the funds and the local contribution of one-third, or in creating a federal program for transit operating subsidies. Whatever solution is found, the progress achieved through the program described here will be extremely useful in this or somewhat modified form because it helps to ensure good service and efficient operations when the transit agency is not financially self-supporting.

Experience will also show how effective the state's professional guidance provided through this program will be in the internal operations of the agencies. At this time, the state may be able to provide greater professional expertise than individual agencies have and at the same time develop a more manageable program than the federal government would be able to do. However, the federal government already has direct contact with some agencies, particularly with respect to the capital improvement financing. Improved cooperation among all 3 government levels is important to ensure that duplication of work, potential discrepancies in intentions, and excessive paper work are minimized.

REFERENCES

1. Interim Reports on the FARE Project. Arthur Andersen and Company, Washington, D.C., 1973.
2. Beier, F. J. Marketing Programs for Mass Transit. *Traffic Quarterly*, Oct. 1972, pp. 533-546.
3. Konzept zur Verbesserung des öffentlichen Personennahverkehrs. Bundesverkehrsministerium, Hoermann-Verlag, Germany, 1972.
4. Ellen, E. R., and Phillips, I. The Financing of Capital and Revenue Costs of Public Transport Undertakings. 40th UITP Congress, The Hague, Rept. 5b, 1973.
5. Gutknecht, R. Alternative Approaches to the Public Transport Fares With Their Traffic and Revenue Implications. 40th UITP Congress, The Hague, Rept. 5a, 1973.
6. Service Standards for Mass Transit in Dade County. Simpson and Curtin, Miami, 1973.
7. Smerk, G. Mass Transit Management: A Handbook for Small Cities. Institute for Urban Transportation, Indiana Univ., 1971.
8. Statistische Übersichten 1972. Verband Öffentlicher Verkehrsbetriebe, Cologne, Germany, 1973.